Freeport-McMoRan Chino Mines Company
P.O. Box 10
Bayard, NM 88023

Thomas L. Shelley, Manager
Environmental/Sustainable Development
Telephone: 575-912-5773
e-mail: tshelley@fmi.com

May 21, 2018

Certified Mail #70173040000031902005
Return Receipt Requested

Mr. Fernando Martinez, Director
Energy, Minerals and Natural Resources Department
Mining and Minerals Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Certified Mail #70173040000031902012
Return Receipts Requested

Mr. Bruce Yurdin, Director
Water Protection Division
New Mexico Environment Department
P.O. Box 26110
Santa Fe, New Mexico 87502

Dear Messrs. Martinez and Yurdin:

Re: Freeport-McMoRan Chino Mines Company – Continental Mine
Financial Assurance Proposal, Permit No. GR002RE and DP-1403

Freeport-McMoRan Chino Mines Company (Chino) submitted to the Mining and Minerals Division (MMD) and the New Mexico Environmental Department (NMED), an application to update the Continental Mine Closure/Closeout Plan (CCP) in a letter dated December 12, 2014. This CCP provided a conceptual plan for closure and reclamation (technical scope of work) of the site. In a letter dated April 19, 2018, the MMD deemed the Continental Mine CCP technically approvable and requested that Chino submit a financial assurance (FA) proposal associated with the approved CCP. This letter transmits the required FA proposal.

Revised Current Dollar Cost Estimate

Since December 2014, Chino has responded to comments and agreed to incorporate changes in the CCP and cost estimate. The primary changes that are incorporated into this revised cost estimate include: update of unit rates to 2018 unit rates for the Continental Mine and the connecting haul road, adjusting cover haul distances from the North Overburden Stockpile, addition of regrading and cover for for the No. 3 Shaft Stockpile (shown as No. 3 Stockpile in cost estimate tables), revision of demolition costs to reflect recent demolition activities, addition of 50 acres of contingency reclamation area to account for small changes in disturbance areas over the next five years, and adjustment of the costs for Upper Creek Containment expansion. The cost estimate includes costs for 3 feet of imported cover material for facilities requiring reclamation cover material except the top of the Main Tailing Impoundment (MTI) which will have 2 feet of imported cover material and 1foot of the tailing material (also suitable as cover material). Chino agreed to calculate the additional cost of importing 3 feet of cover material (i.e., an additional foot of cover) for the top of the MTI. That additional cost is $465,996 in current dollars. Tables 4, and 8 through 10 have been revised to summarize the changes and are provided in Attachment 1 to this letter. Attachment 2 contains the Earthwork and Water Management Cost Estimates with an accompanying letter explaining the estimating process as well as derivation and standard practice sources for unit rates. The revised total current dollar cost is $26,835,620.

Net Present Value (NPV) and Financial Assurance (FA) Proposal

Attachment 3 to this letter contains the NPV calculations. Based upon application of 19.10.12.1205(C) NMAC and established agreements for the FA cost estimate calculation with MMD and NMED (See Attachment 3), the proposed NPV amount is $23,937,772.

The MMD's Guidance was used to calculate the discount and escalation rates. A summary of the indices used is included in Attachment 3. Chino calculated the appropriate discount rates for both earthwork and water management to be 7.27% and 7.42% applied to cash flow years 1 -10 and 11- 100 respectively based on Barclays US Government/Credit and Barclays US Aggregate Indices (see Attachments 3A and 3B). Chino also calculated the appropriate escalation rate for earthwork at 3.14% and water management as 2.43%, which are composites calculated from various consumer price indices (see Attachment 3 for details).

Attachment 4 contains an electronic copy of the cost estimate (including the work books and spreadsheets for the cost estimate and NPV calculations).

As committed in previous meetings, Chino will leave in place the existing total FA amount of $27,987,884.00 (net present value, including the costs for the Cobre Haul Road) until the proposed FA amount has been review and accepted by the MMD and NMED. The existing FA is secured by instruments including a cash trust, collateral and third party guarantee. Once the review process is completed, Chino will re-evaluate the instruments associated with this FA proposal for the Continental Mine.

Thank you for taking the time to review and approve this information. Please contact me at (575) 912-5773 if you have any questions.

Sincerely,

Thomas L. Shelley

Thomas L. Shelley, Manager
Environmental/Sustainable Development

TLS:rlm
20180521-001
Enclosures

xc: Holland Shepherd, Manager, MMD
James Hollen, Reclamation Specialist, MMD
Kurt Vollbrecht, Manager, Mining Environmental Compliance Section, NMED
Anne Maurer, Mining Environmental Compliance Section, NMED

TELESTO
SOLUTIONS • INCORPORATED

21 May 2018

Via Electronic Mail

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

Subject: 2014 Continental Mine Closure/Closeout Cost Estimate Update

Dear Rita:

We appreciate once again the opportunity to serve Freeport-McMoRan Chino Mines Company (Chino). The purpose of this letter is to provide cost updates to the 2014 Continental Mine Closure/Closeout (CCP) report produced by Telesto Solutions, Inc. (Telesto, 2014). This letter also provides an overview of the cost estimating process that we have developed over time with New Mexico Mining and Minerals Division's (MMD) and the New Mexico Environmental Department, Groundwater Bureau (NMED) as provided in Appendices A, B and C.

COST UPDATE

Tables 8, 9 and 10 in the 2014 CCP summarize the estimated costs upon which financial assurance estimate is made. We have included these in Figures 1, 2 and 3, respectively, in this letter. Chino, with our support, has updated the costs presented in the 2014 CCP by:

- Utilizing 2018 unit costs from RSMeans (RSMeans, 2018), EquipmentWatch (Pendton Media, 2018) and the New Mexico Department of Labor (NMDOL, 2018)
- Adding reclamation costs for the No. 3 Shaft Stockpile, additional disturbance areas, a contingency area, and the Cobre Haul Road (CHR)
- Dividing out borrow material areas
- Providing cost estimates to handle special wastes during building demolition

We have retained the table titles and numbering to be consistent with the 2014 CCP. Accompanying Tables 8, 9 and 10 are Appendices A, B and C from the 2014 CCP, which we have updated to reflect the aforementioned changes.

Table 8 Earthwork Capital Costs

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital			
Tailing Ponds			
Magnetite Tailing Pond	$840,196	$237,776	**$1,077,972**
Main Tailings Impoundment	$2,313,012	$654,582	**$2,967,594**
Subtotal	**$3,153,208**	**$892,358**	**$4,045,566**
Waste Rock and Ore Piles			
SWRDF	$8,860,289	$2,507,462	**$11,367,751**
Hanover Mountain Deposit	$1,122,318	$317,616	**$1,439,934**
No. 3 Shaft Stockpile**	$56,522	$15,996	**$72,518**
Low Grade WRF	$323,121	$91,443	**$414,565**
Subtotal	**$10,362,250**	**$2,932,517**	**$13,294,767**
Continental Pit			
Subtotal	**$ 84,223**	**$ 23,835**	**$108,058**
Surface Impoundments			
Subtotal	**$97,518**	**$27,598**	**$125,116**
Historic Sites			
Pearson-Barnes Mine Area	**$163,263**	**$46,204**	**$209,467**
Other Disturbed Areas			
Haul and Exploration Roads	$75,291	$21,307	**$96,598**
Dist. Area Near SWRDF**	$17,895	$5,064	**$22,959**
Contingency Disturbance Area**	$632,427	$178,977	**$811,404**
Borrow Areas**	$47,750	$13,513	**$61,263**
Wells	$7,421	$2,100	**$9,521**
Subtotal	**$780,783**	**$220,962**	**$1,001,744**
Demolition			
Buildings	$1,389,430	$393,209	**$1,782,638**
Cover	$102,002	$28,867	**$130,869**
Rip & Revegetation	$1,068	$302	**$1,370**
Subtotal	**$1,492,500**	**$422,378**	**$1,914,878**
Total Capital Cost	**$16,133,746**	**$4,565,850**	**$20,699,596**
CHR Total Capital Cost*	**$433,176**	**$122,589**	**$555,764**
Total	**$16,566,922**	**$4,688,439**	**$21,255,360**

*Updated from the 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

**Added since 2014 CCP

Figure 1 Update to Table 8 of the 2014 CCP

Table 9 Earthwork O&M Costs

Total Earthwork O&M Cost[1]				
Period (years)	Erosion Control	Road Maintenance	Revegetation Maintenance	Total (Current Year $)
Overall Site				
0 to 19	$501,874	$460,107	$256,388	**$1,218,370**
20 to 39	$308,846	$296,843	$0	**$605,689**
40 to 99	$231,634	$445,265	$0	**$676,899**
Totals	**$1,042,355**	**$1,202,215**	**$256,388**	**$2,500,958**
CHR[2]				
0 to 11	$74,610	-	$17,384	**$91,994**
Totals	**$74,610**	**$0**	**$17,384**	**$91,994**

[1] Earthwork O&M costs include 23.3% indirect costs.

[2]Updated from the 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

Figure 2 Update to Table 9 of the 2014 CCP

Table 10 Water Management Costs

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement			
Ponds and Tanks	$520,595	$147,328	$667,923
Pumps	$659,426	$186,618	$846,044
Pipelines	$0	$0	$0
Electrical	$0	$0	$0
Subtotal	**$1,180,021**	**$333,946**	**$1,513,967**
Removal[1]			
Pumps	$149,324	$42,259	$191,583
Pipelines	$114,136	$32,301	$146,437
Electrical	$52,381	$14,824	$67,205
Subtotal	**$315,841**	**$89,384**	**$405,225**
Operations and Maintenance			
Ponds and Tanks	$225,298	$38,301	$263,599
Pumps	$113,383	$19,275	$132,658
Pipelines	$128,879	$21,909	$150,788
Electrical Infrastructure	$117,759	$20,019	$137,778
Materials			
Electricity and Fuel	$30,408	$5,169	$35,578
Environmental Sampling	$297,192	$50,523	$347,715
Subtotal	**$912,920**	**$155,196**	**$1,068,116**
Total Estimated Cost	**$2,408,782**	**$578,526**	**$2,987,308**

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

Figure 3 Update to Table 10 of the 2014 CCP

COST ESTIMATING OVERVIEW

Appendix A

Appendix A (attached) of the 2014 CCP and the update as attached describes the facilities associated with Chino's Continental Mine that are subject to reclamation in the upcoming 5 years. The format is in that which the MMD provides. Appendix A briefly provides a summary of the 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.

Appendix B

Appendix B provides the information utilized to develop the earthwork cost estimate and its structure is as follows:

- **Main Text –** the main texts describes the specifics of the cost estimating process along with the sub-appendices, which provide back up and support. It describes the reclamation processes utilized to complete the cost estimate
- **Appendix B.1** is a hard copy print out of the excel spreadsheets from which we develop the costs. It contains only the earthworks as water management is provided in Appendix C. Electronic versions are provided in Appendix D
- **Appendix B.2** provides the equations and descriptions of data which we use to populate the variables of the cost estimate and we divide Appendix B.2 into the following sub-appendices:
  - **Appendix B.2.1** provides the production and miscellaneous calculations used to support the earthworks cost estimate
  - **Appendix B.2.2** tabularizes the only the labor rates from the NMDOL which we use in the estimate
  - **Appendix B.2.3** contains copies of the EquipmentWatch sheets from which we obtain unit equipment rates
  - **Appendix B.2.4** consists of the pages from RSMeans (RSMeans, 2018) utilized in the cost estimate
  - **Appendix B.2.5** provides the curve fits that we use in the production sheets for dozers, and haul trucks
  - **Appendix B.2.6** contains copies of the pertinent pages from the Caterpillar Handbook
  - **Appendix B.2.** lists referenced miscellaneous unit costs used throughout the cost estimating spreadsheets

Table 1 Summary of Reclamation Activities

	Rough Grading	Dozer Assist Cover Load	Load Cover	Haul Cover	Rip Rough Grade	Place Cover & Grade	Scarify & Seed / Revegetate	Excavate Down Drains	Excavate Bench Channels	Rip Liner	Load Rip-Rap	Haul Rip-Rap	Place Rip-Rap Down Drains	Place Rip-Rap Bench Channels	Other Processes (e.g., Fence,
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	X	X	
Stockpiles															
South Waste Rock Disposal Facility	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Low Grade Waste Rock Facility		X	X	X		X	X								
No. 3 Shaft Stockpile	X	X	X	X	X	X	X								
Mines															
Continental Pit		X	X	X		X	X								X
Hanover Mountain Deposit		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								
SWRF Dam 2 (Reclaimed year 12)		X	X	X		X	X								
SWRF Dam 3 (Reclaimed year 12)		X	X	X		X	X								
SWRF Dam 1 (Reclaimed year 12)		X	X	X		X	X								
SWRF Dam 2 (Reclaimed year 12)		X	X	X		X	X								
SWRF Dam 3 (Reclaimed year 12)		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								
Disturbed Area Adjacent and North of the SWRDF		X	X	X	X	X	X								
Other															
Remaining Internal Haul Roads	X	X	X	X		X	X								
Exploration Roads	X	X	X	X		X	X								
Borrow Areas							X								
Demolition		X	X	X	X	X	X								X
Cobre Haul Road	X	X	X	X	X	X	X	X		X	X	X	X		X

- **Appendix B.3** provides the basis for the quantities utilized in the cost estimating process. We base the quantities upon the conceptual mine plan at the end of year (EOY) for which we estimate has the highest reclamation cost in the upcoming 5-year period (2023 for the Continental Mine). We have updated the EOY drawings from the 2014 CCP and have attached them to this letter

Overall, the cost estimating process is typical, standard, approach used in the engineering and construction industries (consistent with the RSMeans Construction Cost Estimating Handbook). The earthworks cost estimate is an iterative process. We first assume the type of equipment to complete the desired construction steps. Then, we evaluate the number of equipment pieces needed (e.g., number of trucks, loaders, bulldozers) to form a "fleet." We change the number and type of equipment, recalculate the cost and compared to a base cost, which is the lowest of the previous iterations. We repeat this until the most efficient fleet is found, and once found we utilize the unit costs associated with equipment in the fleet to estimate the total reclamation cost utilizing the spreadsheets, which are include as Appendix D. Figure 4 summarizes the costing steps we use for one piece of equipment in developing our fleet.

Appendix C

Appendix C provides the components that we utilize to develop the water management costs associated with reclamation. This appendix would also contain water treatment cost estimates, but these are not necessary for the Continental Mine as Chino will process any water requiring treatment. Appendix C consists of the following:

- **The main text**, which describes the inputs and approach to estimating water management costs and reclaiming water management systems after closure. The main text references four sub appendices:
  - **Appendix C.1** provides the calculations from which we estimate stormwater management volumes during and after closure
  - **Appendix C.2** is a calculation documentation of the estimated long-term drain down of the water stored within the pore space of the Main Tailings impoundment
  - **Appendix C.3** is akin to Appendix B.1 except for water management. We provide the cost calculation spreadsheets in Appendix D as well
  - **Appendix C.4** contains copies of the unit rates and reference material from which we develop unit costs for the water management cost estimate

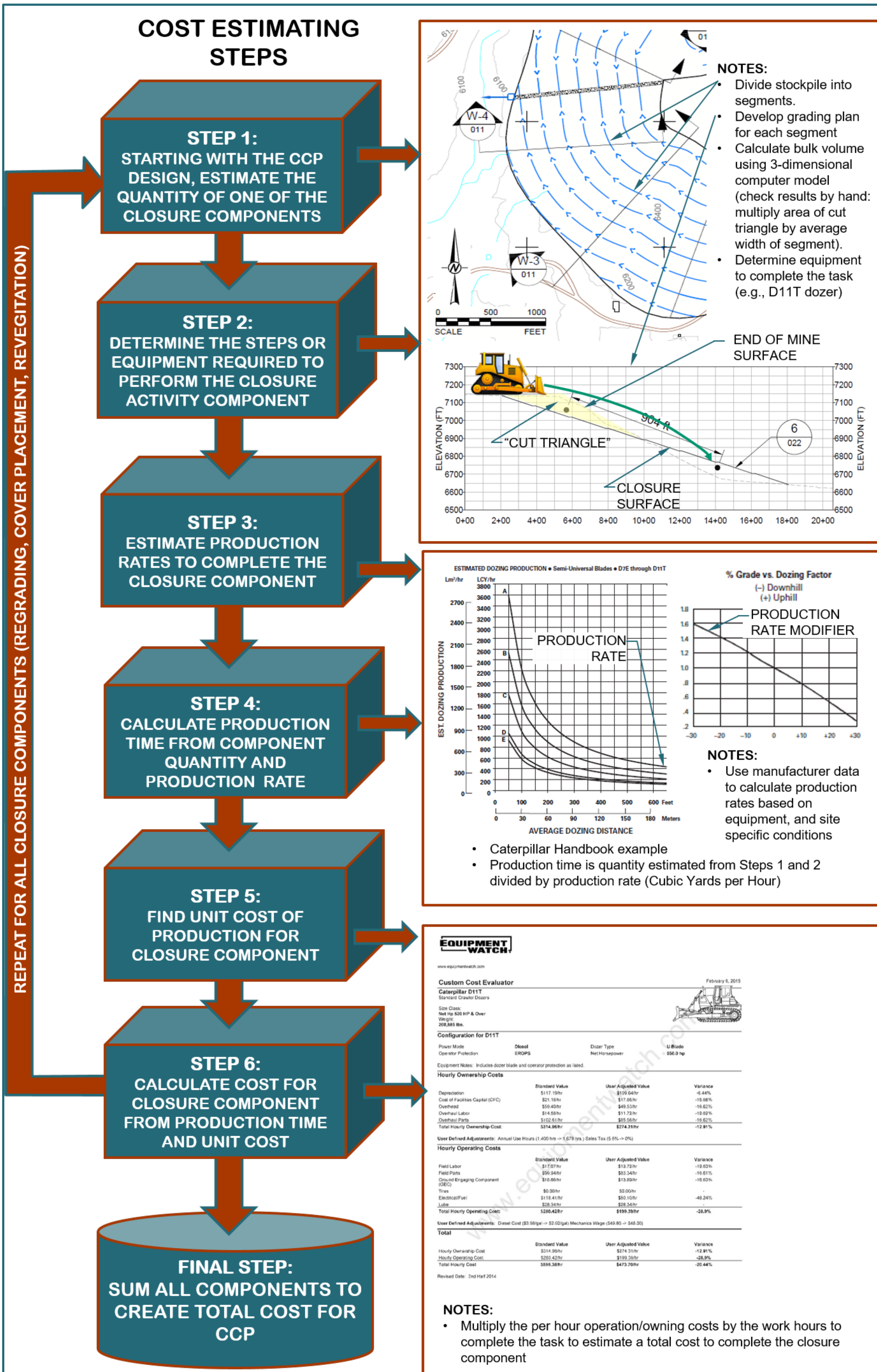


Figure 4 Earthworks Cost Estimating Process

Estimating the water management costs for the 2014 CCP is a straightforward task as it does not rely on an iterative process to find efficiency as does the earthworks cost estimate. We quantify 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 we develop reclamation activities and schedules to which we apply unit costs and apply to the cost estimating spreadsheets.

Appendix D

Appendix D contains the electronic version of the cost estimating spreadsheets from which Appendices A through C are based. Within the spreadsheets, assumptions and other information is provided that we may not have captured in the narrative of the appendices texts. For example, some unit costs include indirect costs, which we remove for the base cost estimating calculation, and then include as part of the total after all of the direct costs are summarized. This is especially true for such things as unit costs developed from EquipmentWatch. EquipmentWatch (Pendton Media, 2018) notes that certain costs (e.g., equipment depreciation, profit, overhead) included in their standard values are typical indirect costs and adjustments to the standard values may be needed if the estimator plans to later add indirect costs (which is our approach). We have removed most of the indirect costs from the EquipmentWatch direct costs and apply them to the total direct costs with the exception of equipment depreciation. RSMeans describes depreciation as an indirect cost (RSMeans, 2018). We retained equipment depreciation as a direct cost in this update to the 2014 CCP as to provide a conservative estimate. Chino should consider removing depreciation cost in its future submittals.

Again, thank you for the opportunity to serve you and your team. Should you have any questions or concerns with this letter or the attached update, please do not hesitate to contact Eddie Humphrey or me.

Sincerely,
Telesto Solutions, Inc.

Walter L. Niccoli

Walter L. Niccoli, PE
Principal/Senior Engineer

WLN:jeh
Enclosure
cc:

REFERENCES

NMDOL. (2018, 3 30). *Prevailing Wage Poster H 2018*. Retrieved from New Mexico Department of Labor: https://www.dws.state.nm.us/Portals/0/DM/Labor

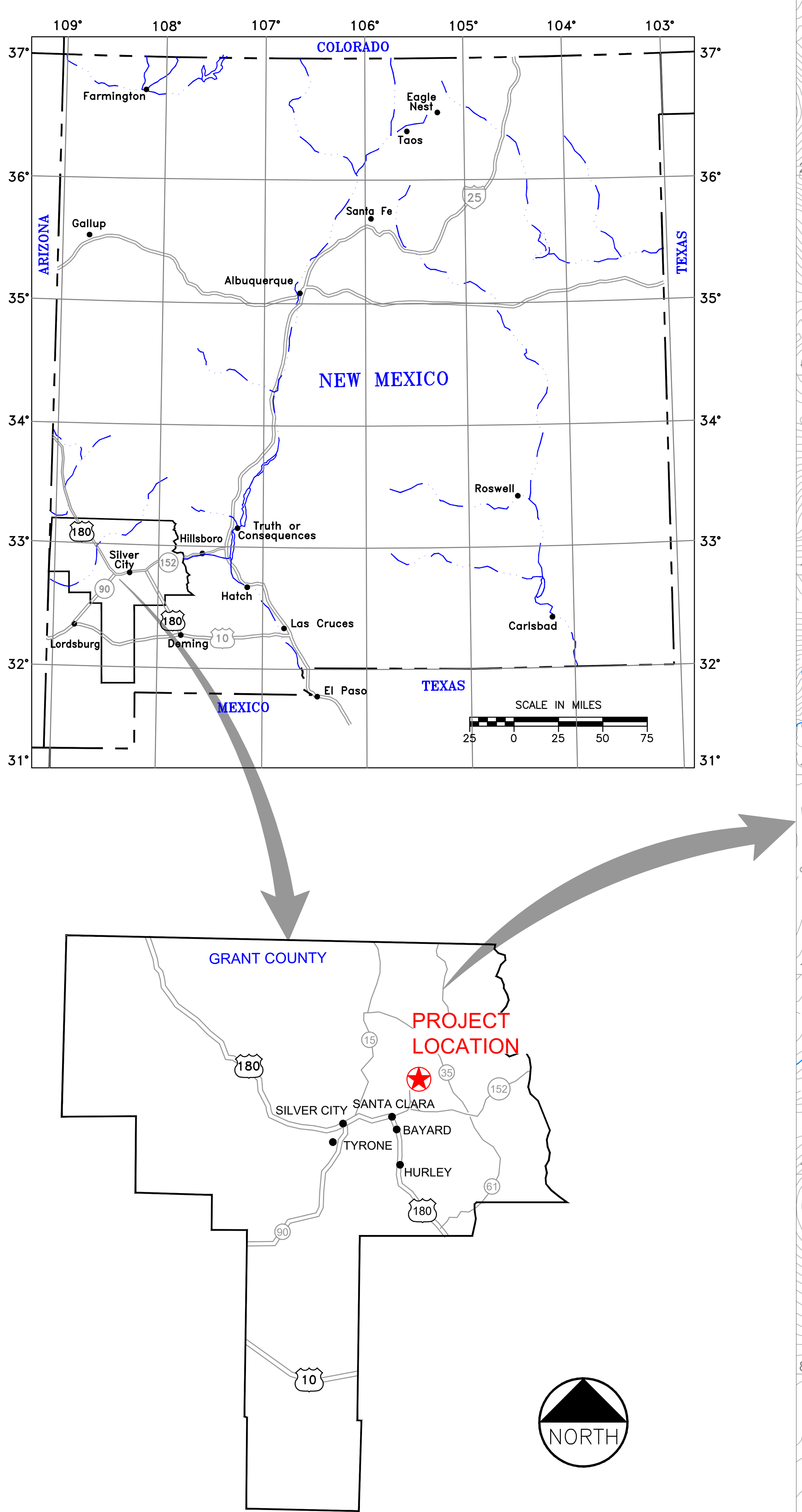
Pendton Media. (2018, 03 01). *EquipmentWatch Construction Estimator*. Retrieved from EquipmentWatch: https://www3.equipmentwatch.com

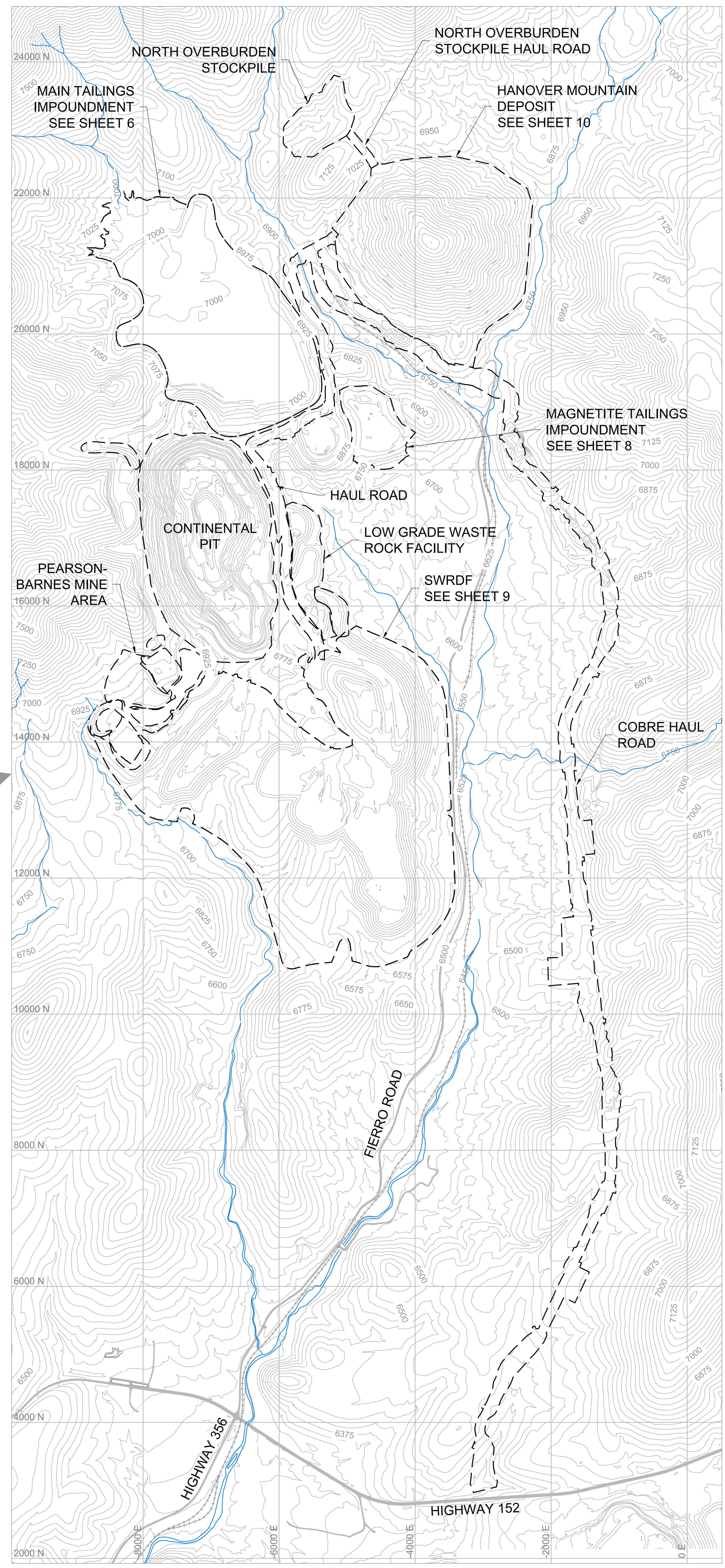
RSMeans. (2018). *Heavy Construction Cost Data. 32nd Edition.* Rockland, MA: RSMeans Construction Publishers & Consultants.

Telesto. (2014). *Freeport-McMoRan Cobre Mining Company 2014 Continental Mine Closure/Closeout Plan Update.* Telesto Solutions, Inc. Fort Collins, Colorado: Fort Collins, Colorado. December 2014.

DRAWINGS

CONTINENTAL MINE
END OF YEAR 2023
CONCEPTUAL RECLAMATION
DRAWINGS





SHEET INDEX

Sheet Number	Sheet Title
1	COVER SHEET
2	EOY 2023 CONFIGURATION
3	EOY 2023 RECLAIMED CONFIGUFURATION
4	SLOPE AND CHANNEL CROSS-SECTION DETAILS
5	COVER HAUL ROUTES
6	MAIN TAILINGS IMPOUNDMENT RECLAIMED
7	MAIN TAILINGS IMPOUNDMENT CROSS-SECTIONS
8	MAGNETITE TAILINGS IMPOUNDMENT RECLAIMED
9	SWRDF RECLAIMED
10	HANOVER MOUNTAIN DEPOSIT RECLAIMED POST END OF YEAR 2023 MINING

COVER SHEET

SHEET NUMBER: 1
REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-McMoRAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN
2	FINAL SUBMITTAL	5/11/18	ST	WLN

NOT FOR CONSTRUCTION

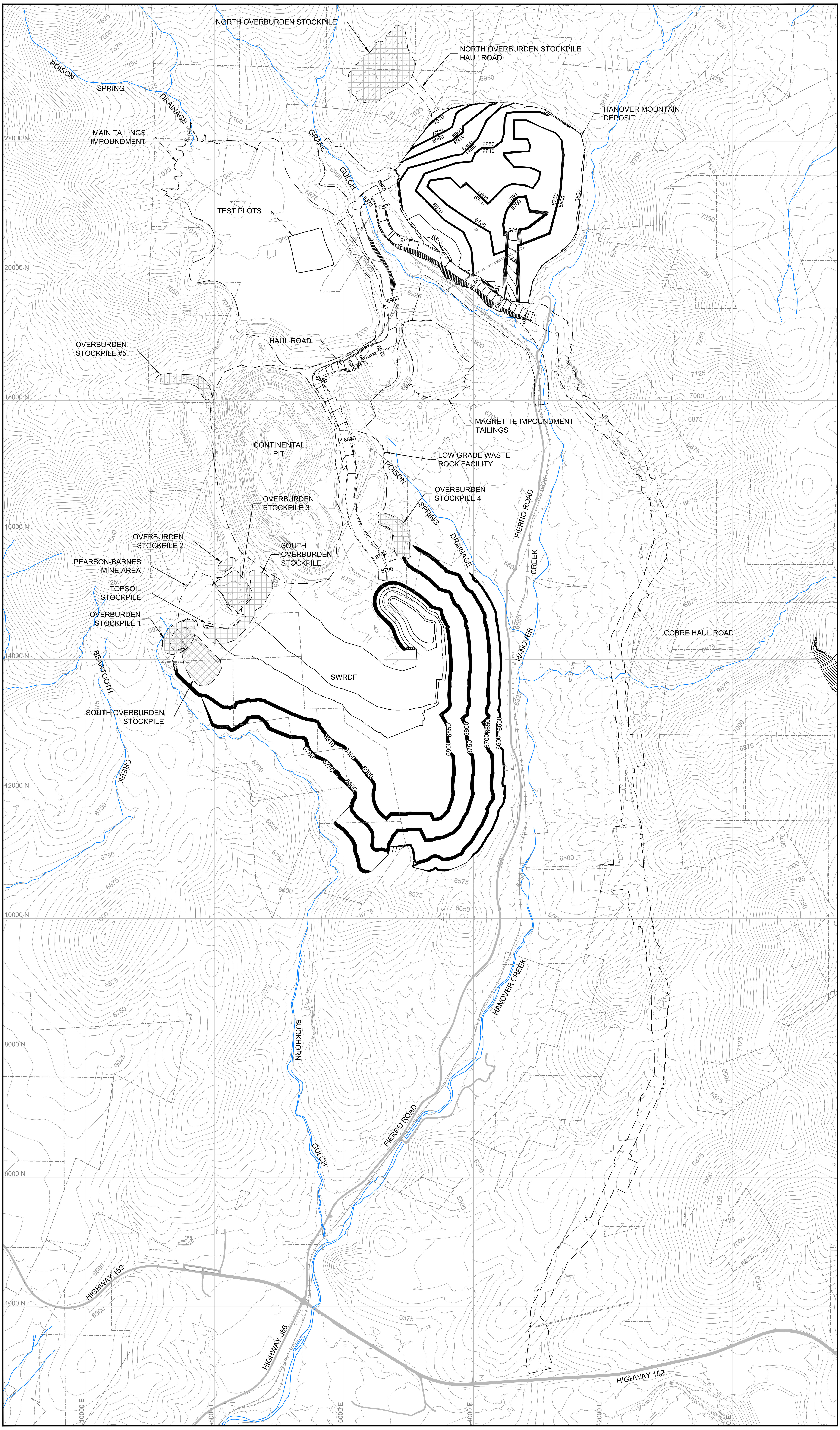
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- COORDINATE GRID
- RAILROAD
- ROADS
- FACILITY FOOTPRINT
- DRAINAGES

ACRONYMS:

PMLU	POST MINING LAND USE
SWRDF	SOUTH WASTE ROCK DISPOSAL FACILITY
EOY	END OF YEAR

0 1000
SCALE IN FEET
COORDINATE SYSTEM CHINO



EOY 2023 CONFIGURATION

SHEET NUMBER: 2

REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-MCMORAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN
2	FINAL SUBMITTAL	5/11/18	ST	WLN

NOT FOR CONSTRUCTION

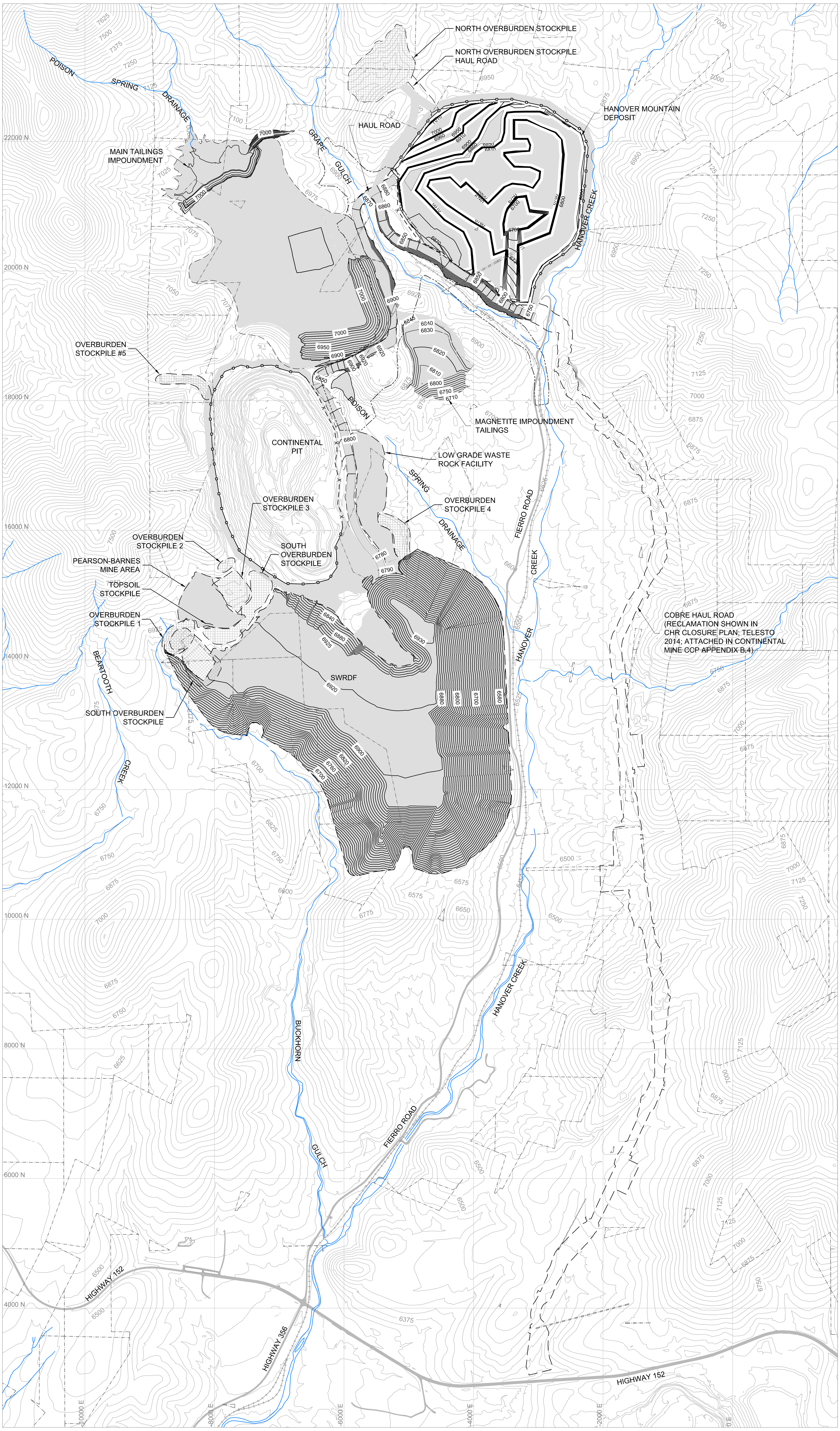
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- END OF YEAR 2023 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS
- RAILROAD
- FACILITY FOOTPRINT
- BLM ADMINISTERED LAND
- INDUSTRIAL PMLU BOUNDARY
- DRAINAGES

0 — 800
SCALE IN FEET

COORDINATE SYSTEM CHINO

N



NOTE:
CHANNELS AND BENCHES NOT SHOWN.

EOY 2023 RECLAIMED CONFIGUFURATION

SHEET NUMBER: 3

REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-McMoRAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN
2	FINAL SUBMITTAL	5/11/18	ST	WLN

NOT FOR CONSTRUCTION

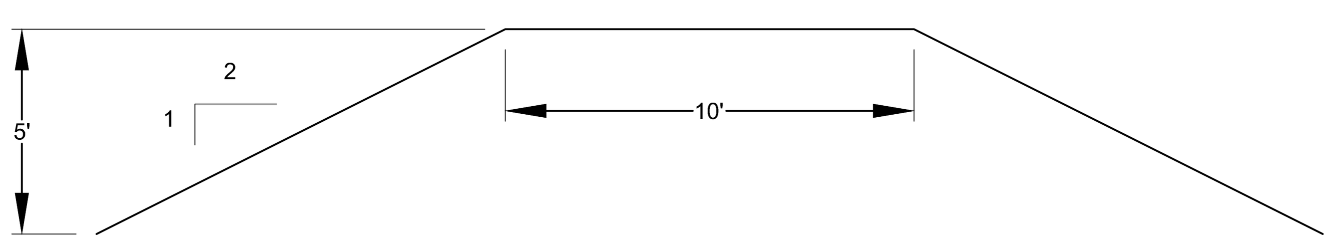
LEGEND

- EXISTING CONTOURS- 25' INT.
- RECLAIMED END OF YEAR 2023 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- RAILROAD
- INDUSTRIAL PMLU BOUNDARY
- FACILITY FOOTPRINT
- REVEGETATED AREA
- CHAIN LINK FENCE
- BERM
- BLM ADMINISTERED LAND
- DRAINAGES

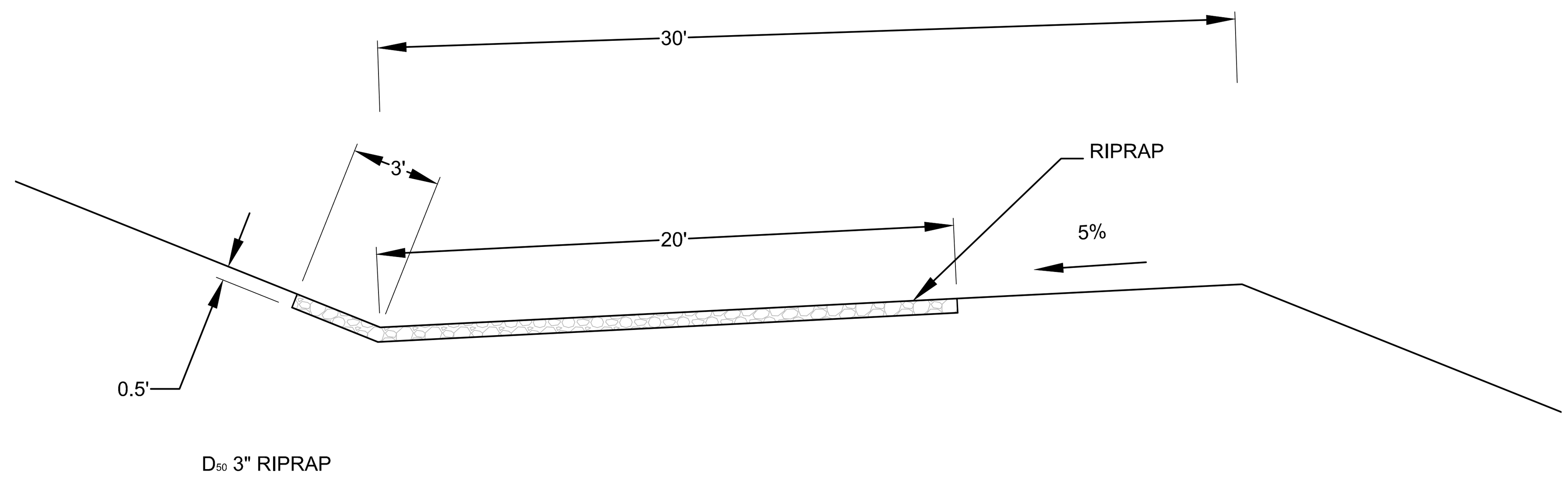
0 800
SCALE IN FEET

COORDINATE SYSTEM CHINO

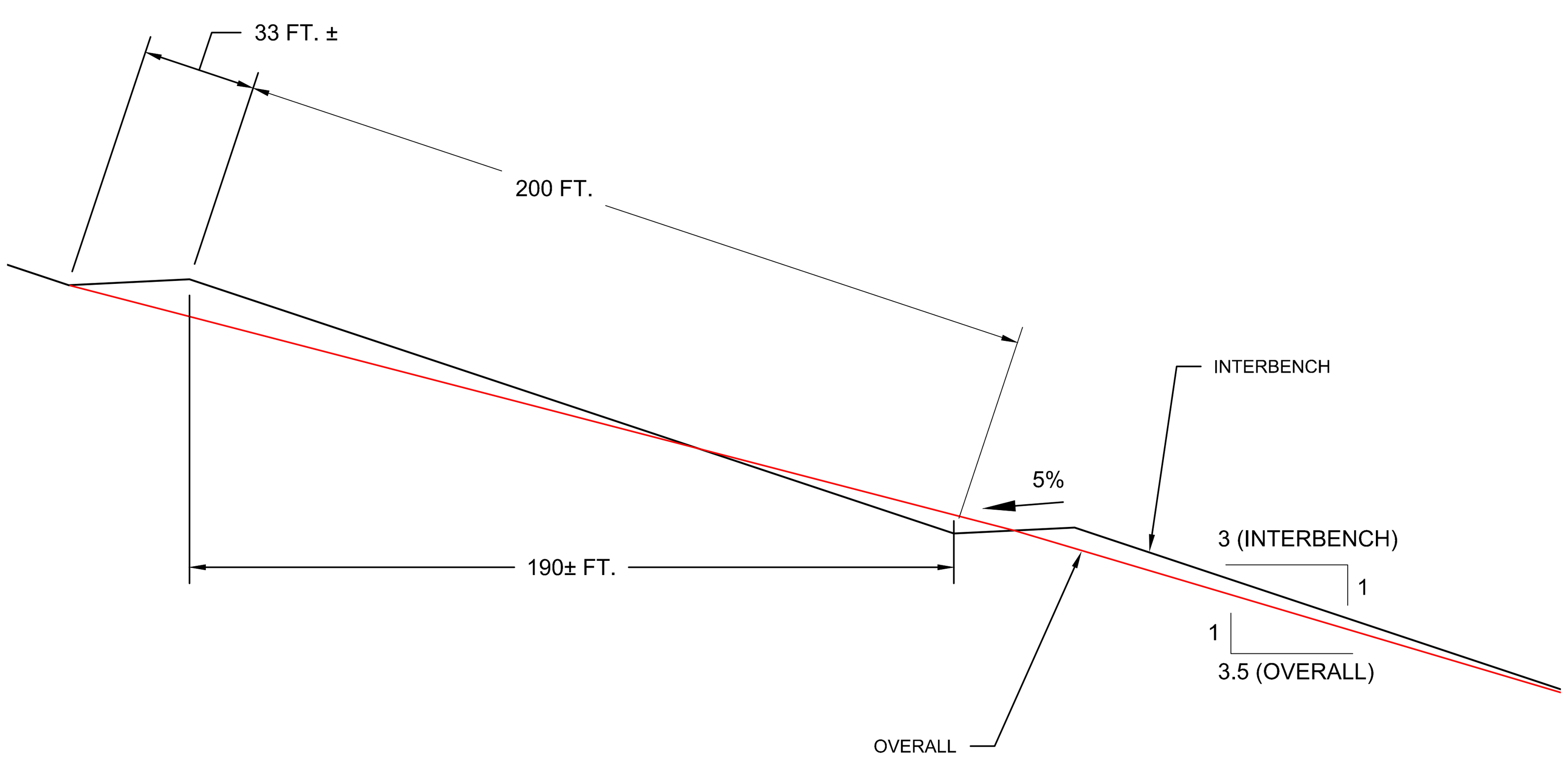
N



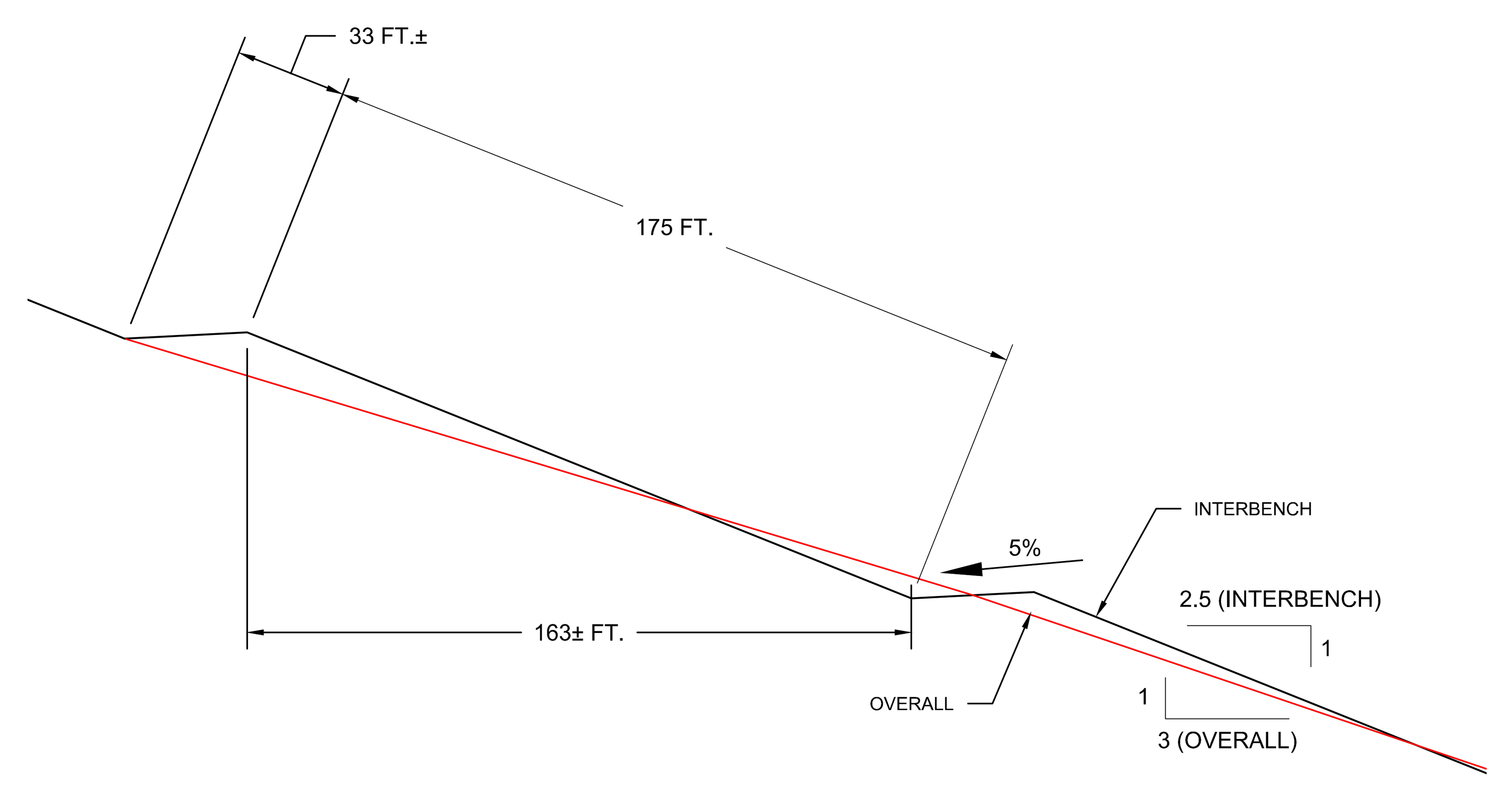
PIT BERM



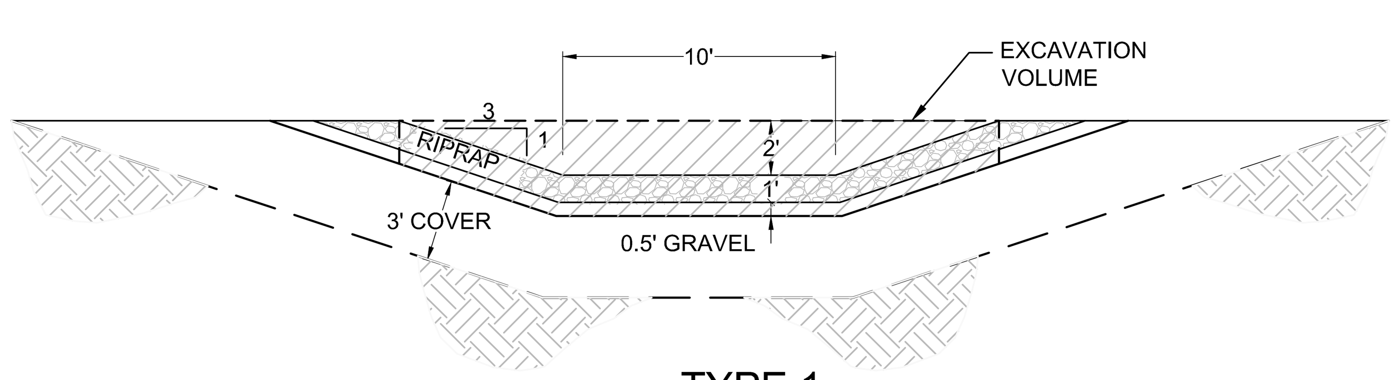
TYPICAL OUTSLOPE CHANNEL



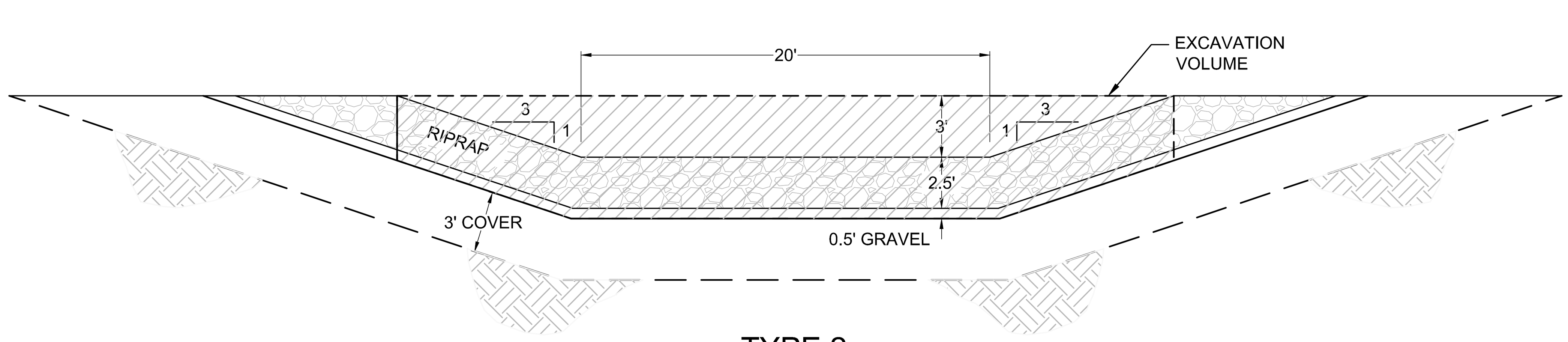
TYPICAL OUTSLOPE BENCH ON A 3:1 SLOPE



TYPICAL OUTSLOPE BENCH ON A 2.5:1 SLOPE



TYPE 1
TOP SURFACE CHANNELS



TYPE 2
TOP SURFACE CHANNELS
AND DOWNDRAINS

SLOPE AND CHANNEL CROSS-SECTION DETAILS

SHEET NUMBER:	REVISION NUMBER:
4	2

PREPARED BY: TELESTO SOLUTIONS • INCORPORATED

PREPARED FOR: FREEPORT-MCMORAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN
2	FINAL SUBMITTAL	5/11/18	ST	WLN

NOT FOR CONSTRUCTION

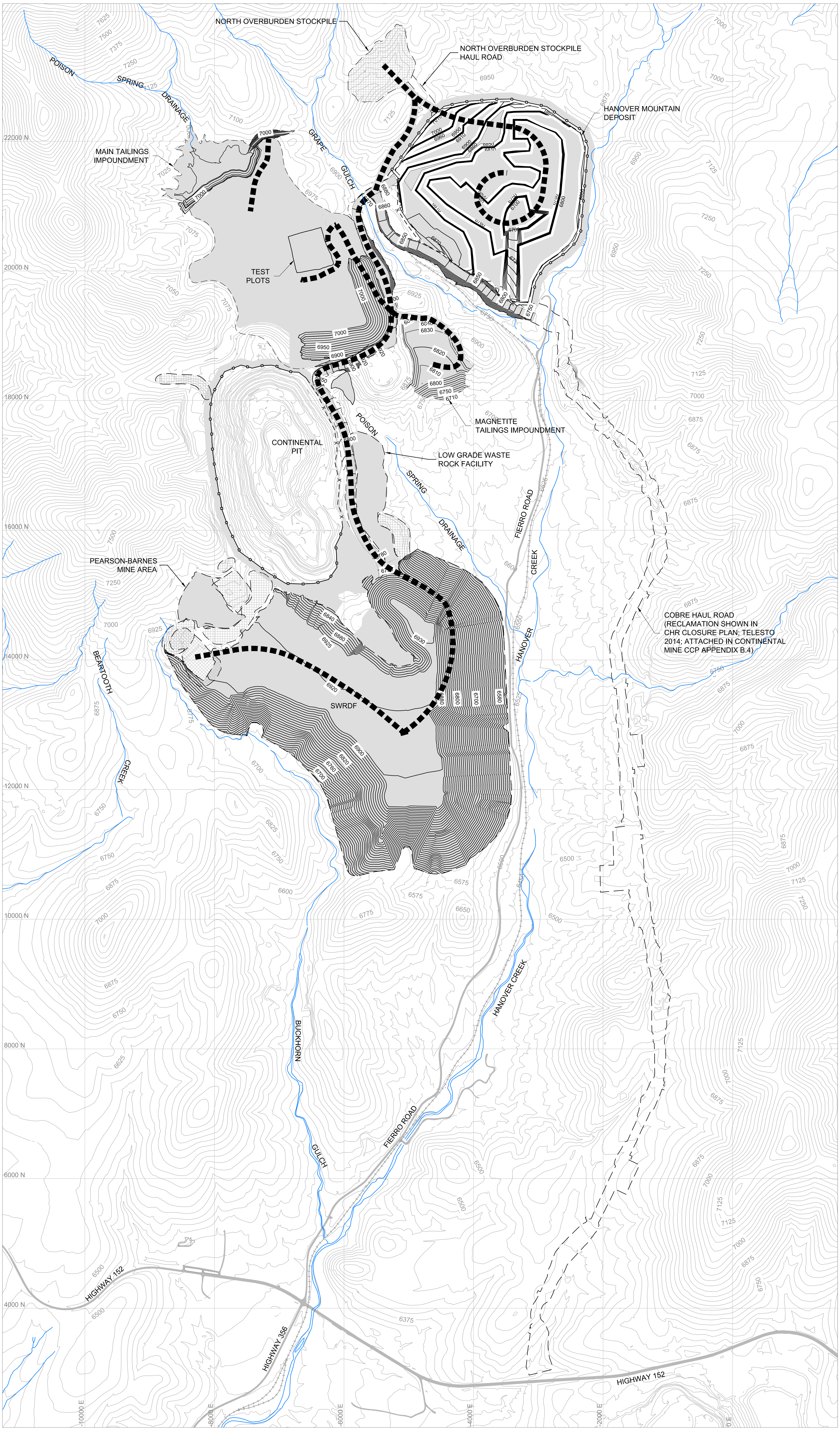
LEGEND / NOTES

RECLAIMED MATERIAL

CROSS-SECTIONAL AREA USED FOR EXCAVATION VOLUME IN COST ESTIMATE (NOT TO SCALE)

SEE APPENDIX B.2.8 TABLES 1-3 LIST CHANNEL, DOWNDRAIN AND BENCH QUANTITIES.

Date: 10/3/2014 8:04:38 AM R:\Cobre\2014_CCP\Calculations\AutoCad\CCP Figures\Startup CCP\200189_002-Sheet 4 Details And Sections 2014.dwg Plotted By: Stacy Tyler



SHEET NUMBER:	REVISION NUMBER:
5	2

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COVER HAUL ROUTES

DATE	DEC. 5, 2014
PROJECT	200189
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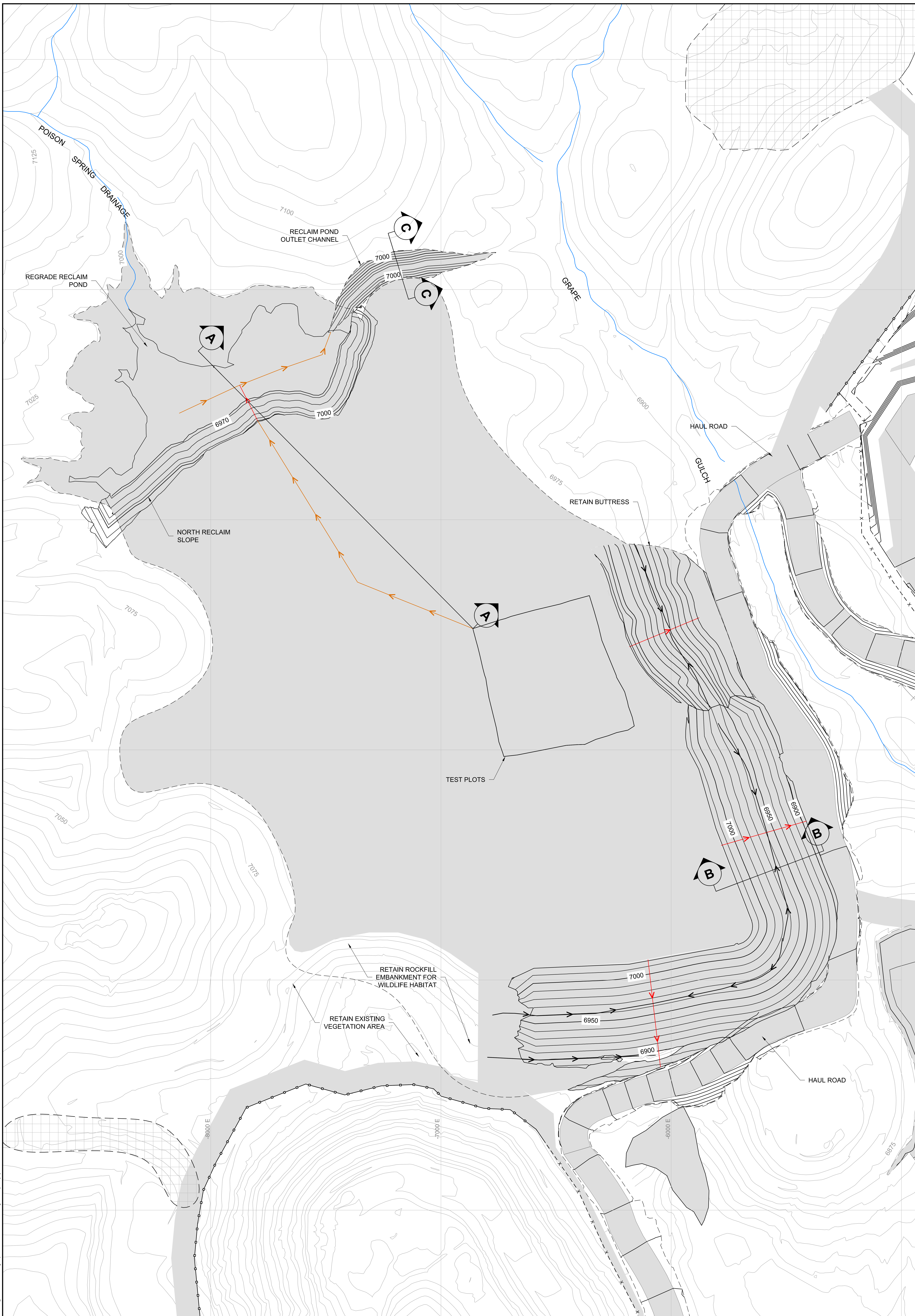
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- RECLAIMED END OF YEAR 2023 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- CONCEPTUAL HAUL ROUTES
- RAILROAD
- REVEGETATED AREA
- CHAIN LINK FENCE
- BERM
- FACILITY FOOTPRINT
- DRAINAGES

0 800
SCALE IN FEET

COORDINATE SYSTEM CHINO

N



MAIN TAILINGS IMPOUNDMENT RECLAIMED

SHEET NUMBER: 6

REVISION NUMBER: 2

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DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

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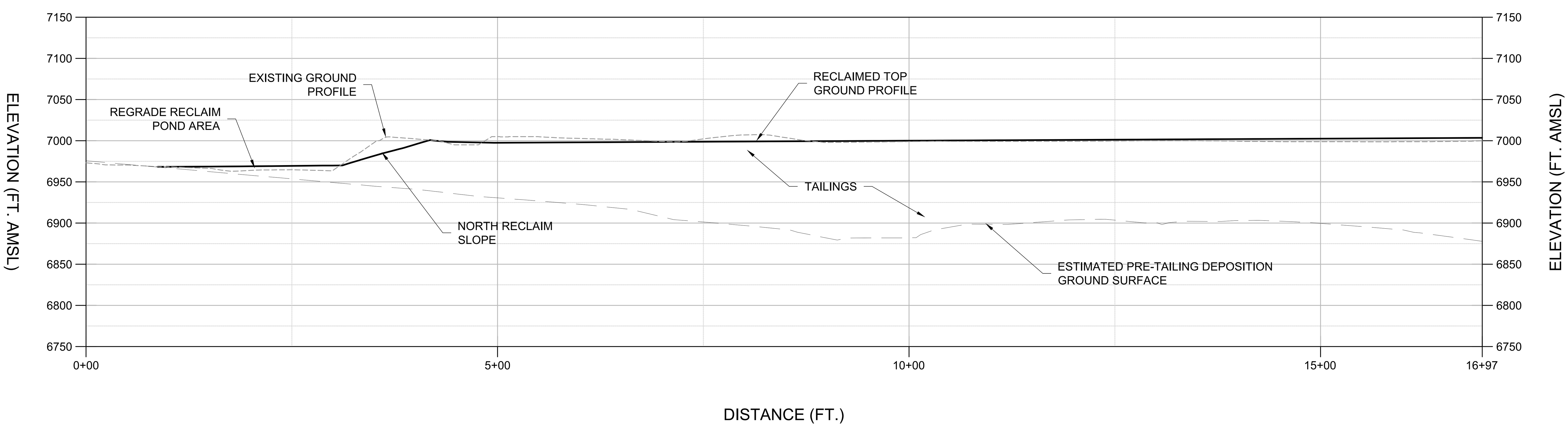
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT. (AMSL)
- RECLAIMED END OF YEAR 2023 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BERM
- FACILITY FOOTPRINT
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- REVEGETATION AREA
- CHAIN LINK FENCE
- TYPICAL OUTSLOPE BENCH SEE TYPICAL SECTIONS ON SHEET 4
- CONCEPTUAL DOWNDRAIN SEE TYPE 2 CHANNEL ON SHEET 4
- CONCEPTUAL TYPE 2 CHANNEL SEE TYPICAL SECTION ON SHEET 4
- DRAINAGES

0 200
SCALE IN FEET

COORDINATE SYSTEM CHINO

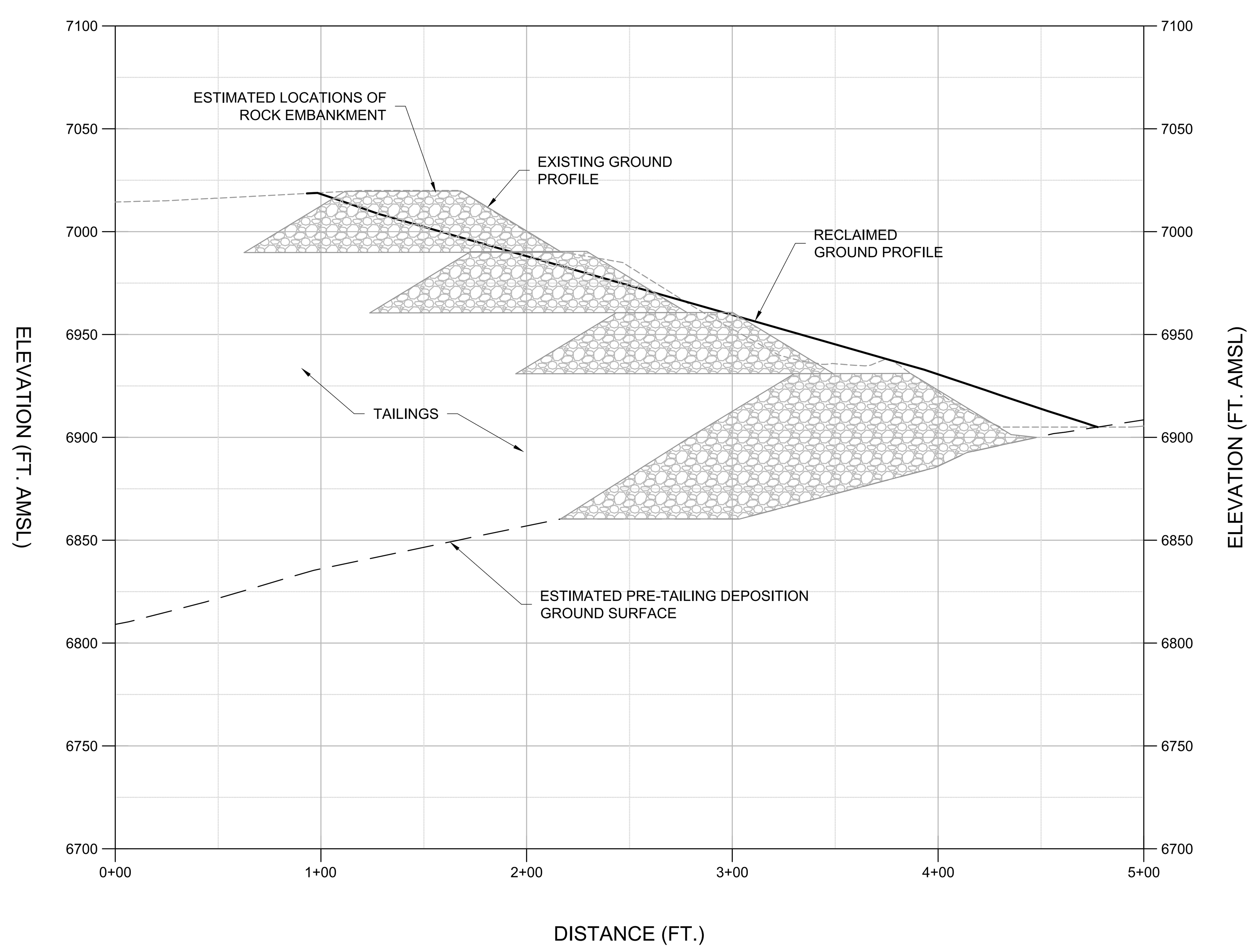
N



MAIN TAILINGS IMPOUNDMENT NORTH RECLAIM SLOPE AND TOP SECTION A-A'

A

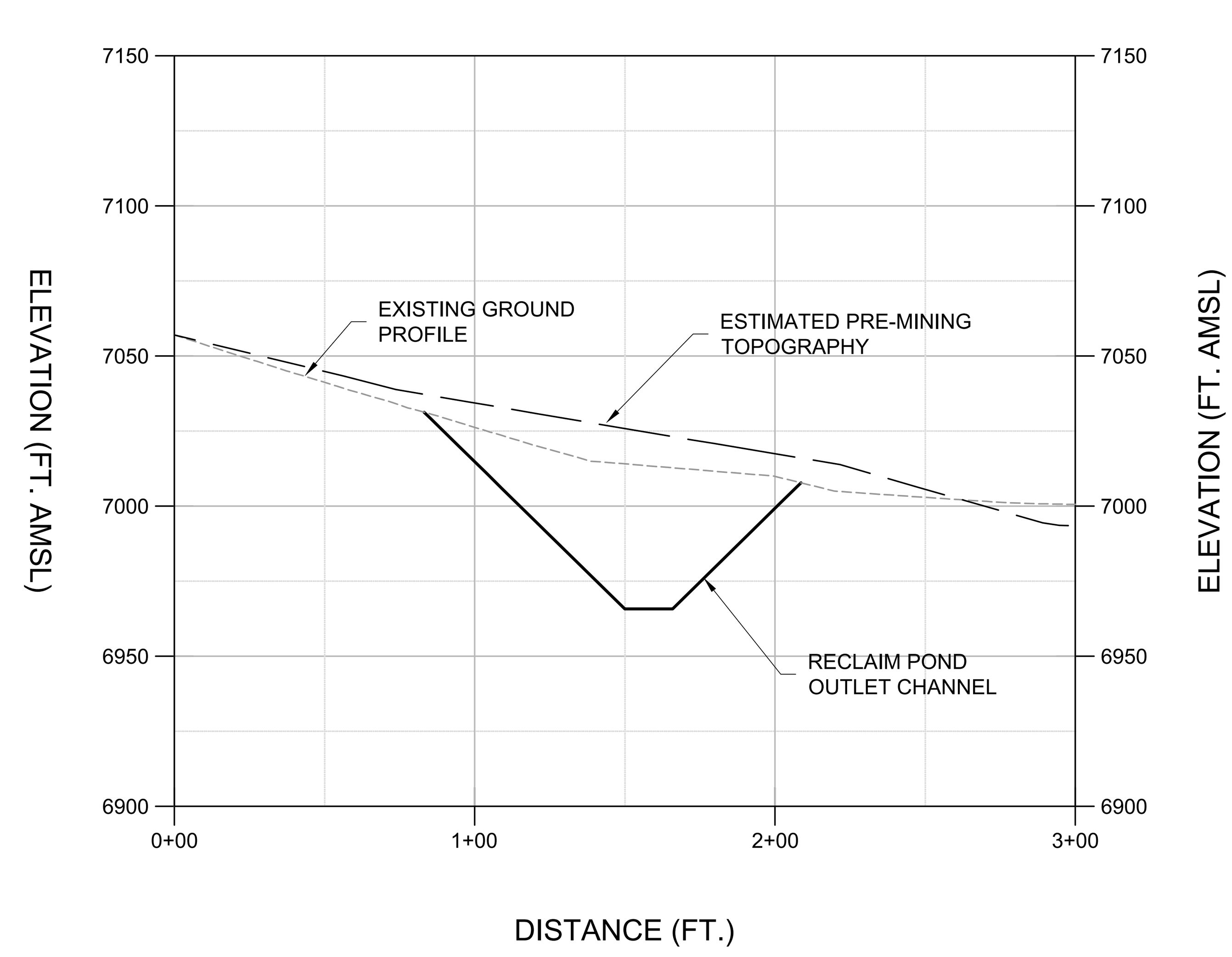
SCALE PER GRID



MAIN TAILINGS IMPOUNDMENT SOUTH RECLAIM SLOPE SECTION B-B'

B

SCALE PER GRID



MAIN TAILINGS IMPOUNDMENT RECLAIM DRAINAGE CHANNEL SECTION C-C'

C

SCALE PER GRID

NOTES:
1. OVERALL RECLAMATION SLOPE SHOWN IN SECTIONS, BENCHES ARE NOT SHOWN. FOR TYPICAL FINAL SLOPE CONFIGURATION SEE SHEET 4.

MAIN TAILINGS IMPOUNDMENT CROSS-SECTIONS

SHEET NUMBER: 7
REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-McMoRAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
DRAWN BY	MM
PROJECT ENGINEER	WLN
CHECKED BY	AT

REVISIONS

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0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN
2	FINAL SUBMITTAL	5/11/18	ST	WLN

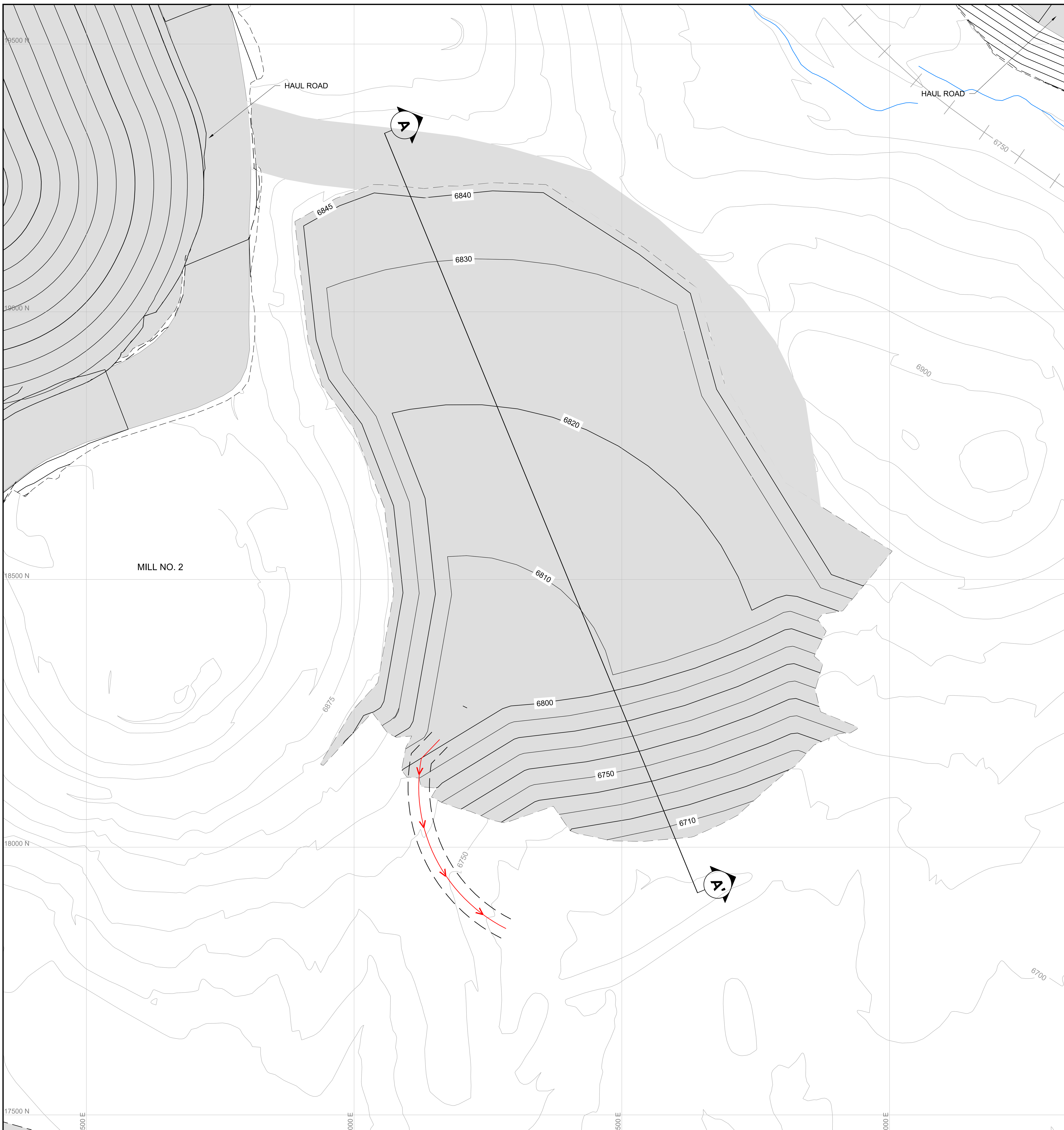
NOT FOR CONSTRUCTION

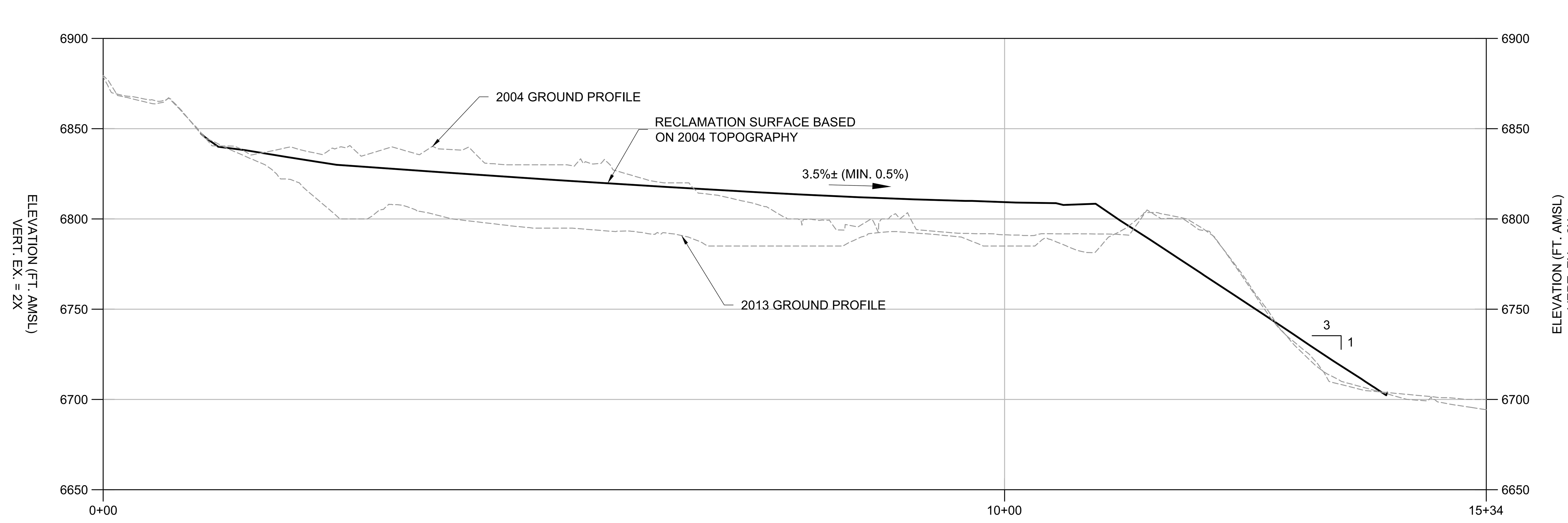
LEGEND / NOTES

0 100
SCALE IN FEET

COORDINATE SYSTEM CHINO

N





A SECTION A-A'

SCALE PER GRID

NOTES:
1. OVERALL RECLAMATION SLOPE SHOWN IN SECTIONS, BENCHES ARE NOT SHOWN. FOR TYPICAL FINAL SLOPE CONFIGURATION SEE SHEET 4.

MAGNETITE TAILINGS IMPOUNDMENT RECLAIMED

SHEET NUMBER: 8

REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-MCMORAN

DATE	DEC. 5, 2014
PROJECT	200189
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LEGEND / NOTES

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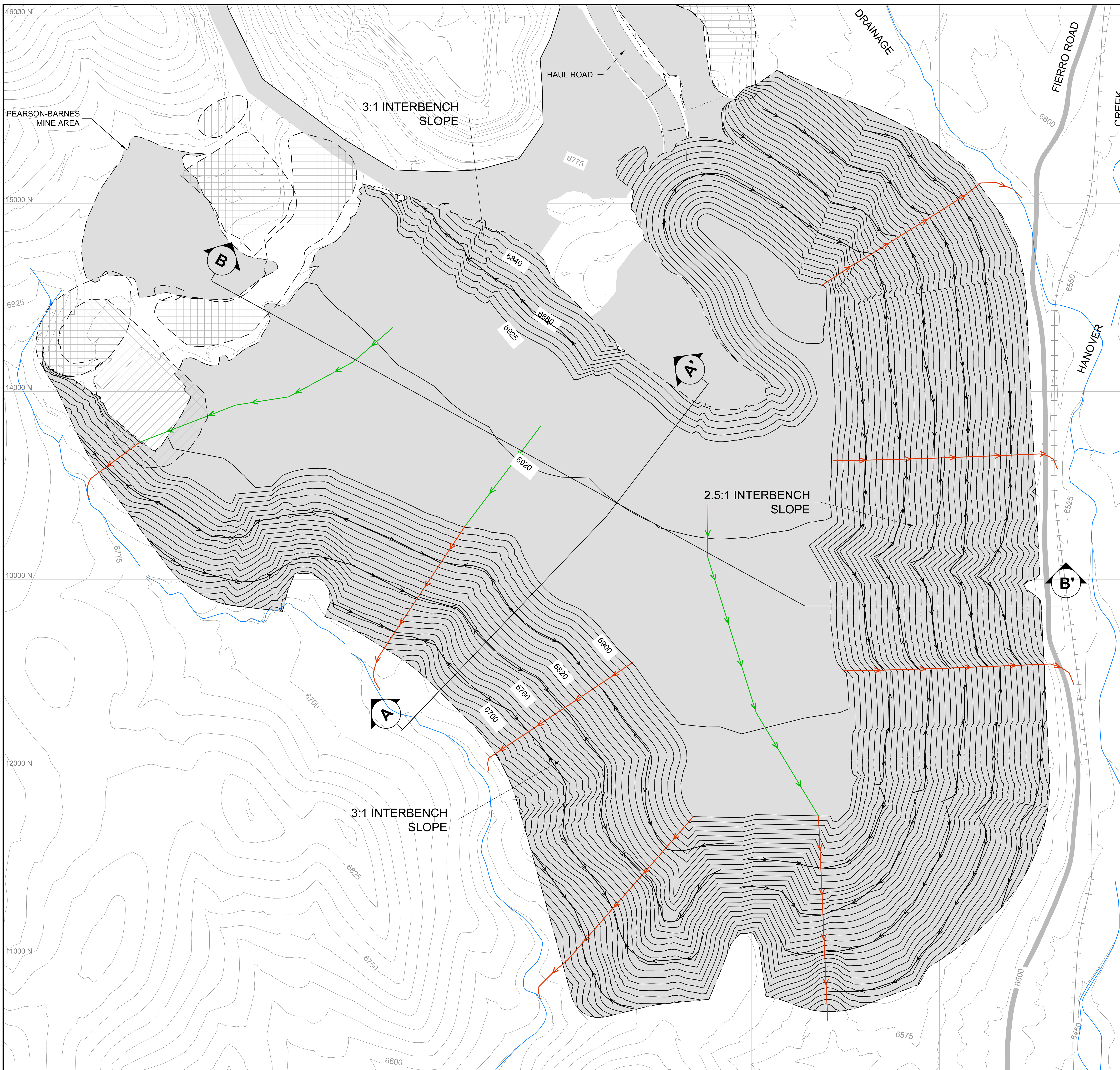
- PROPOSED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- CONCEPTUAL DOWNDRAIN SEE TYPE 2 CHANNEL ON SHEET 4
- RAILROAD
- REVEGETATION AREA
- FACILITY FOOTPRINT
- DRAINAGES

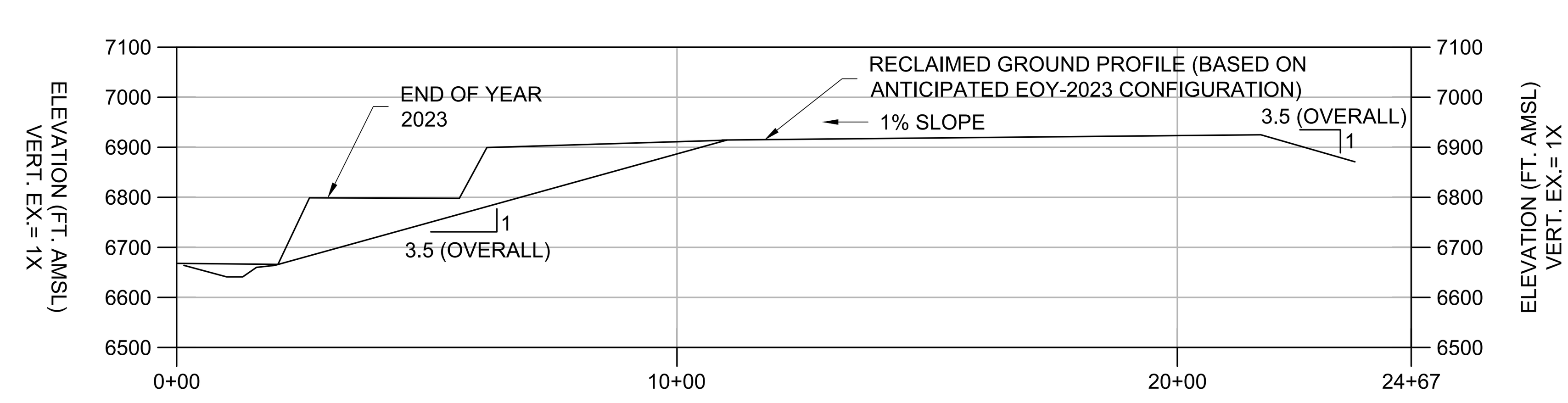
0 100
SCALE IN FEET

COORDINATE SYSTEM CHINO

N

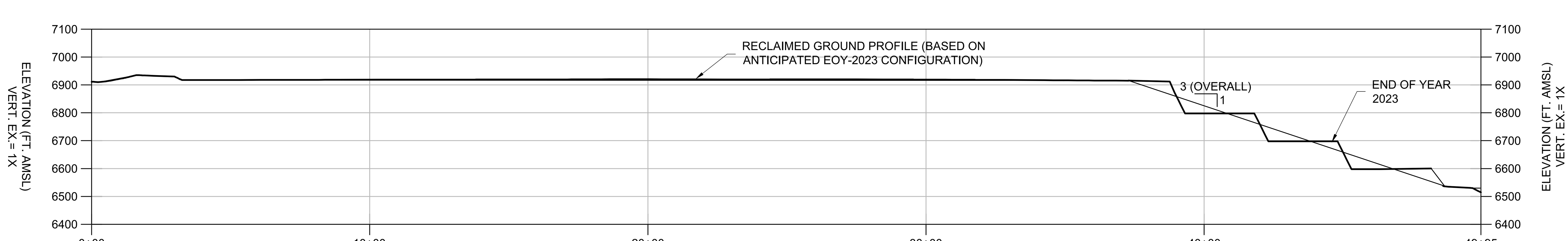


PLAN VIEW



A **SECTION A-A'**

SCALE PER GRID



B **SECTION B-B'**

SCALE PER GRID

NOTES:
1. OVERALL RECLAMATION SLOPE SHOWN IN SECTIONS, BENCHES ARE NOT SHOWN. FOR TYPICAL FINAL SLOPE CONFIGURATION SEE SHEET 4.

SWRDF RECLAIMED

SHEET NUMBER: 9
REVISION NUMBER: 2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-McMoRAN

DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
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LEGEND

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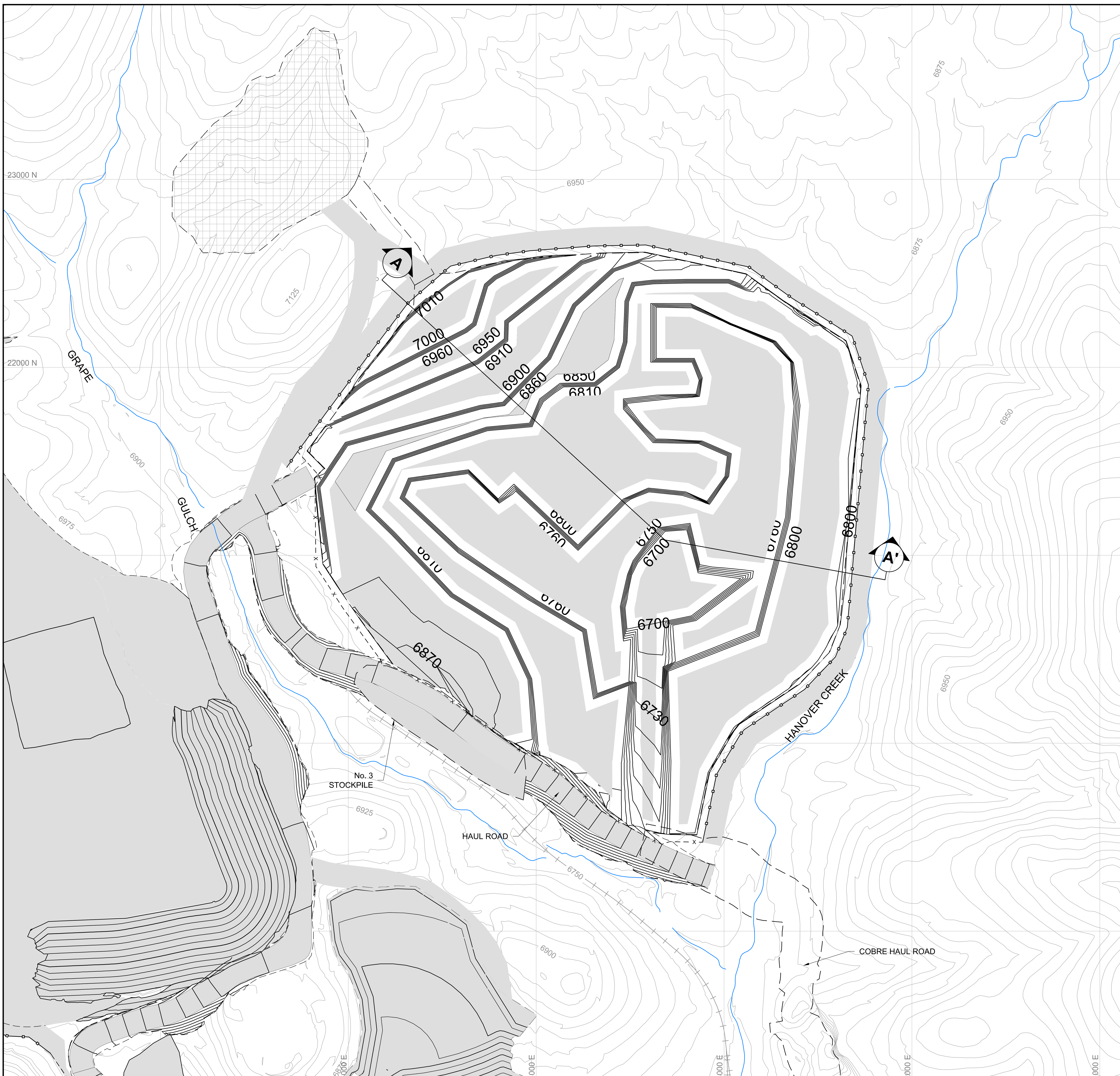
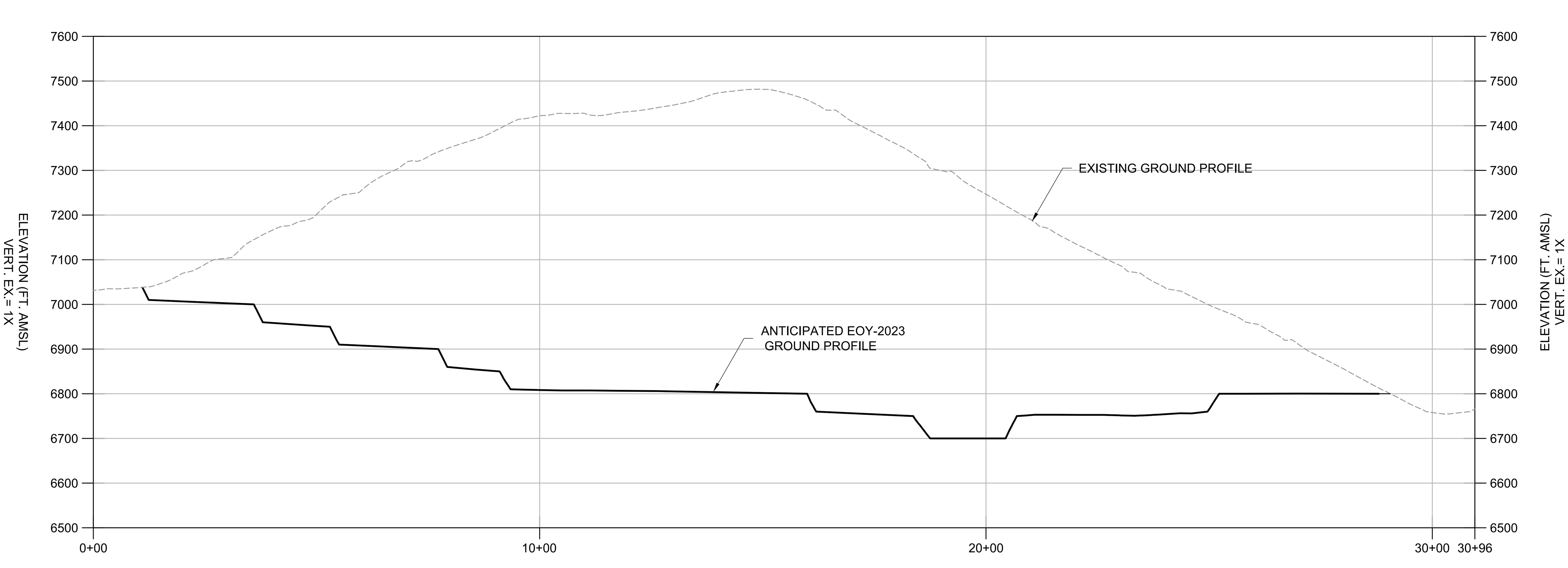
- CONCEPTUAL DOWNDRAIN SEE TYPE 2 CHANNEL ON SHEET 4
- RAILROAD
- FACILITY FOOTPRINT
- REVEGETATION AREA
- TYPICAL OUTSLOPE BENCH SEE TYPICAL SECTIONS ON SHEET 4
- CONCEPTUAL TYPE 1 CHANNEL SEE TYPICAL SECTIONS ON SHEET 4
- DRAINAGES

0 300
SCALE IN FEET

COORDINATE SYSTEM CHINO

N





A **SECTION A-A'**

SCALE PER GRID

HANOVER MOUNTAIN DEPOSIT RECLAIMED POST END OF YEAR 2023 MINING

SHEET NUMBER:	REVISION NUMBER:
10	2

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-MCMORAN

DATE	DEC. 5, 2014
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NOT FOR CONSTRUCTION

LEGEND / NOTES

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- CHAIN LINK FENCE
- BERM
- DRAINAGES

0 300 SCALE IN FEET

N

COORDINATE SYSTEM CHINO

APPENDIX A

FACILITY CHARACTERISTIC FORMS

List of Tables

NOTES:

1. Borrow area reclamation costs can be found in the Cobre_Stockpiles_Tails_Other_2018_NOBS_20180519 spreadsheet 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, C, and D.

2014 Continental Mine Closure/Closeout Plan 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	$19,334
Berm and Fence	$88,724
Capital Cost Totals	**$108,058**
Capital Cost/Acre	**$6,140**

2014 Continental Mine Closure/Closeout Plan 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)	$381,780
Regrade	$2,213
Seed & Mulch	$30,571
Other	$0
Capital Cost Totals	**$414,565**
Capital Cost/Acre	**$14,912**

2014 Continental Mine Closure/Closeout Plan 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)	179
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$1,778,293
Regrade	$95,363
Seed & Mulch	$196,605
Other[1]	$897,333
Capital Cost Totals	**$2,967,594**
Capital Cost/Acre	**$16,579**

[1] Other includes channels, down drains

Note: The Main Tailings Impoundment is unchanged by end of year (EOY) 2019. 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 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)	$803,564
Regrade	$99,798
Seed & Mulch	$68,623
Other[1]	$105,986
Capital Cost Totals	**$1,077,972**
Capital Cost/Acre	**$17,248**

[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 Update
Facility Characteristics Form

SWRDF

Function	Planned Waste Rock Stockpile Expansion By EOY 2019 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 2019 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]	386.4
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$5,614,570
Regrade	$1,921,452
Seed & Mulch	$424,460
Other[2]	$3,430,228
Capital Cost Totals	**$11,390,709**
Capital Cost/Acre	**$29,479**

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

2014 Continental Mine Closure/Closeout Plan 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)	$1,225,961
Regrade	$0
Seed & Mulch	$102,490
Other	$111,483
Capital Cost Totals	**$1,439,934**
Capital Cost/Acre	**$15,433**

[1]Includes berm and fence disturbed area.

2014 Continental Mine Closure/Closeout Plan 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)	$75,889
Regrade	$429
Seed & Mulch	$5,932
Other[2]	$42,865
Capital Cost Totals	**$125,116**
Capital Cost/Acre	**$23,170**

[1]Reclaim Pond included with Main Tailing Impoundment
[2]Other includes reinforced concrete wall demolition

2014 Continental Mine Closure/Closeout Plan Update
Facility Characteristics Form

Haul and Exploration Roads

Function	Existing and Planned Site Traffic
Notes	Includes Haul Roads and Exploration roads.
Construction Method	Cut & fill.
Physical Characteristics	12 to 120 feet wide driving surface with roadside berms.
Existing Engineering Measures	Ongoing maintenance and stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	82
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$0
Regrade	$6,521
Seed & Mulch	$90,077
Other	$0
Capital Cost Totals	**$96,598**
Capital Cost/Acre	**$1,178**

2014 Continental Mine Closure/Closeout Plan Update
Facility Characteristics Form

Contingency Disturbance Area

Function	Unknown
Notes	Allows for reclamation of land disturbances not currently foreseen during the next 5 years.
Construction Method	Scarifying, discing, drill seeding
Physical Characteristics	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)	50
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$625,420
Regrade	$131,060
Seed & Mulch	$54,925
Other	$0
Capital Cost Totals	**$811,404**
Capital Cost/Acre	**$16,228**

2014 Continental Mine Closure/Closeout Plan Update
Facility Characteristics Form

Cobre Haul Road[2]

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)	$41,758
Regrade	$342,924
Seed & Mulch	$109,850
Other[1]	$61,232
Capital Cost Totals	**$555,764**
Capital Cost/Acre	**$5,558**

[1]Other includes spanning arch demolition
[2]Cobre Haul Road Closeout Plan was submitted previously. Costs are updated for 2018.

2014 Continental Mine Closure/Closeout Plan 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 2019 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)	$196,395
Regrade	$0
Seed & Mulch	$13,072
Other	$0
Capital Cost Totals	**$209,467**
Capital Cost/Acre	**$17,602**

2014 Continental Mine Closure/Closeout Plan 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)	$62,278
Regrade	$3,978
Seed & Mulch	$6,261
Other	$0
Capital Cost Totals	**$72,518**
Capital Cost/Acre	**$12,722**

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

Borrow Areas

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)	55.8
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$0
Regrade	$0
Seed & Mulch	$61,263
Other	$0
Capital Cost Totals	**$61,263**
Capital Cost/Acre	**$1,099**

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

Appendix B
Earthwork Cost Estimate
Summary Report

Prepared for

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

Prepared by

Telesto Solutions, Inc.
2950 East Harmony Road, Suite 200
Fort Collins, CO 80528

December 2014
Updated May 2018

TELESTO
SOLUTIONS • INCORPORATED

Signature Page

Appendix B
Earthwork Cost Estimate
Summary Report

December 2014
Updated May 2018

TELESTO
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Report Authors and Contributors

Telesto Solutions, Inc.

Jean Humphrey by: WLN

Jean Humphrey

Walter L Niccoli

Walt Niccoli P.E. – Report Review

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LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Purpose and Summary

As part of the 2014 Continental Mine Closure/Closeout Plan (CCP) Update, an earthwork reclamation cost estimate for financial assurance was prepared by Telesto Solutions Inc. (Telesto) for Freeport-McMoRan Chino Mines Company (Chino). The earthwork reclamation cost estimate is based on a template originally created by the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD, 1996). This earthwork estimate includes reclamation earthwork, demolition, and site operations and maintenance costs. Water management related reclamation costs are included in a separate estimate (2014 CCP Update, Appendix C). The earthwork reclamation 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 assumes reclamation would begin in 2024 (Reclamation year 0). The original 2014 CCP 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 brought all costs and schedules into currency with a 2018 start of mining date.

1.2 Reclamation Overview

A summary of the mine facilities is provided in Table B-1. With the exception of operation and maintenance costs, only facilities requiring reclamation as of EOY 2023 are included in this earthwork reclamation cost estimate.

2.0 COST ESTIMATE

The total current dollar cost for earthwork reclamation is estimated to be **$23,850,000.** A summary of the estimate is provided in Table B-2. The costs presented in this estimate are current (2018) dollar costs, a net present value calculation is presented.

2.1 Financial Assurance Cost Estimate Assumptions

Assumptions used throughout the cost estimate include:

- **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 and topsoil 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-1and Table B-2). The Overburden Stockpiles and Top Soil Stockpile are anticipated to be completely removed and the footprints ripped and revegetated.
- **Dust Suppression and Site Maintenance**: A full time 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 were developed based on the New Mexico Department of Labor (NMDOL) Type H (Heavy Engineering) labor rates effective January 1, 2018 (NMDOL, 2018). These rates include the base, fringe benefit, and apprenticeship contribution rates (Table B-3)
- **Equipment Rates:** Table B-3 summarizes the earth-moving equipment used in the estimate, which would commonly be available to a contractor. The equipment unit operating costs were taken from EquipmentWatch Custom Cost Evaluator (Penton Media, Inc., 2018) and can be found in Appendix B.2.3
- **Equipment Production Factors:** Table B-4 summarizes equipment production factors from Caterpillar (2014, 2017) for each type of equipment used is presented in Table B-3. Productivity curves were also developed from Caterpillar (2014, 2017) and are described in Appendix B.2.4 and B.2.5.
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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	Construction completed mid-year 2018
Haul Roads and Exploration Roads	Various changes to Haul Roads accommodate SWRDF expansion, Hanover Mountain exploration roads are mined out by EOY 2023
Contingency Disturbance Areas	Areas outside immediate footprint which require grading, cover placement, seeding and mulch
Overburden and Topsoil Stockpiles	
East OB Stockpile	EOY 2019 covered by SWRDF
Top Soil Stockpile (TSSP)	Remains in existing configuration by EOY 2019
NOBS	Proposed Topsoil stockpile, in place by EOY 2019
South OB Stockpile	Proposed Topsoil stockpile, in place by EOY 2019
OB Stockpile-1	Remains in existing configuration by EOY 2019
OB Stockpile -2	Remains in existing configuration by EOY 2019
OB Stockpile -3	Remains in existing configuration by EOY 2019
OB Stockpile -4	Remains in existing configuration by EOY 2019
OB Stockpile -5	Remains in existing configuration by EOY 2019
Pit	
Continental Pit	GR002RE 01-1 Pit reclamation waiver

[1] See Appendix C for Surface Impoundments

Table B-2 Earthworks Cost Estimate Summary

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital Item		**28.3%**	
Tailing Ponds			
Main Tailings Impoundment	$2,313,012	$654,582	$2,967,594
Magnetite Tailings Impoundment	$840,196	$237,776	$1,077,972
Subtotal	**$3,153,208**	**$892,358**	**$4,045,566**
Waste Rock and Ore Piles			
SWRDF	$8,860,289	$2,507,462	$11,367,751
No. 3 Stockpile	$56,522	$15,996	$72,518
Low Grade WRF	$323,121	$91,443	$414,565
Subtotal	**$9,239,932**	**$2,614,901**	**$11,854,833**
Mines			
Hanover Mountain Deposit(b)	$1,122,318	$317,616	$1,439,934
Continental Pit	$84,223	$23,835	$108,058
Subtotal	**$1,206,541**	**$341,451**	**$1,547,992**
Surface Impoundments and Wells			
Surface Impoundment Earthworks	$97,518	$27,598	$125,116
Wells	$7,421	$2,100	$9,521
Subtotal	**$104,939**	**$29,698**	**$134,636**
Historic Sites			
Disturbed Area Adjacent and North of the SWRDF	$17,895	$5,064	$22,959
Pearson-Barnes Mine Area	$163,263	$46,204	$209,467
Subtotal	**$181,158**	**$51,268**	**$232,425**
Other Disturbed Areas			
Haul and Exploration Roads	$75,291	$21,307	$96,598
Contingency Disturbance Areas	$632,427	$178,977	$811,404
Borrow Areas	$47,750	$13,513	$61,263
Subtotal	**$755,468**	**$213,797**	**$969,265**
Demolition			
Buildings	$1,389,430	$393,209	$1,782,638
Rip & Revegetation	$1,068	$302	$1,370
Cover	$102,002	$28,867	$130,869
Subtotal	**$1,492,500**	**$422,378**	**$1,914,878**
Total Capital Cost without CHR	**$16,133,746**	**$4,565,850**	**$20,699,596**
Cobre Haul Road	$433,176	$122,589	$555,764
Total Capital Cost with CHR	**$16,566,922**	**$4,688,439**	**$21,255,360**
O&M		**23.30%**	
O&M Main Site	$2,028,352	$472,606	$2,500,958
O&M Cobre Haul Road	$74,610	$17,384	$91,994
Subtotal	**$2,102,962**	**$489,990**	**$2,592,952**
Total Earthwork with O&M	**$18,669,883**	**$5,178,429**	**$23,848,312**

Table B-3 Labor and Equipment Unit costs

Parameter	Value	Comment
Operations and Maintenance Equipment[2]		
Caterpillar 14M	$107.79/hr	Articulated Frame Grader
Off-Highway Water Tanker Truck	$92.86/hr	6,000 Gallon
Caterpillar 980G Loader	$81.48/hr	4-WD Articulated Loader
Caterpillar 730 Truck	$83.36/hr	Mechanical Rear Dump
Labor Rates		
Dozer Operator	$26.29/hr	NMDOL Rate
Mechanic	$26.39/hr	NMDOL Rate
Haul Truck Operator	$23.84/hr	NMDOL Rate
Truck Driver	$23.84/hr	NMDOL Rate
Loader Operator	$26.56/hr	NMDOL Rate
Motor Grader	$26.29/hr	NMDOL Rate
Equipment for Earthwork[3]		
Caterpillar D11T	$414.50/hr	Standard Crawler Dozer
Caterpillar D11T w/ Multishank Ripper	$448.89/hr	Standard Crawler Dozer
Caterpillar D9T	$178.02/hr	LGP Crawler Dozer
Caterpillar D6T XL SU	$88.86/hr	Standard Crawler Dozer
Caterpillar 793	$478.45/hr	Averaged Komatsu HD 1500 and Caterpillar 797
Caterpillar 992K	$294.35/hr	4-WD Articulated Loader
Caterpillar 16M	$133.94/hr	Articulated Frame Grader
Caterpillar 14M	$99.13/hr	Articulated Frame Grader
Off-Highway Water Tanker Truck	$86.99/hr	6,000 Gallon
Hitachi ZAXES 200LC-3	$62.57/hr	Excavator

[2] Equipment Unit Rate Notes: Equipment unit rates from EquipmentWatch Custom Cost Evaluator 2018, first Qtr, adjusted Sales Tax = 0%, Fuel = $2.23/gal (subtracting indirect costs), mechanic wage $26.56/hr. Annual Use Hours increased to correct for 50 min work hour

[3] Equipment Unit Rate Notes: Equipment unit rates from EquipmentWatch Custom Cost Evaluator 2018, first Qtr, adjusted Sales Tax = 0%, Fuel = $2.14/gal (subtracting indirect costs), mechanic wage $26.39/hr. Annual Use Hours increased to correct for 50 min work hour

- **Fuel Costs**: Table B-5 lists the off-road diesel fuel cost based on a quote obtained on March 12, 2018 from Griffin Propane for delivery of dyed ultra-low sulfur diesel to the Continental Mine
- **Capital Indirect Costs**: Total indirect costs of 28.3% were applied to the capital direct costs per MMD (1996) and OSM (2000) guidance. The indirect costs are comprised of: Mobilization and Demobilization (3.8%), Contingencies (4.0%), Engineering Redesign Fee (2.5%), Contractor Profit and Overhead (15.0%), and Project Management Fee (3.0%). Indirect cost percentages are identical to the percentages presented to MMD and the New Mexico Environment Department (NMED) in meetings with Tyrone on September 20, 2012, and on November 2, 2012
- **Operations and Maintenance Indirect Costs**: Total indirect costs of 23.3% were applied for long term operations and maintenance per MMD (1996) and OSM (2000) guidance and comprise the same values and factors as the capital indirect costs with exception of Contractor Profit and Overhead. Contractor Profit and Overhead for long term operations and maintenance is 10.0%, to account for the long term contract and repetitive annual work. Indirect cost percentages are identical to the percentages presented to MMD and the NMED in meetings with Tyrone on September 20, 2012, and on November 2, 2012
- **Revegetation Unit Costs**: The revegetation unit cost (Table B-5) was based on a quote obtained on April, 2018 from Rocky Mountain Reclamation of Laramie, WY. It includes scarifying, discing, rangeland drill seeding, mulching, crimping, and daily per diem (Appendix B.2.7).
- **Revegetation and Scarification:** Scarifying of the final surface is performed at the same time as the revegetation and is included in the revegetation quote.
- **Rip Rap**: The rip rap unit cost is based on a quote obtained in March 2018 from T. G. McMauley, Inc. (Table B-5)
- **Miscellaneous Unit Costs**: Other miscellaneous unit costs shown in Table B-5 were taken from several sources including R.S. Means Heavy Construction Cost Data Edition 32 (R.S. Means, 2018). All costs taken from R.S. Means were adjusted using the location factor for Las Cruces (85.6%). Supporting documentation is included in Appendix B.2.7.
- **Well Abandonment**: The well abandonment unit costs are based on MMD Guidance for wet drill holes and are inflated to 2018 dollars using an inflation factor (MMD, 2013; Appendix B.2.8).
-

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.
Regrading Tops and Outslopes (D11T CD)		
Operator Factor (1)	0.75 coarse grading	Due to small job size assume average instead of excellent operator (CPH 44, 19-55, average)
Material Factor	1.0	CPH 44, 19-55, Loose stockpile
Work Hour	50 min	(CPH 44, 19-55)
Grade Factor – Tops	1.0	(CPH 44, 19-55) 1-5% Slope
Grade Factor - Outslopes(1)	1.6	(CPH 44, 19-55) 1.6 – 3H:1V Slopes
Soil Weight	3,300 lb/cy Stockpile 2,900 lb/cy Tailings 4,185 lb/cy Magnetite Tailings	Standard Values
Production Method/ Blade Factor	1.2	(CPH 44, 19-55, slot dozing)
Visibility Factor	1.0	(CPH 44, 19-55) Clear
Elevation Factor	1.0	(CPH 44, 30-5)
Direct Drive Transmission	1.0	-
Grading Cover, Other Surfaces, and Channels (D11T, D9T, 16M, D6T)		
Material Factor	1.2	CPH 44, 19-55, Loose stockpile
Grade Factor – Tops	1.0	(CPH 44, 19-55) 1-5% slopes
Grade Factor - Outslopes(1)	1.6	(CPH 44, 19-55) 1.6 – 3H:1V Slopes
Soil Weight (lb/cy)	3,300 lb/cy	Standard value
Production Method/Blade	1.2 1.0	(CPH 44, 19-55, slot dozing) No correction applied channels/down drains/benches
Effective Blade Width (feet)	22 D11T Universal Blade 14.25 D9T Semi Universal Blade 16 16M 17.5 D6T XL SU	(CPH 44, 19-49) (CPH 44, 19-47) (CPH 44, 11-17) (CPH 44, 19-43)
Speed (miles/hr)	2.5 mph D11T and 16M 1.0 mph D9T and D6T	(CPH 44)
Operator	0.75	(CPH 44, 19-55, average)
Work Hour (min/hr)	50	(CPH 44, 19-55)
Visibility	1.0	(CPH 44, 19-55) Clear
Elevation	1.0	(CPH 44, 30-5)
Direct Drive Transmission	1.0	-
Ripper (D11T Multishank)		
Ripping Length (ft)	1000 large surface areas 100 liners	-
Penetration (in)	18	-
Pocket Spacing (in)	69	(CPH 44, 19-72)
Number of Pockets	3	(CPH 44, 19-72)
Turn Time (min/pass)	0.25	-

Parameter	Value	Comment/Reference
Speed (mph)	1	-
Work Hour (min/hr)	50	(CPH 44, 19-55)
Distance between passes (in)	69	Maintain pocket spacing between passes
Loader (992K)		
Net Bucket Capacity (cy)	16.0	(CPH 44, 23-288, Standard, 3000 lb/yd3)
Loader Cycle Time (min)	0.65	(CPH 44, 23-223) Avg 0.6-0.7
Bucket Fill Factor	.875	(CPH 44, 30-1) Avg 0.85-0.90 Loose Material 1" and over
Work Hour (min/hr)	50	(CPH 44, 19-55)
Trucks (CAT 793F)		
Struck Capacity (cy)	126	EquipmentWatch.com
Heaped Capacity(cy)	169	EquipmentWatch.com
Rolling Resistance (%)	2.5%	(CPH 44, 30-1) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 44, 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 44, 10-20) Avg 1.0-1.2
Work Hour (min/hr)	50	(CPH 44, 19-55)

Table B-5 Miscellaneous Unit Costs

Activity	Base Unit Cost $/unit[1]	Units	Means Line Item	Means Page	Scaled Cost Las Cruces 85.6 %[2]Reference
Fuel	$2.75	gal	-	-	Griffin Propane Quote (March 12, 2018). ($2.75/gal With indirect costs, $2.14/gal w/o indirect costs)
Revegetation	$1,099	Acre	-	-	Rocky Mountain Reclamation Quote (April, 2018), with tax
Erosion Control Crew	$3,861	day	-	EquipmentWatch and NMDOL	
Riprap	$39.00	cy	-	-	Quote from TG McCauley in March of 2018 which estimates $39/ ton of D50=15" rip rap; density of 1.316 ton/CUYD
Riprap	$31.00	cy	-	-	Quote from TG McCauley in March of 2018 which estimates $31/ ton for D50=8" rip rap; density of 1.316 tons/CU YD.
Chain link fence, open pit perimeters	$21.19	ft	323113.20-0800	316	Fence, chain link industrial, schedule 40, including concrete, 6 ga. wire, 6' high, but omit barbed wire, galv. Steel
Down drain	$5.57	ft	-	-	Excavate and waste 7.6 cy/lf material on slopes with D11T CD, 175-foot downslope excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 3 passes 1 mph.
Type 1 Channel	$3.10	ft	-	-	Excavate and waste 2.4 cy/lf with D11T CD, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T SU 3 passes 1 mph.
Type 2 Channel	$8.91	ft	-	-	Excavate and waste 2.4 cy/lf with D11T CD, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T SU 3 passes 1 mph.
Gravel	$3.29	cy	321123.23-0301	302	Base Course Drainage Layers, Crushed 1 1/2 ", Compacted to 6" deep, hauled ($1.86/cy) and placed ($1.43/cy)
Riprap - Haul	$1.86	cy	-	EquipmentWatch and NM DOL	Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
Building Demolition Cover	$1.76	cy			Assumes same unit cost to haul and spread cover as for No. 3 Shaft Stockpile
Outslope Channel	$045	ft	-	-	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 pass 1 mph.
Rip rap, backfill	$1.43	cy	-	EquipmentWatch and NM DOL	Gravel Backfill, 300 hp, 150' haul sand and gravel
3:1 Slope Stockpile Bench Grading	$1.99	ft	-	-	Excavate and waste 9.26 cy/lf on slopes with D11T CD, 87-foot push. Finish grade with D9T SU 3 passes 1 mph.
3:1 Slope Tailings Bench Grading	$1.75	ft	-	-	Excavate and waste 9.26 cy/lf on slopes with D11T CD, 87-foot push. Finish grade with D9T SU 3 passes 1 mph.
2.5:1 Slope Stockpile Bench Grading	$1.71	ft	-	-	Excavate and waste 9.52 cy/lf on slopes with D11T CD, 78-foot push. Finish grade with D9T SU 3 passes 1 mph.
Structure Demolition	$0.25	cft	024116.13 0100	37	Structure Demolition Building demolition large urban projects inclues 20 mi. haul no foundation or dump fees mixture of types
Reinforced Concrete Wall Demolition	$194.70	hr	Crew B12C	-	1 Crane Oper., 1 Laborer, 1 Hydraulic Excavator 2 CUYD
Road Maintenance Crew	$7,421	month	-	EquipmentWatch and NM DOL	6,000-gal Water truck and 14M grader
Plug & Abandon Wells	$10.60	ft	-	-	$14.00/ft minus 28.3% indirect costs then added inflation from 2013 to 2018. "Estimated costs for abandoning boreholes using bentonite cement grout ranges from approximately $14.00 to $25.00 per foot. For the purposes of estimating a simplified cost of abandoning boreholes the MMD cost is $14.00/ft. The FA cost estimate could be higher or lower based on site specific characteristics".

2.2 Cost Accounting Updates to the Cobre 2014 CCP

During a thorough review of the 2014 CCP, it was determined there was double counting of indirect costs when utilizing EquipmentWatch. EquipmentWatch indicates that certain costs in their standard values include items that are typical indirect costs and adjustments to the standard values may be needed if the estimator plans to later add indirect costs. To address this duplication, the indirect costs were removed from the EquipmentWatch direct costs. Typical indirect costs were removed except for equipment depreciation in this cost update, even though depreciation is an indirect cost (part of overhead) as discussed in the RSMeans Construction Estimating Handbook. However, including depreciation in the EquipmentWatch direct costs is a duplication and future updates (and other cost estimates) may have depreciation removed from the direct costs. Table B-6 summarizes the deviations from EquipmentWatch Standard Values and any other changes made to the costs estimate presented in the 2014 submittal.

Other changes to the cost estimate process:

1. For consistency purposes, EquipmentWatch and NMDOL rates are now used to calculate all earthwork costs (e.g., hauling and placement of riprap, backfill of riprap, regrading, channel building)
2. The earthwork and O&M cost estimate that utilize a 14M motor grader and 6,000-gal water truck are now based on Tyrone Mine's water truck and motor grader actual annual usage with a 793 haul truck fleet

Table B-6 Changes from the 2014 Cost Estimate

Costs	Description of Changes to EquipmentWatch Standard Values and Other Costs
Diesel Fuel Rate	Chino received an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Continental Mine (per MMD's requirements). The indirect cost is removed from the all-inclusive fuel quote and accounted for in the indirect costs.
Electricity	Chino received an all-inclusive quote (direct and indirect costs) for the cost of electricity at the Continental Mine (per MMD's requirements). The indirect cost is removed from the all-inclusive fuel quote and accounted for in the indirect costs.
Mechanics Wages[4]	[1]Per New Mexico statue 11.1.2.8.A, the Mechanics labor rate is developed based on the most current New Mexico Department of Labor (DOL) Type H (Heavy Engineering) labor rates.
Overhead & Depreciation	[1]Overhead and Depreciation (adjusted in the 'User Defined Adjustments' through the 'Discount') are included in Profit and Overhead (RS Means) but also previously included in the EquipmentWatch Total Hourly Cost. RS Means handbook supplies an industry standard for profit and overhead rates for large construction projects. The RS Means Indirect Percentage Rate defined this item.
Annual Use Hours	The Annual Use Hours are adjusted in EquipmentWatch to eliminate the EquipmentWatch 50 minute work hour and is accounted for in Worksheets 5, 6, 7, 9, and 10 found in Appendix C for Earthwork. The Annual Use Hours are not adjusted, in EquipmentWatch, for O&M.
Sales Tax	The Gross receipt sales tax is not applied to NM State contractor projects. Therefore, that item is removed from the EquipmentWatch spreadsheet criteria list.
All Other Wages[5]	Per New Mexico statue 11.1.2.8.A the labor rates are developed based on the most current New Mexico Department of Labor (DOL) Type H (Heavy Engineering) labor rates. FICA, Medicare, Social Security, Unemployment Taxes, and Workman's Compensation are accounted for in Overhead[6],.
Revegetation	Tyrone receives an all-inclusive quote (direct and indirect costs) for revegetation (per MMD's requirements). The indirect cost is removed from the all-inclusive revegetation quote and accounted for in the indirect costs.
Water Sampling and Riprap	Chino received all-inclusive quotes (direct and indirect costs) for water sampling and riprap. The indirect cost is removed from the all-inclusive quotes and accounted for in the indirect costs.
Haul Truck Driver Wages	Was developed based on the most current New Mexico Department of Labor (DOL) Type H (Heavy Engineering) for a Haul Truck Driver II

[1]Uses RS Means process definition for 'Overhead'
[2]https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Public_Works_Minimum_Wage_Act_Policy_Manual
_Active.pdf

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[4] https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Public_Works_Minimum_Wage_Act_Policy_Manual_Active.pdf
[5] https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Public_Works_Minimum_Wage_Act_Policy_Manual_Active.pdf
[6] Uses RS Means process definition for 'Overhead'

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. Cost calculations are located in the Cobre_Stockpiles_Tails_Other_2018_NOBS_20180517.xlsx spreadsheet, Stockpile Sheets 1 through 18, in Appendix B.1. The main activities involved in closing the tailing ponds include:

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

The major assumptions for this cost estimate for areas to be closed include:

- **Regrading:** 200-foot maximum interbench slope length, maximum 3H:1V interbench slopes; 0.5% minimum top surface slope. Rock buttresses, constructed along the east and south portions of the embankments in 2005, are preserved at 3H:1V overall slope. The existing test plots are preserved. Dozers perform all top surface and channel regrading. Southwest rock embankment and Weber Pond area left in existing configuration
- **Top Surface Channels:** Maximum 5% longitudinal slope, 2.5-foot of riprap over 6-inches of gravel bedding underlain by 2-feet of compacted cover material (the cost estimate calculations account for 3 feet of cover; however, in practice, 2 feet of cover is sufficient under channels when accounting for filter and riprap thicknesses in the channels where plant growth is discouraged); constructed to convey runoff from the impoundment top surface and surrounding tributary area to the embankment toe
- **Down drain:** 2.5-foot of riprap over 6-inches of gravel bedding underlain by 3-feet of cover material constructed to drain the top surface and discharge on the west side of the embankment
- **Outslope Channels:** 20-foot wide, 5.0% maximum cross-bench slope, 2.0% longitudinal bench slope, 6-inches of gravel underlain by 2-feet of compacted cover material (see note above).
- **Cover:** 36-inch cover thickness tops and outslopes. A six-inch-thick cover was placed over approximately 90 percent of the impoundment top surface in 2007. Cover criteria would be met with an additional 18 inches of cover material placed over the top surface where a six-inch thickness has already been added. Remaining areas receive a 24-inch thickness of cover material. The upper 12 inches of tailings is included as part of the cover system (DP-

1403, Condition 77) for a total of 36-inches. Chino submitted a report to NMED recently showing that the tailing meets the requirements of the Copper Mine Rule

- **Tailings Pipelines:** Capped and buried in place with 36-inch-thick cover along a 35-foot wide strip. The 35-foot width was based on two 24-inch diameter pipelines, spaced 5 feet apart with 3 feet of cover at 3H:1V sideslopes. It was assumed pipelines on top of the impoundment were covered when the top is covered. Pipeline flushing costs are included separately in the water management portion of the reclamation cost estimate.

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. Cost calculations are located in the Cobre_Mag_Tails_2018_NOBS_20180517.xlsx spreadsheet, Magnetite Tailings Sheets 1 through 18, in Appendix B.1. The main activities involved in closing the MGTI include:

- Regrading top and outslope
- Completing a downdrain channel
- Hauling and grading cover material
- Scarifying and revegetating covered areas, includes

The major assumptions for this cost estimate for areas to be closed include:

- **Regrading**: maximum 3H:1V interbench slopes; 0.5% minimum top surface slope. Dozers perform all regrading
- **Down drain:** 2.5-foot of riprap over 6-inches of gravel bedding underlain by 2-feet of compacted cover material constructed to drain the top surface and discharge on the west side of the embankment
- **Cover**: 36-inch cover thickness – tops and outslopes

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. Cost calculations are located in the Sheets 1 through 18, in Appendix B.1 in the spreadsheet entitled: Cobre_Stockpiles_Tails_Other_2018_NOBS_20180517.xlsx. The main activities involved in closing the SWRDF include:

- Regrading top surfaces and outslope benches
- Hauling and grading cover material
- Completing surface water channels to route
- Scarifying and revegetating covered areas, includes
- Scarifying and revegetating the disturbed area adjacent and North of the SWRDF includes ripping

Due to its small size, the No. 3 Shaft Stockpile did not require benching or drainage channels. Assumptions for this reclamation cost estimate include:

- **Regrading**: 200-foot maximum interbench slope length, maximum 3H:1V interbench slopes; 1% minimum top surface slope; East side 175-foot maximum interbench slope length, maximum 2.5H:1V interbench slope to preserve the road located at the toe of the stockpile
- **Top Surface Channels**: maximum 5% longitudinal slope, 1-foot of riprap over 6-inches of gravel bedding underlain by 2-feet of compacted cover material
- **Benches**: 30-foot bench width, 5.0% maximum cross-bench slope, 2.0% longitudinal bench slope and 3-feet of cover.
- **Outslope Channels**: 20-foot wide, 5.0% maximum cross-bench slope, 2.0% longitudinal bench slope, 6-inches of gravel underlain by 3-feet of cover.
- **Down drains**: 2.5-foot of riprap over 6-inches of gravel bedding underlain by 3-feet of cover material.
- **Cover:** 36-inch cover thickness tops and outslopes. Although, the upper 24 inches of waste rock are approved as part of the cover (DP-1403, Condition 77) on the east side of the East, and Union Hill WRFs unburied by the expansion, the updated estimate includes a full 36 inches of cover material hauled from the NOBS. Chino indicates they may provide additional testing and information at final design to further evaluate and pursue suitability of this material under the Copper Mine Rule in the future

6.0 OTHER STOCKPILES

The cost estimate includes reclamation of the Low-Grade Waste Rock Stockpiles located east of the Continental Pit. Cost calculations are located in the

Cobre_Stockpiles_Tails_Other_2018_NOBS_20180517.xlsx spreadsheet, Stockpile Sheets 1 through 18, in Appendix B.1. The main activities involved in closing the ore stockpiles include:

- Surface grading
- Hauling and grading cover material
- Completing surface water channels
- Scarifying and revegetating covered areas, includes ripping

Assumptions for this reclamation cost estimate include:

- **Cover:** 36-inch cover thickness tops and outslopes. Although, the upper 24 inches of material is approved as part of the cover (DP-1403, Condition 77), a full 36 inches of cover hauled from the NOBS was assumed for this cost update.

7.0 HANOVER MOUNTAIN DEPOSIT

In the 2014 CCP, the proposed Hanover Mountain Deposit was planned to be mined from 2015 through 2020. At the time of this update, mining is proposed to commence in mid-2018. Cost calculations are located in the Cobre_Stockpiles_Tails_Other_2018_NOBS_20180517.xlsx, Stockpile Sheets 1 through 18, in Appendix B.1. The main activities involved in closing the mining of the Hanover Mountain Deposit include:

- Hauling and grading cover material
- Scarifying and revegetating covered areas, includes
- Safety Fencing and Berms to prevent run-on

Assumptions for this reclamation cost estimate include:

- **Cover**: 36-inch cover thickness tops and outslopes in areas that are 50-feet from highwalls
- **Fencing and Berms**: A combination of 6-foot chain link fencing and 2H:1V slope, 5-feet high, and 10-feet top width berms will be constructed approximately 40 feet from the highwalls for public safety (Sheet 15). Revegetation is included for an approximately 25-foot-wide disturbance area used to construct the chain link fencing, and approximately 100-foot-wide disturbance area used to construct the berm (Sheet 14).

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 (Stockpile Sheet 15).

Assumptions for this reclamation cost estimate include:

- **Fencing and Berms**: A combination of 6-foot chain link fencing and 2H:1V slope, 5-feet high, 10-feet top width berms will be constructed approximately 40 feet from the open pit highwalls for public safety (Sheet 15). Revegetation is included for an approximately 25-foot-wide disturbance area used to construct the chain link fencing, and approximately 100-foot-wide disturbance area used to construct the berm (Sheet 14).

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. Cost calculations, to demolish buildings and other miscellaneous structures upon closure, are located in Cobre_Demolition_2018_NOBS_20180517.xlsx, Demolition Sheets 1 through 4, in Appendix B.1.

The main activities and assumptions for this reclamation cost estimate include:

- All equipment and above-grade structures are demolished and removed from the area or buried (Demolition Sheet 1). The definition of demolition from RS Means (2018) is used and includes all internal equipment minus those containing wastes requiring special handling
- Wastes requiring special handling are removed and hauled to the appropriate facility in Phoenix, Arizona
- Debris is placed either into the stockpiles or other designated area
- Demolition debris is covered with 36-inches of cover material (Demolition Sheet 2)

- Demolition areas are covered with 36-inches of cover material, scarified and revegetated (Demolition Sheets 2 and 3)
- Salvage value for all structures and equipment is zero
- Any new buildings constructed prior to reclamation have an Industrial PMLU

10.0 OTHER MISCELLANEOUS COSTS

This category includes miscellaneous estimated closure costs such as wells, surface impoundments, Pearson-Barnes Mine Area, and roads. Additionally, a generic 50-acre surface disturbance contingency 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 operation and maintenance costs associated with utilities such as tanks, ponds, pumps, pipelines, and electrical infrastructure are located in a separate water management cost estimate. Cost calculations are located in the Cobre_Demolition_2018_NOBS_20180517.xlsx spreadsheet, Stockpile Sheets 1 through 18, in Appendix B.1.

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 reclamation year 99 (Appendix B.1, Stockpile Sheet 15). Well abandonment unit cost estimates are based on MMD guidance for abandoning wet drill holes (MMD, 2013;Table B-5, Appendix B.2.8).

10.2 Surface impoundments

Surface impoundments are stormwater and seepage retention structures. Existing and planned impoundments and their PMLU are listed in Appendix B.3. The operation and maintenance (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 Update. The main activities involved in closing surface impoundments include:

- Ripping liners and burying in place
- Grading to drain
- Hauling and grading cover material
- Scarifying and revegetating covered areas, includes ripping

Assumptions for this reclamation cost estimate include:

- **Cover**: 36-inch cover thickness

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, includes ripping

Assumptions for this reclamation cost estimate include:

- **Cover**: 36-inch cover thickness, tapering down to existing channels. Existing channels will remain in their current configuration

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 post-closure include:

- Grading to drain
- Hauling and grading cover material
- Scarifying and revegetating covered areas, includes ripping

Assumptions for this reclamation cost estimate include:

- **Exploration Roads**: Approximately 15 miles of average 20-feet wide roads located in the area to the west of the MTI, and areas on Hermosa Mountain west of the Continental Pit
- **Haul Roads:** Roads located outside facility footprints are included as a separate line item in the reclamation cost estimate. Roads located within a facility footprint are reclaimed along with that facility
- **Cover**: 36-inch cover thickness

10.5 Contingency Disturbance Area

A 50-acre contingency disturbance area was added to account for 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 contingency is to account for scarifying and revegetating these potentially disturbed areas. The estimated costs are integrated into Table B-2.

11.0 OPERATIONS AND MAINTENANCE

Operations and maintenance estimated costs relate to periodic erosion control, road maintenance, and vegetation maintenance. Cost calculations are located in Cobre_O&M_2018_NOBS_20180517.xlsx spreadsheet, O&M Sheet 19 through 21, in Appendix B.1. Operations and maintenance costs are assumed to diminish with time:

Erosion Control (O&M Sheet 20):

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

Road Maintenance (O&M Sheet 20):

- 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

Revegetation Maintenance (O&M Sheet 19):

- 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.

12.0 REFERENCES

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APPENDIX B.1
COST CALCULATIONS

Earthworks Unit Rates

Stockpiles and Main Tailings Impoundment Reclamation Cost Estimates

EOY 2023

UNIT COSTS for SPREADSHEETS

EARTHWORK EQUIPMENT Equipment Description		Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Owning and Operating Cost (w/out fuel) ($/hr)	Fuel-Adjusted Own/Op Cost ($/hr)	Reference
Cat D11T		29.8	$63.77	$350.73	$414.50	1
Cat D11T Bulldozer w/ multi shank ripper		29.8	$63.77	$385.12	$448.89	1
Cat D6T XL		7.8	$16.72	$72.14	$88.86	1
Cat D9T		14.4	$30.76	$147.26	$178.02	1
Komatsu HD 1500-5		28.1	$60.27	$160.14	$220.41	1
CAT 797B Truck		67.4	$144.47	$592.01	$736.48	1
Cat 793 truck	(Ave. Costing for Komatsu HD 1500 & CAT 797B)	47.8	$102.37	$376.08	$478.45	1
Cat 992K Loader		25.6	$54.94	$239.41	$294.35	1
Cat 980G Loader		9.6	$20.58	$55.30	$75.88	1
Cat 16M	Motor Grader	9.5	$20.37	$113.57	$133.94	1
Cat 14M	Motor Grader	8.3	$17.76	$81.37	$99.13	1
Off-Hwy Water Tanker Truck,6,000-gal.		11.3	$24.12	$62.87	$86.99	1
Hitachi ZAXES 200LC-3		6.68	$14.31	$48.26	$62.57	1

O&M EQUIPMENT Equipment Description		Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Owning and Operating Cost (w/out fuel) ($/hr)	Fuel-Adjusted Own/Op Cost ($/hr)	Reference
Cat 14M	Motor Grader	8.3	$18.48	$89.31	$107.79	1
Off-Hwy Water Tanker Truck,6,000-gal.		11.2	$25.09	$67.77	$92.86	1
Cat 980G Loader		9.6	$21.41	$60.07	$81.48	1
Cat 730 Truck		6.3	$14.14	$69.22	$83.36	1

FUEL

Earthwork Oil Broker Quote	$2.14 per gallon	2
O&M Oil Broker Quote	$2.23 per gallon	2
Electric cost	$0.06 per kWhr	3

EARTHWORK AND O&M LABOR Labor Description		NMDOL Type A Operator Group	NMDOL Type A Operator Classification	Total 2018 Rate ($/hr)	
Cat D11T Bulldozer		Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat D11T Bulldozer w/ multi shank ripper		Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat D9T SU		Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat D6T XL SU		Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat 793 truck		Truck Driver III	Haul Truck	$23.84	4
Cat 992K Loader		Equipment Operator VI	Loader (over 10 cy)	$26.56	4
Cat 16M	Motor Grader	Equipment Operator IV	Motor Grader	$26.29	4
Cat 14M	Motor Grader	Equipment Operator IV	Motor Grader	$26.29	4
Off-Hwy Water Tanker Truck,6,000-gal.		Truck Driver III	N/A	$23.84	4
Mechanic		Operator Group V	N/A	$26.39	4
Cat 980G Loader		Equipment Operator VI	Loader (over 10 cy)	$26.56	4
Foreman		Laborer II	N/A	$23.48	4
Laborer		Laborer I	N/A	$22.73	4
Hitachi ZAXES 200LC-3		Equipment Operator VIII	Bulldozer (mult. Units)	$28.37	4

Well plugging and abandon	$10.60	MMD, 2013	$14.00/ft minus 28.3% indirect costs then added inflation from 2013 to 2018. "Estimated costs for abandoning boreholes using bentonite cement grout ranges from approximately $14.00 to $25.00 per foot. For the purposes of estimating a simplified cost of abandoning boreholes the MMD cost is $14.00/ft. The FA cost estimate could be higher or lower based on site specific characteristics".
New Mexico Las Cruces	85.6%		Location RS Means Heavy Construction Cost Data (32nd Annual Edition, 2018)
Rocky Mountain Reclamation Quote April, 2018 (before taxes)	$1,099 /acre		Includes Direct and Indirect Costs
Inflation Adjustment 2013 to 2018	1.05607		https://edzarenski.com/2016/10/24/construction-inflation-index-tables-2017/

Erosion Control and Monitoring (O&M)

Equivalent to RS Means Modified Crew B-13A (1 Labor Foreman, 2 laborers, 1 equip. operators (med.), 2 truck drivers (heavy), 1 crawler loader (4 cy), 2 dump trucks (8 cy, 220 HP)
NM Dept of Labor Prevailing Wage Poster H and EquipmentWatch online estimator)

Modified Crew B-13C (for O&M)	#	$/hour	$/day
Labor Foreman (outside)	1	$23.48	$187.84
Laborers	2	$22.73	$363.68
Equipment Operators (med.)	1	$26.56	$212.48
Truck Drivers (heavy)	2	$23.84	$381.44
		$/hour	$/day
Loader,980G	1	$81.48	$651.84
Dump Trucks, Cat730	2	$83.36	$1,333.76

Subtotal	$3,131	$/day
	100%	Location Adjustment
Total Direct Cost	$3,131	$/day
Indirect Cost Percentage	23.30%	(for O&M See attachment for determination)
Total Cost	$3,861	$/day

Road Maintenance crew (for O&M)

Equipment - Equipment Watch March 2018
Labor - NM Department of Labor Type H (Heavy Engineering) labor rates.
See Attachments for rate development.

	Operating Cost ($/hr)	Labor Rate ($/hr)	Subtotal 24 hrs/month ($/month)
Cat 14M Motor Grader	$107.79	$26.29	$3,218
6,000-gal Water Truck	$92.86	$23.84	$2,801

Total Direct Cost	$6,019	
Indirect Cost Percentage	23.30%	for O&M
Total Cost	$7,421	

References
1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect cost is removed from the all-inclusive fuel quote and accounted for in the indirects.
3. https://www.electricitylocal.com/states/new-mexico/silver-city/
4. Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2018 labor rates.
https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2018.pdf

outslope rip rap D50=15" CU YD	CU YD	total CU YD	$/CU YD	D50 =15" total cost	top surface CU YD	total Riprap CU YD	$/CU YD	D50 =8" total cost	Average $/cu yd
36,959	17,023	53,982	$ 40.00	$ 2,159,448	3,817	57,799	31.80	$ 121,370	$ 39.46
5,818	1,647	7,465	$ 40.00	$ 298,623	9,206	16,671	31.80	$ 292,726	$ 35.47
			=cost of $/ton*1.316 tons/ CU YD						

This is from a quote from TG McCauley in March of 2018 which estimates $39/ ton of D50=15" rip rap and $31/ ton for D50=8" rip rap. McCauley assumes a density of 1.316 tons/CU YD.
The above is a weighted average of the different sizes and quantities needed at SWRDF and MTI

General Information

Applicant	Cobre Mining Company Hanover, New Mexico 88401
Disturbed Surface Area (acres)	915
Type of Operation	Existing/Surface/Copper
Current value before escalation and discounting	**$17,706,746**
Based on Projected EOY 2023 Mine Plan	

Stockpiles, Main Tailings Impoundment, Surface Impoundments, Haul Roads, Borrow Areas, Wells and Continental Pit

Demolition

Demo cost are addressed elsewhere.

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Material Handling Plan Summary Sheet

Item	Description	Location 1	Location 2	Total Haul/Push Distance (ft)	Grade (%)	Equipment
1100	Regrade Top	SWRDF	-	540	see dozer	Cat D11T
1101	Regrade Outslope	SWRDF	-	99	see dozer	Cat D11T
1102	Regrade Top	MTI	-	200	see dozer	Cat D11T
1103	Regrade Outslope	MTI Reclaim Pond	-	200	see dozer	Cat D11T
1104	Regrade Outslope	MTI	-	250	see dozer	Cat D11T
1105	Regrade Top	No. 3 Stockpile Top	-	60	see dozer	Cat D11T
1106	Regrade Outslope	No. 3 Stockpile Outslope	-	128	see dozer	Cat D11T
1105	Dozer Assist	NOBS	SWRDF Top	-	see dozer	Cat D11T
1106	Dozer Assist	NOBS	SWRDF Outslopes	-	see dozer	Cat D11T
1107	Dozer Assist	NOBS	SWRDF Top	-	see dozer	Cat D11T
1108	Dozer Assist	NOBS	Hanover Mountain Deposit	-	see dozer	Cat D11T
1108	Dozer Assist	NOBS	No. 3 Stockpile Top	-	see dozer	Cat D11T
1109	Dozer Assist	NOBS	No. 3 Stockpile Outslope	-	see dozer	Cat D11T
1110	Dozer Assist	NOBS	Pearson-Barnes Mine Area	-	see dozer	Cat D11T
1111	Dozer Assist	NOBS	Low Grade WRF	-	see dozer	Cat D11T
1112	Dozer Assist	NOBS	MTI Reclaim Pond	-	see dozer	Cat D11T
1112	Dozer Assist	NOBS	MTI Top	-	see dozer	Cat D11T
1113	Dozer Assist	NOBS	MTI Outslope	-	see dozer	Cat D11T
1114	Dozer Assist	Reclaim Pond Outlet Channel	MTI Top	-	see dozer	Cat D11T
1115	Dozer Assist	NOBS	Tailing Pipeline Corridor	-	see dozer	Cat D11T
1116	Dozer Assist	NOBS	Grape Gulch Pond #3	-	see dozer	Cat D11T
1116	Dozer Assist	NOBS	Magnetite Seepage Pond	-	see dozer	Cat D11T
1117	Dozer Assist	NOBS	SWRF Dam 1	-	see dozer	Cat D11T
1118	Dozer Assist	NOBS	SWRF Dam 2	-	see dozer	Cat D11T
1119	Dozer Assist	NOBS	SWRF Dam 3	-	see dozer	Cat D11T
1120	Dozer Assist	NOBS	North Tailings Decant Pond	-	see dozer	Cat D11T
1120	Dozer Assist	NOBS	East WRF Containment	-	see dozer	Cat D11T
1121	Dozer Assist	NOBS	Blackman's Seep (Pond #2)	-	see dozer	Cat D11T
1122	Dozer Assist	NOBS	Decant Pond #4	-	see dozer	Cat D11T
1123	Dozer Assist	NOBS	Upper Creek Containment Pond 1	-	see dozer	Cat D11T
1124	Dozer Assist	NOBS	Contingency Disturbance Area	-	see dozer	Cat D11T
1200	Load cover soil	NOBS	SWRDF Top			992K
1201	Load cover soil	NOBS	SWRDF Outslopes			992K
1202	Load cover soil	NOBS	SWRDF Top			992K
1203	Load cover soil	NOBS	Hanover Mountain Deposit			992K
1204	Load cover soil	NOBS	No. 3 Stockpile Top			992K
1205	Load cover soil	NOBS	No. 3 Stockpile Outslope			992K
1206	Load cover soil	NOBS	Pearson-Barnes Mine Area			992K
1207	Load cover soil	NOBS	Low Grade WRF			992K
1208	Load cover soil	NOBS	MTI Reclaim Pond			992K
1209	Load cover soil	NOBS	MTI Top			992K
1210	Load cover soil	NOBS	MTI Outslope			992K
1211	Load cover soil	Reclaim Pond Outlet Channel	MTI Top			992K
1212	Load cover soil	NOBS	Tailing Pipeline Corridor			992K
1213	Load cover soil	NOBS	Grape Gulch Pond #3			992K
1214	Load cover soil	NOBS	Magnetite Seepage Pond			992K
1215	Load cover soil	NOBS	SWRF Dam 1			992K
1216	Load cover soil	NOBS	SWRF Dam 2			992K
1217	Load cover soil	NOBS	SWRF Dam 3			992K
1218	Load cover soil	NOBS	North Tailings Decant Pond			992K
1219	Load cover soil	NOBS	East WRF Containment			992K
1220	Load cover soil	NOBS	Blackman's Seep (Pond #2)			992K
1221	Load cover soil	NOBS	Decant Pond #4			992K
1222	Load cover soil	NOBS	Upper Creek Containment Pond 1			992K
1223	Load cover soil	NOBS	Contingency Disturbance Area			992K
1300	Haul cover soil	NOBS	SWRDF Top	12,559	see Trucks	Cat 793 truck
1301	Haul cover soil	NOBS	SWRDF Outslopes	12,559	see Trucks	Cat 793 truck
1302	Haul cover soil	NOBS	SWRDF Top	12,559	see Trucks	Cat 793 truck
1303	Haul cover soil	NOBS	Hanover Mountain Deposit	5,707	see Trucks	Cat 793 truck
1304	Haul cover soil	NOBS	No. 3 Stockpile Top	4,251	see Trucks	Cat 793 truck
1305	Haul cover soil	NOBS	No. 3 Stockpile Outslope	4,251	see Trucks	Cat 793 truck
1306	Haul cover soil	NOBS	Pearson-Barnes Mine Area	12,559	see Trucks	Cat 793 truck
1307	Haul cover soil	NOBS	Low Grade WRF	10,620	see Trucks	Cat 793 truck
1308	Haul cover soil	NOBS	MTI Reclaim Pond	7,193	see Trucks	Cat 793 truck
1309	Haul cover soil	NOBS	MTI Top	7,193	see Trucks	Cat 793 truck
1310	Haul cover soil	NOBS	MTI Outslope	7,193	see Trucks	Cat 793 truck
1311	Haul cover soil	Reclaim Pond Outlet Channel	MTI Top	1,172	see Trucks	Cat 793 truck
1312	Haul cover soil	NOBS	Tailing Pipeline Corridor	7,193	see Trucks	Cat 793 truck
1313	Haul cover soil	NOBS	Grape Gulch Pond #3	3,856	see Trucks	Cat 793 truck
1314	Haul cover soil	NOBS	Magnetite Seepage Pond	6,480	see Trucks	Cat 793 truck
1315	Haul cover soil	NOBS	SWRF Dam 1	12,559	see Trucks	Cat 793 truck
1316	Haul cover soil	NOBS	SWRF Dam 2	12,559	see Trucks	Cat 793 truck
1317	Haul cover soil	NOBS	SWRF Dam 3	12,559	see Trucks	Cat 793 truck
1318	Haul cover soil	NOBS	North Tailings Decant Pond	4,110	see Trucks	Cat 793 truck
1319	Haul cover soil	NOBS	East WRF Containment	4,110	see Trucks	Cat 793 truck
1320	Haul cover soil	NOBS	Blackman's Seep (Pond #2)	3,856	see Trucks	Cat 793 truck
1321	Haul cover soil	NOBS	Decant Pond #4	4,110	see Trucks	Cat 793 truck
1322	Haul cover soil	NOBS	Upper Creek Containment Pond 1	3,856	see Trucks	Cat 793 truck
1323	Haul cover soil	NOBS	Contingency Disturbance Area	0	see Trucks	Cat 793 truck
1400	Rip liners	East WRF Containment	-	1,000		D11T w/ ripper
1401	Rip liners	Decant Pond #4	-	1,000		D11T w/ ripper
1402	Rip liners	Blackman's Seep (Pond #2)	-	1,000		D11T w/ ripper
1403	Rip liners	Grape Gulch Pond #3	-	1,000		D11T w/ ripper
1404	Rip liners	Magnetite Seepage Pond	-	1,000		D11T w/ ripper
1405	Rip surface	Reclaim Pond Outlet Channel	-	1,000		D11T w/ ripper
1406	Rip liners	Upper Creek Containment Pond 1	-	1,000		D11T w/ ripper
1500	Grade surface	Haul Roads	-			Cat 16M
1501	Grade surface	Exploration Roads	-			Cat 16M
1502	Grade surface	Low Grade WRF	-			Cat 16M
1503	Grade surface	Grape Gulch Pond #3	-			Cat 16M
1504	Grade surface	Magnetite Seepage Pond	-			Cat 16M
1505	Grade surface	SWRF Dam 1	-			Cat 16M
1506	Grade surface	SWRF Dam 2	-			Cat 16M
1507	Grade surface	SWRF Dam 3	-			Cat 16M
1508	Grade surface	North Tailings Decant Pond	-			Cat 16M
1509	Grade surface	East WRF Containment	-			Cat 16M
1510	Grade surface	Blackman's Seep (Pond #2)	-			Cat 16M
1511	Grade surface	Decant Pond #4	-			Cat 16M
1512	Grade surface	Upper Creek Containment Pond 1	-			Cat 16M
1512	Grade surface	Contingency Disturbance Area	-			Cat 16M
1513	Grade cover soil	SWRDF Top	-			Cat D11T
1514	Grade cover soil	SWRDF Outslopes	-			Cat D11T
1515	Grade cover soil	SWRDF Top	-			Cat D11T
1516	Grade cover soil	Hanover Mountain Deposit	-			Cat D11T
1517	Grade cover soil	No. 3 Stockpile Top	-			Cat D11T
1518	Grade cover soil	No. 3 Stockpile Outslope	-			Cat D11T
1519	Grade cover soil	Pearson-Barnes Mine Area	-			Cat D11T
1520	Grade cover soil	Low Grade WRF	-			Cat D11T
1521	Grade cover soil	MTI Reclaim Pond	-			Cat D11T
1522	Grade cover soil	MTI Top	-			Cat D11T
1523	Grade cover soil	MTI Outslope	-			Cat D11T
1524	Grade cover soil	MTI Top	-			Cat D11T
1525	Grade cover soil	Tailing Pipeline Corridor	-			Cat D11T
1526	Grade cover soil	Grape Gulch Pond #3	-			Cat D11T
1527	Grade cover soil	Magnetite Seepage Pond	-			Cat D11T
1528	Grade cover soil	SWRF Dam 1	-			Cat D11T
1529	Grade cover soil	SWRF Dam 2	-			Cat D11T
1530	Grade cover soil	SWRF Dam 3	-			Cat D11T
1531	Grade cover soil	North Tailings Decant Pond	-			Cat D11T
1532	Grade cover soil	East WRF Containment	-			Cat D11T
1533	Grade cover soil	Blackman's Seep (Pond #2)	-			Cat D11T
1534	Grade cover soil	Decant Pond #4	-			Cat D11T
1535	Grade cover soil	Upper Creek Containment Pond 1	-			Cat D11T
1536	Grade cover soil	Contingency Disturbance Area	-			Cat D11T
1600	Off-Hwy Water Tanker Truck 6,000 gal					Off-Hwy Water Tanker Truck,6,000-gal.
1601	Motor Grader 14M					Cat 14M

OB = Overburden
WRF= Waste Rock Facility

Earthwork Quantity Worksheet

Item	Description	Location 1	Location 2	Area (ac)	Cover Depth (in)	Bank/stockpile Volume (bcy)	Swell Factor (%)	Loose/stockpile Volume (lcy)
1100	Regrade Top	SWRDF	Top			666,680	0%	666,680
1101	Regrade Outslope	SWRDF	Outslope			4,438,079	0%	4,438,079
1102	Regrade Top	MTI	Top			50,795	0%	50,795
1103	Regrade Outslope	MTI Reclaim Pond	Top and Outslope			67,765	0%	67,765
1104	Regrade Outslope	MTI	Outslope			170,294	0%	170,294
1105	Regrade Top	No. 3 Stockpile Top	Top			9,438	0%	9,438
1106	Regrade Outslope	No. 3 Stockpile Outslope	Outslope			14,489	0%	14,489
1105	Dozer Assist	NOBS	SWRDF Top			381,822	0%	381,822
1106	Dozer Assist	NOBS	SWRDF Outslopes			1,145,467	0%	1,145,467
1107	Dozer Assist	NOBS	SWRDF Top			110,693	0%	110,693
1108	Dozer Assist	NOBS	Hanover Mountain Deposit			418,122	0%	418,122
1108	Dozer Assist	NOBS	No. 3 Stockpile Top			5,826	0%	5,826
1109	Dozer Assist	NOBS	No. 3 Stockpile Outslope			19,719	0%	19,719
1110	Dozer Assist	NOBS	Pearson-Barnes Mine Area			53,330	0%	53,330
1111	Dozer Assist	NOBS	Low Grade WRF			124,720	0%	124,720
1112	Dozer Assist	NOBS	MTI Reclaim Pond			147,889	0%	147,889
1112	Dozer Assist	NOBS	MTI Top			242,448	0%	242,448
1113	Dozer Assist	NOBS	MTI Outslope			162,812	0%	162,812
1114	Dozer Assist	Reclaim Pond Outlet Channel	MTI Top			62,226	15%	71,560
1115	Dozer Assist	NOBS	Tailing Pipeline Corridor			6,480	0%	6,480
1116	Dozer Assist	NOBS	Grape Gulch Pond #3			1,703	0%	1,703
1116	Dozer Assist	NOBS	Magnetite Seepage Pond			896	0%	896
1117	Dozer Assist	NOBS	SWRF Dam 1			2,330	0%	2,330
1118	Dozer Assist	NOBS	SWRF Dam 2			1,524	0%	1,524
1119	Dozer Assist	NOBS	SWRF Dam 3			3,764	0%	3,764
1120	Dozer Assist	NOBS	North Tailings Decant Pond			2,061	0%	2,061
1120	Dozer Assist	NOBS	East WRF Containment			2,241	0%	2,241
1121	Dozer Assist	NOBS	Blackman's Seep (Pond #2)			45	0%	45
1122	Dozer Assist	NOBS	Decant Pond #4			2,779	0%	2,779
1123	Dozer Assist	NOBS	Upper Creek Containment Pond 1			6,857	0%	6,857
1124	Dozer Assist	NOBS	Contingency Disturbance Area			224,074	0%	224,074
1200	Load cover soil	NOBS	SWRDF Top	85	36	381,822	8%	412,368
1201	Load cover soil	NOBS	SWRDF Outslopes	256	36	1,145,467	8%	1,237,104
1202	Load cover soil	NOBS	SWRDF Top	25	36	110,693	8%	119,548
1203	Load cover soil	NOBS	Hanover Mountain Deposit	93	36	418,122	8%	451,572
1204	Load cover soil	NOBS	No. 3 Stockpile Top	1	36	5,826	8%	6,292
1205	Load cover soil	NOBS	No. 3 Stockpile Outslope	4	36	19,719	8%	21,296
1206	Load cover soil	NOBS	Pearson-Barnes Mine Area	12	36	53,330	8%	57,596
1207	Load cover soil	NOBS	Low Grade WRF	28	36	124,720	8%	134,697
1208	Load cover soil	NOBS	MTI Reclaim Pond	33	36	147,889	8%	159,720
1209	Load cover soil	NOBS	MTI Top	108	18	242,448	8%	261,844
1210	Load cover soil	NOBS	MTI Outslope	36	36	162,812	8%	175,837
1211	Load cover soil	Reclaim Pond Outlet Channel	MTI Top	-	-	62,226	15%	71,560
1212	Load cover soil	NOBS	Tailing Pipeline Corridor	1.4	36	6,480	8%	6,999
1213	Load cover soil	NOBS	Grape Gulch Pond #3	0.4	36	1,703	8%	1,839
1214	Load cover soil	NOBS	Magnetite Seepage Pond	0.2	36	896	8%	968
1215	Load cover soil	NOBS	SWRF Dam 1	0.5	36	2,330	8%	2,517
1216	Load cover soil	NOBS	SWRF Dam 2	0.3	36	1,524	8%	1,646
1217	Load cover soil	NOBS	SWRF Dam 3	0.8	36	3,764	8%	4,066
1218	Load cover soil	NOBS	North Tailings Decant Pond	0.5	36	2,061	8%	2,226
1219	Load cover soil	NOBS	East WRF Containment	0.5	36	2,241	8%	2,420
1220	Load cover soil	NOBS	Blackman's Seep (Pond #2)	0.0	36	45	8%	48
1221	Load cover soil	NOBS	Decant Pond #4	0.6	36	2,779	8%	3,001
1222	Load cover soil	NOBS	Upper Creek Containment Pond 1	1.5	36	6,857	8%	7,405
1223	Load cover soil	NOBS	Contingency Disturbance Area	50.0	36	224,074	8%	242,000
1300	Haul cover soil	NOBS	SWRDF Top			412,368	0%	412,368
1301	Haul cover soil	NOBS	SWRDF Outslopes			1,237,104	0%	1,237,104
1302	Haul cover soil	NOBS	SWRDF Top			119,548	0%	119,548
1303	Haul cover soil	NOBS	Hanover Mountain Deposit			451,572	0%	451,572
1304	Haul cover soil	NOBS	No. 3 Stockpile Top			6,292	0%	6,292
1305	Haul cover soil	NOBS	No. 3 Stockpile Outslope			21,296	0%	21,296
1306	Haul cover soil	NOBS	Pearson-Barnes Mine Area			57,596	0%	57,596
1307	Haul cover soil	NOBS	Low Grade WRF			134,697	0%	134,697
1308	Haul cover soil	NOBS	MTI Reclaim Pond			159,720	0%	159,720
1309	Haul cover soil	NOBS	MTI Top			261,844	0%	261,844
1310	Haul cover soil	NOBS	MTI Outslope			175,837	0%	175,837
1311	Haul cover soil	Reclaim Pond Outlet Channel	MTI Top			71,560	0%	71,560
1312	Haul cover soil	NOBS	Tailing Pipeline Corridor			6,999	0%	6,999
1313	Haul cover soil	NOBS	Grape Gulch Pond #3			1,839	0%	1,839
1314	Haul cover soil	NOBS	Magnetite Seepage Pond			968	0%	968
1315	Haul cover soil	NOBS	SWRF Dam 1			2,517	0%	2,517
1316	Haul cover soil	NOBS	SWRF Dam 2			1,646	0%	1,646
1317	Haul cover soil	NOBS	SWRF Dam 3			4,066	0%	4,066
1318	Haul cover soil	NOBS	North Tailings Decant Pond			2,226	0%	2,226
1319	Haul cover soil	NOBS	East WRF Containment			2,420	0%	2,420
1320	Haul cover soil	NOBS	Blackman's Seep (Pond #2)			48	0%	48
1321	Haul cover soil	NOBS	Decant Pond #4			3,001	0%	3,001
1322	Haul cover soil	NOBS	Upper Creek Containment Pond 1			7,405	0%	7,405
1323	Haul cover soil	NOBS	Contingency Disturbance Area			242,000	0%	242,000
1400	Rip liners	East WRF Containment	-	0.5				
1401	Rip liners	Decant Pond #4	-	0.6				
1402	Rip liners	Blackman's Seep (Pond #2)	-	0.0				
1403	Rip liners	Grape Gulch Pond #3	-	0.4				
1404	Rip liners	Magnetite Seepage Pond	-	0.2				
1405	Rip surface	Reclaim Pond Outlet Channel	-	1.7				
1406	Rip liners	Upper Creek Containment Pond 1	-	1.5				
1500	Grade surface	Haul Roads	-	45				
1501	Grade surface	Exploration Roads	-	37				
1502	Grade surface	Low Grade WRF	-	28				
1503	Grade surface	Grape Gulch Pond #3	-	0.4				
1504	Grade surface	Magnetite Seepage Pond	-	0.2				
1505	Grade surface	SWRF Dam 1	-	0.5				
1506	Grade surface	SWRF Dam 2	-	0.3				
1507	Grade surface	SWRF Dam 3	-	0.8				
1508	Grade surface	North Tailings Decant Pond	-	0.5				
1509	Grade surface	East WRF Containment	-	0.5				
1510	Grade surface	Blackman's Seep (Pond #2)	-	0.0				
1511	Grade surface	Decant Pond #4	-	0.6				
1512	Grade surface	Upper Creek Containment Pond 1	-	1.5				
1512	Grade surface	Contingency Disturbance Area	-	50.0				
1513	Grade cover soil	SWRDF Top	-			412,368	0%	412,368
1514	Grade cover soil	SWRDF Outslopes	-			1,237,104	0%	1,237,104
1515	Grade cover soil	SWRDF Top	-			119,548	0%	119,548
1516	Grade cover soil	Hanover Mountain Deposit	-			451,572	0%	451,572
1517	Grade cover soil	No. 3 Stockpile Top	-			6,292	0%	6,292
1518	Grade cover soil	No. 3 Stockpile Outslope	-			21,296	0%	21,296
1519	Grade cover soil	Pearson-Barnes Mine Area	-			57,596	0%	57,596
1520	Grade cover soil	Low Grade WRF	-			134,697	0%	134,697
1521	Grade cover soil	MTI Reclaim Pond	-			159,720	0%	159,720
1522	Grade cover soil	MTI Top	-			261,844	0%	261,844
1523	Grade cover soil	MTI Outslope	-			175,837	0%	175,837
1524	Grade cover soil	MTI Top	-			71,560	0%	71,560
1525	Grade cover soil	Tailing Pipeline Corridor	-			6,999	0%	6,999
1526	Grade cover soil	Grape Gulch Pond #3	-			1,839	0%	1,839
1527	Grade cover soil	Magnetite Seepage Pond	-			968	0%	968
1528	Grade cover soil	SWRF Dam 1	-			2,517	0%	2,517
1529	Grade cover soil	SWRF Dam 2	-			1,646	0%	1,646
1530	Grade cover soil	SWRF Dam 3	-			4,066	0%	4,066
1531	Grade cover soil	North Tailings Decant Pond	-			2,226	0%	2,226
1532	Grade cover soil	East WRF Containment	-			2,420	0%	2,420
1533	Grade cover soil	Blackman's Seep (Pond #2)	-			48	0%	48
1534	Grade cover soil	Decant Pond #4	-			3,001	0%	3,001
1535	Grade cover soil	Upper Creek Containment Pond 1	-			7,405	0%	7,405
1536	Grade cover soil	Contingency Disturbance Area	-			242,000	0%	242,000
1600	Off-Hwy Water Tanker Truck 6,000 gal							
1601	Motor Grader 14M							

Productivity and Hours Required for Dozer Use---Earthmoving

Task Description	Location 1	Location 2	Equipment	Loose Volume (cy)	Productivity (cy/hr)	Total Task Time (hours)	PERFORMANCE FACTORS Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	Grade (%)
Regrade Top	SWRDF	Top	Cat D11T	666,680	498	1,338	1.0	1.02	3,300	1.20	540	701	1.00	50	1.00	1.00	1.00	-1.0
Regrade Outslope	SWRDF	Outslope	Cat D11T	4,438,079	2,154	2,060	1.0	1.02	3,300	1.20	99	3031	1.00	50	1.00	1.00	1.00	-1.0
Regrade Top	MTI	Top	Cat D11T	50,795	1,330	38	1.0	1.02	2,900	1.20	200	1651	1.00	50	1.00	1.00	1.00	-0.8
Regrade Outslope	MTI Reclaim Pond	Top and Outslope	Cat D11T	67,765	1,910	35	1.0	1.66	3,300	1.20	200	1651	1.00	50	1.00	1.00	1.00	-33.0
Regrade Outslope	MTI	Outslope	Cat D11T	170,294	1,793	95	1.0	1.66	2,900	1.20	250	1362	1.00	50	1.00	1.00	1.00	-33.0
Regrade Top	No. 3 Stockpile Top	Top	Cat D11T	9,438	3,773	3	1.0	1.02	2,900	1.20	60	4664	1.00	50	1.00	1.00	1.00	-1.0
Regrade Outslope	No. 3 Stockpile Outslope	Outslope	Cat D11T	14,489	3,197	5	1.0	1.66	2,900	1.20	128	2428	1.00	50	1.00	1.00	1.00	-33.0
Dozer Assist	NOBS	SWRDF Top	Cat D11T	N/A	N/A	383	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	SWRDF Outslopes	Cat D11T	N/A	N/A	1,149	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	SWRDF Top	Cat D11T	N/A	N/A	111	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Hanover Mountain Deposit	Cat D11T	N/A	N/A	419	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	No. 3 Stockpile Top	Cat D11T	N/A	N/A	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	No. 3 Stockpile Outslope	Cat D11T	N/A	N/A	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Pearson-Barnes Mine Area	Cat D11T	N/A	N/A	53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Low Grade WRF	Cat D11T	N/A	N/A	125	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	MTI Reclaim Pond	Cat D11T	N/A	N/A	148	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	MTI Top	Cat D11T	N/A	N/A	243	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	MTI Outslope	Cat D11T	N/A	N/A	163	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	Reclaim Pond Outlet Channel	MTI Top	Cat D11T	N/A	N/A	66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Tailing Pipeline Corridor	Cat D11T	N/A	N/A	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Grape Gulch Pond #3	Cat D11T	N/A	N/A	1.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Magnetite Seepage Pond	Cat D11T	N/A	N/A	0.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	SWRF Dam 1	Cat D11T	N/A	N/A	2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	SWRF Dam 2	Cat D11T	N/A	N/A	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	SWRF Dam 3	Cat D11T	N/A	N/A	3.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	North Tailings Decant Pond	Cat D11T	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	East WRF Containment	Cat D11T	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Blackman's Seep (Pond #2)	Cat D11T	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Decant Pond #4	Cat D11T	N/A	N/A	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Upper Creek Containment Pond 1	Cat D11T	N/A	N/A	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	NOBS	Contingency Disturbance Area	Cat D11T	N/A	N/A	225	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Productivity and Hours Required for Dozer Use---Grading

PERFORMANCE FACTORS

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Area (acres)	Productivity (acres/hr)	Productivity (cy/hr)	Task Time (hours)	Material	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade	Effective Blade Width (feet)	Speed (miles/hr)	Work Hour (min/hr)	Visibility	Elevation	Direct Drive Trans.	Grade (%)	Operator	Maximum Push Distance (feet)	Normal Production (cy/hr)
Grade surface	Haul Roads	-	Cat 16M	-	45.0	2.6		17.4	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Exploration Roads	-	Cat 16M	-	37.0	2.6		14.3	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Low Grade WRF	-	Cat 16M	-	27.8	2.6		10.8	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Grape Gulch Pond #3	-	Cat 16M	-	0.4	2.6		0.1	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Magnetite Seepage Pond	-	Cat 16M	-	0.2	2.6		0.1	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	SWRF Dam 1	-	Cat 16M	-	0.5	2.6		0.2	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	SWRF Dam 2	-	Cat 16M	-	0.3	2.6		0.1	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	SWRF Dam 3	-	Cat 16M	-	0.8	2.6		0.3	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	North Tailings Decant Pond	-	Cat 16M	-	0.5	2.6		0.2	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	East WRF Containment	-	Cat 16M	-	0.5	2.6		0.2	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Blackman's Seep (Pond #2)	-	Cat 16M	-	0.0	2.6		0.0	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Decant Pond #4	-	Cat 16M	-	0.6	2.6		0.2	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Upper Creek Containment Pond 1	-	Cat 16M	-	2	2.6		0.6	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade surface	Contingency Disturbance Area	-	Cat 16M	-	50	2.6		19.3	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	-1.0	0.75	-	
Grade cover soil	SWRDF Top	-	Cat D11T	412,368		-	1,921	214.7	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	SWRDF Outslopes	-	Cat D11T	1,237,104		-	3,032	408	1.2	1.6	3,300	1.2	-	-	50	1	1	1	-30.5	0.75	100	3002
Grade cover soil	SWRDF Top	-	Cat D11T	119,548		-	1,921	62	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Hanover Mountain Deposit	-	Cat D11T	451,572		-	1,921	235.1	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	No. 3 Stockpile Top	-	Cat D11T	6,292		-	3,522	1.8	2.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	No. 3 Stockpile Outslope	-	Cat D11T	21,296		-	8,336	2.6	3.2	1.7	3,300	1.2	-	-	50	1	1	1	-33	0.75	100	3002
Grade cover soil	Pearson-Barnes Mine Area	-	Cat D11T	57,596		-	1,243	46.3	1.2	0.7	3,300	1.2	-	-	50	1	1	1	17	0.75	100	3002
Grade cover soil	Low Grade WRF	-	Cat D11T	134,697		-	3,126	43.1	1.2	1.7	3,300	1.2	-	-	50	1	1	1	-33	0.75	100	3002
Grade cover soil	MTI Reclaim Pond	-	Cat D11T	159,720		-	3,126	51.1	1.2	1.7	3,300	1.2	-	-	50	1	1	1	-33	0.75	100	3002
Grade cover soil	MTI Top	-	Cat D11T	261,844		-	1,912	136.9	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-0.8	0.75	100	3002
Grade cover soil	MTI Outslope	-	Cat D11T	175,837		-	3,126	56.2	1.2	1.7	3,300	1.2	-	-	50	1	1	1	-33	0.75	100	3002
Grade cover soil	MTI Top	-	Cat D11T	71,560		-	1,912	37.4	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-0.8	0.75	100	3002
Grade cover soil	Tailing Pipeline Corridor	-	Cat D11T	6,999		-	1,921	3.6	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Grape Gulch Pond #3	-	Cat D11T	1,839		-	1,921	1.0	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Magnetite Seepage Pond	-	Cat D11T	968		-	1,921	0.5	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	SWRF Dam 1	-	Cat D11T	2,517		-	1,921	1.3	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	SWRF Dam 2	-	Cat D11T	1,646		-	1,921	0.9	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	SWRF Dam 3	-	Cat D11T	4,066		-	1,921	2.1	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	North Tailings Decant Pond	-	Cat D11T	2,226		-	1,921	1.2	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	East WRF Containment	-	Cat D11T	2,420		-	1,921	1.3	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Blackman's Seep (Pond #2)	-	Cat D11T	48		-	1,921	0.0	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Decant Pond #4	-	Cat D11T	3,001		-	1,921	1.6	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Upper Creek Containment Pond 1	-	Cat D11T	7,405		-	1,921	3.9	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002
Grade cover soil	Contingency Disturbance Area	-	Cat D11T	242,000		-	1,921	126.0	1.2	1.0	3,300	1.2	-	-	50	1	1	1	-1.0	0.75	100	3002

*Push distances: Assumed 100 feet.

Productivity and Hours Required for Ripper-Equipped Dozer Use

Note: Scarifying/Ripping Covered Areas Currently Included in Revegetation Costs

								PERFORMANCE FACTORS:								
Task Description	Location 1	Location 2	Equipment	Area (acres)	Volume (cy)	Productivity (acres/hr)	Task Time (hours)	Ripping Length (feet)	Ripper Penetration (in)	Pocket Spacing (in)	No. of Pockets	Turn Time (min/pass)	Work Hour (min/hr)	Speed (mph)	1000 ft (passes/acre)	ripper path width (feet)
Rip liners	East WRF Containment	-	D11T w/ ripper	0.50	1,210	1.70	0.3	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip liners	Decant Pond #4	-	D11T w/ ripper	0.62	1,500	1.70	0.4	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip liners	Blackman's Seep (Pond #2)	-	D11T w/ ripper	0.01	24	1.70	0.01	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip liners	Grape Gulch Pond #3	-	D11T w/ ripper	0.38	920	1.70	0.2	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip liners	Magnetite Seepage Pond	-	D11T w/ ripper	0.20	484	1.70	0.1	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip surface	Reclaim Pond Outlet Channel	-	D11T w/ ripper	1.70	4,114	1.70	1.0	1,000	18	69	3	0.25	50	1	2.53	17.3
Rip liners	Upper Creek Containment Pond 1	-	D11T w/ ripper	1.53	3,703	1.70	0.9	1,000	18	69	3	0.25	50	1	2.53	17.3

Productivity and Hours Required for Hydraulic Excavator

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Productivity and Hours Required for Truck Use

<u>Truck-Loader Matching</u>
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

									PERFORMANCE FACTORS																
Task Description	Location 1*	Location 2	Equipment	Volume (cy)	Truck Cycle Time (min)	Optimum No. of Trucks	Productivity (cy/hr)	Task Time (hrs)	Struck Capacity (cy)	Heaped Capacity (cy)	Loader Cycles per Truck	Total Haul Distance (feet)	Haul Distance Segment 1 (feet)	Haul Distance Segment 2 (feet)	Haul Distance Segment 3 (feet)	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)	Haul Effective Grade Segment 1 (%)	Haul Effective Grade Segment 2 (%)	Haul Effective Grade Segment 3 (%)
Haul cover soil	NOBS	SWRDF Top	Cat 793 truck	412,368	20.4	2	825	500	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-0.96%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	SWRDF Outslopes	Cat 793 truck	1,237,104	20.4	2	825	1,500	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-0.96%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	SWRDF Top	Cat 793 truck	119,548	20.4	2	825	145	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	Hanover Mountain Deposit	Cat 793 truck	451,572	15.9	2	1,057	427	126	169	12	5,707	1,759	2,466	1,482	-9.9%	-8.1%	6.7%	2.5%	536	752	452	-7%	-6%	9%
Haul cover soil	NOBS	No. 3 Stockpile Top	Cat 793 truck	6,292	12.5	2	1,342	6	126	169	12	4,251	1,357	1,451	1,443	-1.8%	-3.3%	-2.2%	2.5%	414	442	440	1%	-1%	0%
Haul cover soil	NOBS	No. 3 Stockpile Outslope	Cat 793 truck	21,296	12.5	2	1,342	20	126	169	12	4,251	1,357	1,451	1,443	-1.8%	-3.3%	-2.2%	2.5%	414	442	440	1%	-1%	0%
Haul cover soil	NOBS	Pearson-Barnes Mine Area	Cat 793 truck	57,596	20.4	2	825	70	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	Low Grade WRF	Cat 793 truck	134,697	17.8	2	941	143	126	169	12	10,620	5,310	2,310	3,000	0.0%	-8.9%	-2.3%	2.5%	1,618	704	914	3%	-6%	0%
Haul cover soil	NOBS	MTI Reclaim Pond	Cat 793 truck	159,720	16.7	2	1,007	159	126	169	12	7,193	2,310	1,940	2,943	-8.9%	1.6%	3.6%	2.5%	704	591	897	-6%	4%	6%
Haul cover soil	NOBS	MTI Top	Cat 793 truck	261,844	16.7	2	1,007	260	126	169	12	7,193	2,310	1,940	2,943	-8.9%	1.6%	3.6%	2.5%	704	591	897	-6%	4%	6%
Haul cover soil	NOBS	MTI Outslope	Cat 793 truck	175,837	16.7	2	1,007	175	126	169	12	7,193	2,310	1,940	2,943	-8.9%	1.6%	3.6%	2.5%	704	591	897	-6%	4%	6%
Haul cover soil	Reclaim Pond Outlet Channel	MTI Top	Cat 793 truck	71,560	10.6	2	1,592	66	126	169	12	1,172	1,172	-	-	0.9%	-	-	2.5%	357	0	0	3%	0%	0%
Haul cover soil	NOBS	Tailing Pipeline Corridor	Cat 793 truck	6,999	16.7	2	1,007	7	126	169	12	7,193	2,310	1,940	2,943	-8.9%	1.6%	3.6%	2.5%	704	591	897	-6%	4%	6%
Haul cover soil	NOBS	Grape Gulch Pond #3	Cat 793 truck	1,839	13.1	2	1,282	2	126	169	12	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	0	-6%	-5%	0%
Haul cover soil	NOBS	Magnetite Seepage Pond	Cat 793 truck	968	15.0	2	1,118	1	126	169	12	6,480	2,310	1,940	2,230	-8.9%	1.6%	-4.0%	2.5%	704	591	680	-6%	4%	-2%
Haul cover soil	NOBS	SWRF Dam 1	Cat 793 truck	2,517	20.4	2	825	3	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	SWRF Dam 2	Cat 793 truck	1,646	20.4	2	825	2	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	SWRF Dam 3	Cat 793 truck	4,066	20.4	2	825	5	126	169	12	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895	-6%	2%	7%
Haul cover soil	NOBS	North Tailings Decant Pond	Cat 793 truck	2,226	13.0	2	1,288	2	126	169	12	4,110	2310	1800	-	-8.9%	-1.1%	-	2.5%	704	549	0	-6%	1%	0%
Haul cover soil	NOBS	East WRF Containment	Cat 793 truck	2,420	13.0	2	1,288	2	126	169	12	4,110	2310	1800	-	-8.9%	-1.1%	-	2.5%	704	549	0	-6%	1%	0%
Haul cover soil	NOBS	Blackman's Seep (Pond #2)	Cat 793 truck	48	13.1	2	1,282	0	126	169	12	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	0	-6%	-5%	0%
Haul cover soil	NOBS	Decant Pond #4	Cat 793 truck	3,001	13.0	2	1,288	3	126	169	12	4,110	2,310	1,800	-	-8.9%	-1.1%	-	2.5%	704	549	0	-6%	1%	0%
Haul cover soil	NOBS	Upper Creek Containment Pond 1	Cat 793 truck	7,405	13.1	2	1,282	7	126	169	12	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	0	-6%	-5%	0%
Haul cover soil	NOBS	Contingency Disturbance Area	Cat 793 truck	242,000	16.5	2	1,020	237	126	169	12	8,477	2,284	3,573	2,621	-7.5%	-2.2%	2.4%	2.5%	696	1,089	799	-5%	0%	5%

*Cover material supplied from North Overburden Stockpile for each facility. Suitable cover material from Reclaim Pond spillway applied to the MTI as cover with balance from North Overburden Stockpile.

Productivity and Hours Required for Truck Use

<u>Truck-Loader Matching</u>
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

Task Description	Location 1*	Location 2	Return Effective Grade Segment 1 (%)	Return Effective Grade Segment 2 (%)	Return Effective Grade Segment 3 (%)	Haul Time (min)	Return Time (min)	Loading Time (min)	Load/ Maneuver 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 cover soil	NOBS	SWRDF Top	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	SWRDF Outslopes	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	SWRDF Top	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00272	0.00199	0.00113	0.00110
Haul cover soil	NOBS	Hanover Mountain Deposit	12%	11%	-4%	3.2	3.1	7.8	0.7	1.1	50	0.00110	0.00110	0.00401	0.00226	0.00181	0.00110
Haul cover soil	NOBS	No. 3 Stockpile Top	4%	6%	5%	1.4	1.5	7.8	0.7	1.1	50	0.00110	0.00110	0.00110	0.00114	0.00117	0.00114
Haul cover soil	NOBS	No. 3 Stockpile Outslope	4%	6%	5%	1.4	1.5	7.8	0.7	1.1	50	0.00110	0.00110	0.00110	0.00114	0.00117	0.00114
Haul cover soil	NOBS	Pearson-Barnes Mine Area	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	Low Grade WRF	3%	11%	5%	4.0	4.3	7.8	0.7	1.1	50	0.00135	0.00110	0.00110	0.00113	0.00199	0.00114
Haul cover soil	NOBS	MTI Reclaim Pond	11%	1%	-1%	4.0	3.0	7.8	0.7	1.1	50	0.00110	0.00175	0.00249	0.00199	0.00111	0.00110
Haul cover soil	NOBS	MTI Top	11%	1%	-1%	4.0	3.0	7.8	0.7	1.1	50	0.00110	0.00175	0.00249	0.00199	0.00111	0.00110
Haul cover soil	NOBS	MTI Outslope	11%	1%	-1%	4.0	3.0	7.8	0.7	1.1	50	0.00110	0.00175	0.00249	0.00199	0.00111	0.00110
Haul cover soil	Reclaim Pond Outlet Channel	MTI Top	2%	0%	0%	0.6	0.4	7.8	0.7	1.1	50	0.00155	0.00110	0.00110	0.00112	0.00110	0.00110
Haul cover soil	NOBS	Tailing Pipeline Corridor	11%	1%	-1%	4.0	3.0	7.8	0.7	1.1	50	0.00110	0.00175	0.00249	0.00199	0.00111	0.00110
Haul cover soil	NOBS	Grape Gulch Pond #3	11%	10%	0%	1.3	2.2	7.8	0.7	1.1	50	0.00110	0.00110	0.00110	0.00199	0.00173	0.00110
Haul cover soil	NOBS	Magnetite Seepage Pond	11%	1%	7%	2.6	2.9	7.8	0.7	1.1	50	0.00110	0.00175	0.00110	0.00199	0.00111	0.00120
Haul cover soil	NOBS	SWRF Dam 1	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	SWRF Dam 2	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	SWRF Dam 3	11%	3%	-2%	5.9	4.9	7.8	0.7	1.1	50	0.00110	0.00119	0.00271	0.00199	0.00113	0.00110
Haul cover soil	NOBS	North Tailings Decant Pond	11%	4%	0%	1.4	2.0	7.8	0.7	1.1	50	0.00110	0.00117	0.00110	0.00199	0.00114	0.00110
Haul cover soil	NOBS	East WRF Containment	11%	4%	0%	1.4	2.0	7.8	0.7	1.1	50	0.00110	0.00117	0.00110	0.00199	0.00114	0.00110
Haul cover soil	NOBS	Blackman's Seep (Pond #2)	11%	10%	0%	1.3	2.2	7.8	0.7	1.1	50	0.00110	0.00110	0.00110	0.00199	0.00173	0.00110
Haul cover soil	NOBS	Decant Pond #4	11%	4%	0%	1.4	2.0	7.8	0.7	1.1	50	0.00110	0.00117	0.00110	0.00199	0.00114	0.00110
Haul cover soil	NOBS	Upper Creek Containment Pond 1	11%	10%	0%	1.3	2.2	7.8	0.7	1.1	50	0.00110	0.00110	0.00110	0.00199	0.00173	0.00110
Haul cover soil	NOBS	Contingency Disturbance Area	10%	5%	0%	3.6	3.3	7.8	0.7	1.1	50	0.00110	0.00110	0.00204	0.00167	0.00114	0.00110

*Cover material supplied from North Overburden Stockpile for each facility. Suitable cover m
MTI as cover with balance from North Overburden Stockpile.

Productivity for Front End Loader

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Net Bucket Capacity (cy)	Loader Cycle Time (min)	Productivity (cy/hr)	Task Time (hours)	PERFORMANCE FACTORS Rated Bucket Capacity (cy)	Bucket Fill Factor	Work Hour (min/hr)
Load cover soil	NOBS	SWRDF Top	992K	412,368	14	0.65	1,077	383	16	0.875	50
Load cover soil	NOBS	SWRDF Outslopes	992K	1,237,104	14	0.65	1,077	1,149	16	0.875	50
Load cover soil	NOBS	SWRDF Top	992K	119,548	14	0.65	1,077	111	16	0.875	50
Load cover soil	NOBS	Hanover Mountain Deposit	992K	451,572	14	0.65	1,077	419	16	0.875	50
Load cover soil	NOBS	No. 3 Stockpile Top	992K	6,292	14	0.65	1,077	6	16	0.875	50
Load cover soil	NOBS	No. 3 Stockpile Outslope	992K	21,296	14	0.65	1,077	20	16	0.875	50
Load cover soil	NOBS	Pearson-Barnes Mine Area	992K	57,596	14	0.65	1,077	53	16	0.875	50
Load cover soil	NOBS	Low Grade WRF	992K	134,697	14	0.65	1,077	125	16	0.875	50
Load cover soil	NOBS	MTI Reclaim Pond	992K	159,720	14	0.65	1,077	148	16	0.875	50
Load cover soil	NOBS	MTI Top	992K	261,844	14	0.65	1,077	243	16	0.875	50
Load cover soil	NOBS	MTI Outslope	992K	175,837	14	0.65	1,077	163	16	0.875	50
Load cover soil	Reclaim Pond Outlet Channel	MTI Top	992K	71,560	14	0.65	1,077	66	16	0.875	50
Load cover soil	NOBS	Tailing Pipeline Corridor	992K	6,999	14	0.65	1,077	6	16	0.875	50
Load cover soil	NOBS	Grape Gulch Pond #3	992K	1,839	14	0.65	1,077	2	16	0.875	50
Load cover soil	NOBS	Magnetite Seepage Pond	992K	968	14	0.65	1,077	1	16	0.875	50
Load cover soil	NOBS	SWRF Dam 1	992K	2,517	14	0.65	1,077	2	16	0.875	50
Load cover soil	NOBS	SWRF Dam 2	992K	1,646	14	0.65	1,077	2	16	0.875	50
Load cover soil	NOBS	SWRF Dam 3	992K	4,066	14	0.65	1,077	4	16	0.875	50
Load cover soil	NOBS	North Tailings Decant Pond	992K	2,226	14	0.65	1,077	2	16	0.875	50
Load cover soil	NOBS	East WRF Containment	992K	2,420	14	0.65	1,077	2	16	0.875	50
Load cover soil	NOBS	Blackman's Seep (Pond #2)	992K	48	14	0.65	1,077	0.0	16	0.875	50
Load cover soil	NOBS	Decant Pond #4	992K	3,001	14	0.65	1,077	2.8	16	0.875	50
Load cover soil	NOBS	Upper Creek Containment Pond 1	992K	7,405	14	0.65	1,077	6.9	16	0.875	50
Load cover soil	NOBS	Contingency Disturbance Area	992K	242,000	14	0.65	1,077	224.7	16	0.875	50

Productivity and Hours Required for Scraper Use

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Productivity and Hours Required for Motor grader Use---Grading

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Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units Equipment	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)
Dozers-Earthmoving											
Cat D11T	Regrade Top	SWRDF	Top	$414.50	$26.29	1	1,338	$589,604.44	666,680	cy	0.88
Cat D11T	Regrade Outslope	SWRDF	Outslope	$414.50	$26.29	1	2,060	$908,019.72	4,438,079	cy	0.20
Cat D11T	Regrade Top	MTI	Top	$414.50	$26.29	1	38	$16,836.97	50,795	cy	0.33
Cat D11T	Regrade Outslope	MTI Reclaim Pond	Top and Outslope	$414.50	$26.29	1	35	$15,635.00	67,765	cy	0.23
Cat D11T	Regrade Outslope	MTI	Outslope	$414.50	$26.29	1	95	$41,856.10	170,294	cy	0.25
Cat D11T	Regrade Top	No. 3 Stockpile Top	Top	$414.50	$26.29	1	3	$1,102.53	9,438	cy	0.12
Cat D11T	Regrade Outslope	No. 3 Stockpile Outslope	Outslope	$414.50	$26.29	1	5	$1,997.82	14,489	cy	0.14
Cat D11T	Dozer Assist	NOBS	SWRDF Top	$414.50	$26.29	1	383	$168,784.28	381,822	cy	0.44
Cat D11T	Dozer Assist	NOBS	SWRDF Outslopes	$414.50	$26.29	1	1,149	$506,352.85	1,145,467	cy	0.44
Cat D11T	Dozer Assist	NOBS	SWRDF Top	$414.50	$26.29	1	111	$48,931.59	110,693	cy	0.44
Cat D11T	Dozer Assist	NOBS	Hanover Mountain Deposit	$414.50	$26.29	1	419	$184,830.68	418,122	cy	0.44
Cat D11T	Dozer Assist	NOBS	No. 3 Stockpile Top	$414.50	$26.29	1	6	$2,575.35	5,826	cy	0.44
Cat D11T	Dozer Assist	NOBS	No. 3 Stockpile Outslope	$414.50	$26.29	1	20	$8,716.56	19,719	cy	0.44
Cat D11T	Dozer Assist	NOBS	Pearson-Barnes Mine Area	$414.50	$26.29	1	53	$23,574.33	53,330	cy	0.44
Cat D11T	Dozer Assist	NOBS	Low Grade WRF	$414.50	$26.29	1	125	$55,132.24	124,720	cy	0.44
Cat D11T	Dozer Assist	NOBS	MTI Reclaim Pond	$414.50	$26.29	1	148	$65,374.19	147,889	cy	0.44
Cat D11T	Dozer Assist	NOBS	MTI Top	$414.50	$26.29	1	243	$107,174.06	242,448	cy	0.44
Cat D11T	Dozer Assist	NOBS	MTI Outslope	$414.50	$26.29	1	163	$71,971.05	162,812	cy	0.44
Cat D11T	Dozer Assist	Reclaim Pond Outlet Channel	MTI Top	$414.50	$26.29	1	66	$29,289.82	62,226	cy	0.47
Cat D11T	Dozer Assist	NOBS	Tailing Pipeline Corridor	$414.50	$26.29	1	6	$2,864.58	6,480	cy	0.44
Cat D11T	Dozer Assist	NOBS	Grape Gulch Pond #3	$414.50	$26.29	1	2	$752.79	1,703	cy	0.44
Cat D11T	Dozer Assist	NOBS	Magnetite Seepage Pond	$414.50	$26.29	1	1	$396.21	896	cy	0.44
Cat D11T	Dozer Assist	NOBS	SWRF Dam 1	$414.50	$26.29	1	2	$1,030.14	2,330	cy	0.44
Cat D11T	Dozer Assist	NOBS	SWRF Dam 2	$414.50	$26.29	1	2	$673.55	1,524	cy	0.44
Cat D11T	Dozer Assist	NOBS	SWRF Dam 3	$414.50	$26.29	1	4	$1,664.07	3,764	cy	0.44
Cat D11T	Dozer Assist	NOBS	North Tailings Decant Pond	$414.50	$26.29	1	2	$911.28	2,061	cy	0.44
Cat D11T	Dozer Assist	NOBS	East WRF Containment	$414.50	$26.29	1	2	$990.52	2,241	cy	0.44
Cat D11T	Dozer Assist	NOBS	Blackman's Seep (Pond #2)	$414.50	$26.29	1	0	$19.81	45	cy	0.44
Cat D11T	Dozer Assist	NOBS	Decant Pond #4	$414.50	$26.29	1	3	$1,228.24	2,779	cy	0.44
Cat D11T	Dozer Assist	NOBS	Upper Creek Containment Pond 1	$414.50	$26.29	1	7	$3,030.99	6,857	cy	0.44
Cat D11T	Dozer Assist	NOBS	Contingency Disturbance Area	$414.50	$26.29	1	225	$99,051.81	224,074	cy	0.44
Dozers-Grading											
Cat 16M	Grade surface	Haul Roads	-	$133.94	$26.29	1	17.4	$2,789.17	45.0	ac	61.98
Cat 16M	Grade surface	Exploration Roads	-	$133.94	$26.29	1	14.3	$2,293.32	37.0	ac	61.98
Cat 16M	Grade surface	Low Grade WRF	-	$133.94	$26.29	1	10.8	$1,724.95	27.8	ac	61.98
Cat 16M	Grade surface	Grape Gulch Pond #3	-	$133.94	$26.29	1	0.1	$23.55	0.4	ac	61.98
Cat 16M	Grade surface	Magnetite Seepage Pond	-	$133.94	$26.29	1	0.1	$12.40	0.2	ac	61.98
Cat 16M	Grade surface	SWRF Dam 1	-	$133.94	$26.29	1	0.2	$32.23	0.5	ac	61.98
Cat 16M	Grade surface	SWRF Dam 2	-	$133.94	$26.29	1	0.1	$21.07	0.3	ac	61.98
Cat 16M	Grade surface	SWRF Dam 3	-	$133.94	$26.29	1	0.3	$52.06	0.8	ac	61.98
Cat 16M	Grade surface	North Tailings Decant Pond	-	$133.94	$26.29	1	0.2	$28.51	0.5	ac	61.98
Cat 16M	Grade surface	East WRF Containment	-	$133.94	$26.29	1	0.2	$30.99	0.5	ac	61.98
Cat 16M	Grade surface	Blackman's Seep (Pond #2)	-	$133.94	$26.29	1	0.0	$0.62	0.0	ac	61.98
Cat 16M	Grade surface	Decant Pond #4	-	$133.94	$26.29	1	0.2	$38.43	0.6	ac	61.98
Cat 16M	Grade surface	Upper Creek Containment Pond 1	-	$133.94	$26.29	1	0.6	$94.83	1.5	ac	61.98
Cat 16M	Grade surface	Contingency Disturbance Area	-	$133.94	$26.29	1	19.3	$3,099.08	50.0	ac	61.98
Cat D11T	Grade cover soil	SWRDF Top	-	$414.50	$26.29	1	214.7	$94,625.91	412,368.0	cy	0.23
Cat D11T	Grade cover soil	SWRDF Outslopes	-	$414.50	$26.29	1	408.0	$179,848.00	1,237,104.0	cy	0.15
Cat D11T	Grade cover soil	SWRDF Top	-	$414.50	$26.29	1	62.2	$27,432.63	119,548.0	cy	0.23
Cat D11T	Grade cover soil	Hanover Mountain Deposit	-	$414.50	$26.29	1	235.1	$103,622.03	451,572.0	cy	0.23
Cat D11T	Grade cover soil	No. 3 Stockpile Top	-	$414.50	$26.29	1	1.8	$787.54	6,292.0	cy	0.13
Cat D11T	Grade cover soil	No. 3 Stockpile Outslope	-	$414.50	$26.29	1	2.6	$1,126.02	21,296.0	cy	0.05
Cat D11T	Grade cover soil	Pearson-Barnes Mine Area	-	$414.50	$26.29	1	46.3	$20,425.55	57,596.0	cy	0.35
Cat D11T	Grade cover soil	Low Grade WRF	-	$414.50	$26.29	1	43.1	$18,992.22	134,697.2	cy	0.14
Cat D11T	Grade cover soil	MTI Reclaim Pond	-	$414.50	$26.29	1	51.1	$22,520.42	159,720.0	cy	0.14
Cat D11T	Grade cover soil	MTI Top	-	$414.50	$26.29	1	136.9	$60,357.43	261,844.0	cy	0.23
Cat D11T	Grade cover soil	MTI Outslope	-	$414.50	$26.29	1	56.2	$24,792.94	175,837.2	cy	0.14
Cat D11T	Grade cover soil	MTI Top	-	$414.50	$26.29	1	37.4	$16,495.21	71,559.9	cy	0.23
Cat D11T	Grade cover soil	Tailing Pipeline Corridor	-	$414.50	$26.29	1	3.6	$1,605.97	6,998.6	cy	0.23
Cat D11T	Grade cover soil	Grape Gulch Pond #3	-	$414.50	$26.29	1	1.0	$422.04	1,839.2	cy	0.23
Cat D11T	Grade cover soil	Magnetite Seepage Pond	-	$414.50	$26.29	1	0.5	$222.13	968.0	cy	0.23
Cat D11T	Grade cover soil	SWRF Dam 1	-	$414.50	$26.29	1	1.3	$577.53	2,516.8	cy	0.23
Cat D11T	Grade cover soil	SWRF Dam 2	-	$414.50	$26.29	1	0.9	$377.62	1,645.6	cy	0.23
Cat D11T	Grade cover soil	SWRF Dam 3	-	$414.50	$26.29	1	2.1	$932.93	4,065.6	cy	0.23
Cat D11T	Grade cover soil	North Tailings Decant Pond	-	$414.50	$26.29	1	1.2	$510.89	2,226.4	cy	0.23
Cat D11T	Grade cover soil	East WRF Containment	-	$414.50	$26.29	1	1.3	$555.32	2,420.0	cy	0.23
Cat D11T	Grade cover soil	Blackman's Seep (Pond #2)	-	$414.50	$26.29	1	0.0	$11.11	48.4	cy	0.23
Cat D11T	Grade cover soil	Decant Pond #4	-	$414.50	$26.29	1	1.6	$688.59	3,000.8	cy	0.23
Cat D11T	Grade cover soil	Upper Creek Containment Pond 1	-	$414.50	$26.29	1	3.9	$1,699.27	7,405.2	cy	0.23
Cat D11T	Grade cover soil	Contingency Disturbance Area	-	$414.50	$26.29	2	126.0	$111,063.27	242,000.0	cy	0.46
Loaders											
992K	Load cover soil	NOBS	SWRDF Top	$294.35	$26.56	1	500	$160,469.95	412,368	cy	0.39
992K	Load cover soil	NOBS	SWRDF Outslopes	$294.35	$26.56	1	1,500	$481,409.84	1,237,104	cy	0.39

Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units Equipment	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)
992K	Load cover soil	NOBS	SWRDF Top	$294.35	$26.56	1	145	$46,521.46	119,548	cy	0.39
992K	Load cover soil	NOBS	Hanover Mountain Deposit	$294.35	$26.56	1	427	$137,076.03	451,572	cy	0.30
992K	Load cover soil	NOBS	No. 3 Stockpile Top	$294.35	$26.56	1	6	$1,874.94	6,292	cy	0.30
992K	Load cover soil	NOBS	No. 3 Stockpile Outslope	$294.35	$26.56	1	20	$6,345.95	21,296	cy	0.30
992K	Load cover soil	NOBS	Pearson-Barnes Mine Area	$294.35	$26.56	1	70	$22,413.06	57,596	cy	0.39
992K	Load cover soil	NOBS	Low Grade WRF	$294.35	$26.56	1	143	$45,914.08	134,697	cy	0.34
992K	Load cover soil	NOBS	MTI Reclaim Pond	$294.35	$26.56	1	159	$50,901.09	159,720	cy	0.32
992K	Load cover soil	NOBS	MTI Top	$294.35	$26.56	1	260	$83,446.95	261,844	cy	0.32
992K	Load cover soil	NOBS	MTI Outslope	$294.35	$26.56	1	175	$56,037.48	175,837	cy	0.32
992K	Load cover soil	Reclaim Pond Outlet Channel	MTI Top	$294.35	$26.56	1	66	$21,323.98	71,560	cy	0.30
992K	Load cover soil	NOBS	Tailing Pipeline Corridor	$294.35	$26.56	1	7.0	$2,230.39	6,999	cy	0.32
992K	Load cover soil	NOBS	Grape Gulch Pond #3	$294.35	$26.56	1	1.7	$548.06	1,839	cy	0.30
992K	Load cover soil	NOBS	Magnetite Seepage Pond	$294.35	$26.56	1	0.9	$288.45	968	cy	0.30
992K	Load cover soil	NOBS	SWRF Dam 1	$294.35	$26.56	1	3.1	$979.39	2,517	cy	0.39
992K	Load cover soil	NOBS	SWRF Dam 2	$294.35	$26.56	1	2.0	$640.37	1,646	cy	0.39
992K	Load cover soil	NOBS	SWRF Dam 3	$294.35	$26.56	1	4.9	$1,582.10	4,066	cy	0.39
992K	Load cover soil	NOBS	North Tailings Decant Pond	$294.35	$26.56	1	2.1	$663.44	2,226	cy	0.30
992K	Load cover soil	NOBS	East WRF Containment	$294.35	$26.56	1	2.2	$721.13	2,420	cy	0.30
992K	Load cover soil	NOBS	Blackman's Seep (Pond #2)	$294.35	$26.56	1	0.0	$14.42	48	cy	0.30
992K	Load cover soil	NOBS	Decant Pond #4	$294.35	$26.56	1	2.8	$894.20	3,001	cy	0.30
992K	Load cover soil	NOBS	Upper Creek Containment Pond 1	$294.35	$26.56	1	6.9	$2,206.66	7,405	cy	0.30
992K	Load cover soil	NOBS	Contingency Disturbance Area	$294.35	$26.56	1	237.3	$76,136.01	242,000	cy	0.31

Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units Equipment	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)
Trucks											
Cat 793 truck	Haul cover soil	NOBS	SWRDF Top	$478.45	$23.84	2	500	$502,331.79	412,368	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	SWRDF Outslopes	$478.45	$23.84	2	1,500	$1,506,995.38	1,237,104	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	SWRDF Top	$478.45	$23.84	2	145	$145,629.83	119,548	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	Hanover Mountain Deposit	$478.45	$23.84	2	427	$429,099.97	451,572	cy	0.95
Cat 793 truck	Haul cover soil	NOBS	No. 3 Stockpile Top	$478.45	$23.84	2	6	$5,869.27	6,292	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	No. 3 Stockpile Outslope	$478.45	$23.84	2	20	$19,865.23	21,296	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Pearson-Barnes Mine Area	$478.45	$23.84	2	70	$70,161.37	57,596	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	Low Grade WRF	$478.45	$23.84	2	143	$143,728.47	134,697	cy	1.07
Cat 793 truck	Haul cover soil	NOBS	MTI Reclaim Pond	$478.45	$23.84	2	159	$159,339.73	159,720	cy	1.00
Cat 793 truck	Haul cover soil	NOBS	MTI Top	$478.45	$23.84	2	260	$261,220.58	261,844	cy	1.00
Cat 793 truck	Haul cover soil	NOBS	MTI Outslope	$478.45	$23.84	2	175	$175,418.56	175,837	cy	1.00
Cat 793 truck	Haul cover soil	Reclaim Pond Outlet Channel	MTI Top	$478.45	$23.84	2	66	$66,752.15	71,560	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Tailing Pipeline Corridor	$478.45	$23.84	2	7.0	$6,981.98	6,999	cy	1.00
Cat 793 truck	Haul cover soil	NOBS	Grape Gulch Pond #3	$478.45	$23.84	2	1.7	$1,715.63	1,839	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Magnetite Seepage Pond	$478.45	$23.84	2	0.9	$902.96	968	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	SWRF Dam 1	$478.45	$23.84	2	3.1	$3,065.87	2,517	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	SWRF Dam 2	$478.45	$23.84	2	2.0	$2,004.61	1,646	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	SWRF Dam 3	$478.45	$23.84	2	4.9	$4,952.57	4,066	cy	1.22
Cat 793 truck	Haul cover soil	NOBS	North Tailings Decant Pond	$478.45	$23.84	2	2.1	$2,076.82	2,226	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	East WRF Containment	$478.45	$23.84	2	2.2	$2,257.41	2,420	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Blackman's Seep (Pond #2)	$478.45	$23.84	2	0.0	$45.15	48	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Decant Pond #4	$478.45	$23.84	2	2.8	$2,799.19	3,001	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Upper Creek Containment Pond 1	$478.45	$23.84	2	6.9	$6,907.68	7,405	cy	0.93
Cat 793 truck	Haul cover soil	NOBS	Contingency Disturbance Area	$478.45	$23.84	2	237.3	$238,334.59	242,000	cy	0.98
Rippers											
D11T w/ ripper	Rip liners	East WRF Containment	-	$448.89	$26.29	1	0.3	$139.36	1,210	cy	0.12
D11T w/ ripper	Rip liners	Decant Pond #4	-	$448.89	$26.29	1	0.4	$172.80	1,500	cy	0.12
D11T w/ ripper	Rip liners	Blackman's Seep (Pond #2)	-	$448.89	$26.29	1	0.0	$2.79	24	cy	0.12
D11T w/ ripper	Rip liners	Grape Gulch Pond #3	-	$448.89	$26.29	1	0.2	$105.91	920	cy	0.12
D11T w/ ripper	Rip liners	Magnetite Seepage Pond	-	$448.89	$26.29	1	0.1	$55.74	484	cy	0.12
D11T w/ ripper	Rip surface	Reclaim Pond Outlet Channel	-	$448.89	$26.29	1	1.0	$473.81	4,114	cy	0.12
D11T w/ ripper	Rip liners	Upper Creek Containment Pond 1	-	$448.89	$26.29	1	0.9	$426.43	3,703	cy	0.12
Cat 16M	Grade surface	Haul Roads	-	$448.89	$26.29	1	0.0	$0.00	0	cy	---
Water Truck and Grader											
Off-Hwy Water Tanker Truck 6,000 gal	SWRDF			$86.99	$23.84	1	2,145	$237,747.38			
Off-Hwy Water Tanker Truck 6,000 gal	Hanover Mountain Deposit			$86.99	$23.84	1	427	$47,340.80			
Off-Hwy Water Tanker Truck 6,000 gal	No. 3 Stockpile Top			$86.99	$23.84	1	6	$647.53			
Off-Hwy Water Tanker Truck 6,000 gal	Pearson-Barnes Mine Area			$86.99	$23.84	1	70	$7,740.61			
Off-Hwy Water Tanker Truck 6,000 gal	Low Grade WRF			$86.99	$23.84	1	143	$15,856.96			
Off-Hwy Water Tanker Truck 6,000 gal	MTI			$86.99	$23.84	1	667	$15,856.96			
Off-Hwy Water Tanker Truck 6,000 gal	Surface Impoundments			$86.99	$23.84	1	27	$2,948.78			
Off-Hwy Water Tanker Truck 6,000 gal	Contingency Disturbance Areas			$86.99	$23.84	1	262	$29,053.96			
Motor Grader 14M	SWRDF			$99.13	$26.29	1	2,145	$269,045.17			
Motor Grader 14M	Hanover Mountain Deposit			$99.13	$26.29	1	427	$53,572.89			
Motor Grader 14M	No. 3 Stockpile Top			$99.13	$26.29	1	6	$732.78			
Motor Grader 14M	Pearson-Barnes Mine Area			$99.13	$26.29	1	70	$8,759.61			
Motor Grader 14M	Low Grade WRF			$99.13	$26.29	1	143	$17,944.42			
Motor Grader 14M	MTI			$99.13	$26.29	1	667	$83,613.29			
Motor Grader 14M	Surface Impoundments			$99.13	$26.29	1	27	$3,336.96			
Motor Grader 14M	Contingency Disturbance Areas			$99.13	$26.29	1	262	$32,878.71			
								$9,447,857.22			

SWRDF	$5,873,750.23	$7,536,022
Hanover Mountain Deposit	$955,542.41	
No. 3 Stockpile	$51,641.51	
Pearson-Barnes Mine Area	$153,074.51	
Low Grade WRF	$299,293.33	
MTI	$1,460,370.69	
Haul and Exploration Roads	$5,082.49	
Surface Impoundments	$59,484.61	
Contingency Disturbance Area	$589,617.42	
Earthwork Direct Cos	**$9,447,857.22**	

Fuel-

Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units Equipment	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)

EQUIPMENT

Equipment Description		Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Owning and Operating Cost (w/out fuel) ($/hr)	Adjusted Own/Op Cost ($/hr)	Reference
Cat D11T CD Bulldozer		29.8	$63.77	$350.73	$414.50	1
Cat D11T Bulldozer w/ multi shank ripper		29.8	$63.77	$385.12	$448.89	1
Cat 793 truck		47.8	$102.37	$376.08	$478.45	1
Cat 992K Loader	(Costing for Komatsu HD 1500)	25.6	$54.94	$239.41	$294.35	1
Cat 16M		9.5	$20.37	$113.57	$133.94	1
Cat 14M		8.3	$17.76	$81.37	$99.13	1
Off-Hwy Water Tanker Truck,6,000-gal.		11.3	$24.12	$62.87	$86.99	1

FUEL

Oil Broker Quote	$ 2.14	per gallon	2

LABOR

Labor Description	NMDOL Type A Operator Group	NMDOL Type A Operator Classification	Nominal Total Rate ($/hr)	
Cat D11T Bulldozer	Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat D11T Bulldozer w/ multi shank ripper	Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat 793 truck	Truck Driver III	Haul Truck	$23.84	4
Cat 992K Loader	Equipment Operator VI	Loader (over 10 cy)	$26.56	4
Cat 16M	Equipment Operator IV	Motor Grader	$26.29	4
Cat 14M	Equipment Operator IV	Motor Grader	$26.29	4
Off-Hwy Water Tanker Truck,6,000-gal.	Truck Driver III	N/A	$23.84	4

References
1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect cost is removed from the all-inclusive fuel
3. https://www.electricitylocal.com/states/new-mexico/silver-city/
4. Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2018 labor rates.

Revegetation Costs

Description:

Chiseling or ripping, scarifying, disking, rangeland drill seeding, mulching, crimping, mobilization.

Unit or Disturbance	(acres)	Unit Cost ($/acre)	Direct Cost ($)
SWRDF Top	85	$856	$72,948
SWRDF Outslopes	256	$856	$218,844
SWRDF Top	25	$856	$21,148
Hanover Mountain Deposit	93	$856	$79,883
No. 3 Stockpile Top	1	$856	$1,113
No. 3 Stockpile Outslope	4	$856	$3,767
Pearson-Barnes Mine Area	12	$856	$10,189
Low Grade WRF	28	$856	$23,828
MTI Reclaim Pond	33	$856	$28,254
MTI Outslope	36	$856	$31,106
MTI Top	108	$856	$92,640
Tailing Pipeline Corridor	1.4	$856	$1,238
Haul Roads	45	$856	$38,529
Exploration Roads	37	$856	$31,679
Continental Pit berm and fence disturbance	18	$856	$15,069
Disturbed Area Adjacent and North of the SWRDF	21	$856	$17,895
Surface Impoundments			
Grape Gulch Pond #3	0.4	$856	$325
Magnetite Seepage Pond	0.2	$856	$171
SWRF Dam 1	0.5	$856	$445
SWRF Dam 2	0.3	$856	$291
SWRF Dam 3	0.8	$856	$719
North Tailings Decant Pond	0.5	$856	$394
East WRF Containment	0.5	$856	$428
Blackman's Seep (Pond #2)	0.01	$856	$9
Decant Pond #4	0.6	$856	$531
Upper Creek Containment Pond 1	1.5	$856	$1,310
Borrow Areas			
Top Soil Stockpile	0.2	$856	$193
NOBS (proposed)	17	$856	$14,869
South OB Stockpile (proposed)	18	$856	$15,668
Reclaim Pond Outlet Channel	1.7	$856	$1,456
OB Stockpile-1	4.6	$856	$3,958
OB Stockpile-2	0.9	$856	$779
OB Stockpile-3	5.0	$856	$4,312
OB Stockpile-4	4.3	$856	$3,651
OB Stockpile-5	3.3	$856	$2,865
Contingency Disturbance Areas			
Contingency Disturbance Areas	50.0	$856	$42,810

SWRDF	$330,834
Hanover Mountain Deposit	$79,883
No. 3 Stockpile	$4,880
Pearson-Barnes Mine Area	$10,189
Low Grade WRF	$23,828
MTI	$153,239
Haul and Exploration Roads	$70,208
Surface Impoundments	$4,623
Continental Pit	$15,069
Contingency Disturbance Areas	$42,810
Borrow Areas	$47,750
Revegetation Direct Cost	**$783,314**

Other Reclamation Activity Costs

Item	Activity	Quantity	Unit	Unit Cost ($/unit)	Direct Cost ($)	Reference	Line Item	Page	Description
Surface Impoundments									
Reinforced Concrete Wall Demolition	SWRF Dam 1	54	hr	$194.70	$10,514	Means	Crew B-12C	541	1 Equip. Oper (crane), 1 laborer, 1 Hyd. Excavator, 2 C.Y. Approximately 40 hrs to demo a 200' reinforced concrete dam.
Reinforced Concrete Wall Demolition	SWRF Dam 2	30.6	hr	$194.70	$5,958	Means	Crew B-12C	541	1 Equip. Oper (crane), 1 laborer, 1 Hyd. Excavator, 2 C.Y. Approximately 40 hrs to demo a 200' reinforced concrete dam.
Reinforced Concrete Wall Demolition	SWRF Dam 3	47	hr	$194.70	$9,151	Means	Crew B-12C	541	1 Equip. Oper (crane), 1 laborer, 1 Hyd. Excavator, 2 C.Y. Approximately 40 hrs to demo a 200' reinforced concrete dam.
Reinforced Concrete Wall Demolition	East WRF Containment	40	hr	$194.70	$7,788	Means	Crew B-12C	541	1 Equip. Oper (crane), 1 laborer, 1 Hyd. Excavator, 2 C.Y. Approximately 40 hrs to demo a 200' reinforced concrete dam.
Wells									
Plug & Abandon Well	close after 100-years	700	ft	$10.60	$7,421	MMD, 2013			$14.00/ft minus 28.3% indirect costs then added inflation from 2013 to 2018. "Estimated costs for abandoning boreholes using bentonite cement grout ranges from approximately $14.00 to $25.00 per foot. For the purposes of estimating a simplified cost of abandoning boreholes the MMD cost is $14.00/ft. The FA cost estimate could be higher or lower based on site specific characteristics".
Channels and Benches									
SWRDF	Downdrain Length	8,595	ft	$5.57	$47,874	Appendix B.2.8			Downdrain: Excavate and waste 7.6 cy/lf material on slopes with D11T, 175-foot downslope excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 3 passes 1 mph.
MTI	Downdrain Length	1,353	ft	$5.57	$7,536	Appendix B.2.8			Downdrain: Excavate and waste 7.6 cy/lf material on slopes with D11T, 175-foot downslope excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 3 passes 1 mph.
SWRDF	3:1 slope Bench Grading	14,126	ft	$1.99	$28,111	Appendix B.2.8			Excavate and waste 9.26 cy/lf on slopes with D11T, 87-foot push. Finish grade with D9T 3 passes 1 mph.
MTI	3:1 slope Bench Grading	3,894	ft	$1.75	$6,815	Appendix B.2.8			Excavate and waste 9.26 cy/lf on slopes with D11T, 87-foot push. Finish grade with D9T 3 passes 1 mph.
SWRDF	2.5:1 slope Bench Grading	25,463	ft	$1.71	$43,542	Appendix B.2.8			Excavate and waste 9.52 cy/lf on slopes with D11T, 78-foot push. Finish grade with D9T 3 passes 1 mph.
SWRDF	Outslope Channels	39,589	feet	$0.45	$17,815	Appendix B.2.8			Excavate and waste 0.43 cy/lf with D11T, 175-foot excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 1 pass 1 mph.
MTI	Outslope Channels	3,894	feet	$0.45	$1,752	Appendix B.2.8			Excavate and waste 0.43 cy/lf with D11T, 175-foot excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 1 pass 1 mph.
SWRDF	Type 1 Top Channels	3,964	feet	$3.10	$12,288	Appendix B.2.8			Type 1 channel:Excavate and waste 2.4 cy/lf with D11T, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T 3 passes 1 mph.
MTI	Type 2 Top Channels	2,141	feet	$8.91	$19,076	Appendix B.2.8			Type 2 channel: Excavate and waste 2.4 cy/lf with D11T, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T 3 passes 1 mph.
Riprap & Gravel									
SWRDF	Downdrain Gravel, Haul	9,025	cy	$1.86	$16,787	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Downdrain Gravel, Backfill	9,025	cy	$1.43	$12,906	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
SWRDF	Downdrain Riprap, Haul	36,959	cy	$1.86	$68,744	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Downdrain Riprap, Backfill	36,959	cy	$1.43	$52,851	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Downdrain Gravel, Haul	1,421	cy	$1.86	$2,643	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
MTI	Downdrain Gravel, Backfill	1,421	cy	$1.43	$2,032	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Downdrain Riprap, Haul	5,818	cy	$1.86	$10,821	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
MTI	Downdrain Riprap, Backfill	5,818	cy	$1.43	$8,320	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
SWRDF	Outslope Channel Riprap, Haul	17,023	cy	$1.86	$31,663	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Outslope Channel Riprap, Backfill	17,023	cy	$1.43	$24,343	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
SWRDF	Top Channel Riprap, Haul	3,817	cy	$1.86	$7,100	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Top Channel Riprap, Backfill	3,817	cy	$1.43	$5,458	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Outslope Channel Riprap, Haul	1,647	cy	$1.86	$3,063	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
MTI	Top Channel Riprap, Haul	9,206	cy	$1.43	$13,165	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Riprap, Backfill	10,853	cy	$1.86	$20,187	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Top Channel Gravel, Haul	2,202	cy	$1.43	$3,149	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
SWRDF	Top Channel Gravel, Backfill	2,202	cy	$1.86	$4,096	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
MTI	Top Channel Gravel, Haul	2,248	cy	$1.43	$3,215	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Top Channel Gravel, Backfill	2,248	cy	$1.86	$4,181	Appendix B.2.8			Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
SWRDF	Riprap	57,799	cy	$39.46	$2,280,819	Direct purchase			See reference note on "0 Unit Cost" tab for calculations
MTI	Riprap	16,671	cy	$35.47	$591,350	Direct purchase			See reference note on "0 Unit Cost" tab for calculations
SWRDF	Gravel	11,227	cy	$1.43	$16,055	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
MTI	Gravel	3,669	cy	$1.43	$5,247	Appendix B.2.8			Gravel Backfill, 980G loader, 150' haul
Continental Pit									
Safety berm, Pits perimeter		6,635	feet	$2.59	$17,185	Appendix B8			Excavate 3.7 cy/lf with D6T XL SU, 100-foot push. Finish grade 1.2 cy/lf with D6T XL SU 50 ft push.
Chain link fence, Pits perimeter		2,453	feet	$21.19	$51,969	Means	323113.20-0800	316	Fence, chain link industrial, schedule 40, including concrete, 6 ga. wire, 6' high, but omit barbed wire, galv. Steel
Hanover Mountain Mine									
Berm		6,670	feet	$2.59	$17,275	Appendix B8			Excavate 3.7 cy/lf with D6T XL SU, 100-foot push. Finish grade 1.2 cy/lf with D6T XL SU 50 ft push.
Chain link fence		3,286	feet	$21.19	$69,617	Means	323113.20-0800	316	Fence, chain link industrial, schedule 40, including concrete, 6 ga. wire, 6' high, but omit barbed wire, galv. Steel

SWRDF	$2,673,599
Hanover Mountain Deposit	$86,892
Wells	$7,421
MTI	$699,402
Surface Impoundments	$33,410
Continental Pit	$69,154
Other Direct Cost	**$3,569,878**

References
See Appendix B.2.8 for Channel, Bench, and Downdrain unit rate development.
RS Means Heavy Construction Cost Data (32nd Annual Edition 2018)
Location factor for New Mexico Las Cruces 85.6%

Reclamation Summary

Cobre Mining Company

Stockpiles, Tailings, Reservoirs, Haul Roads and Distrubed Area Reclamation
Based on Projected EOY 2023 Mine Plan

			Current Value
DIRECT COSTS	Facility and Structure Removal		-
	Earthmoving		$9,447,857
	Revegetation		$783,314
	Other		$3,569,878
	Subtotal, Direct Costs		**$13,801,049**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$524,439.87
	Contingencies	4.0%	$552,042
	Engineering Redesign Fee	2.5%	$345,026
	Contractor Profit and Overhead	15.0%	$2,070,157
	Project Management Fee	3.0%	$414,031
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$3,905,697**
TOTAL COST			**$17,706,746**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Reclamation Summary

			SWRDF(a)	Hanover Mountain Deposit(b)	No. 3 Stockpile(b)	Pearson-Barnes Mine Area	Low Grade WRF	MTI (d)	Haul and Exploration Roads	Surface Impoundments	Wells	Continental Pit	Contingency Disturbance Areas	Borrow Areas	Totals
DIRECT COSTS															
	Earthmoving		$5,873,750	$955,542	$51,642	$153,075	$299,293	$1,460,371	$5,082	$59,485	$0	$0	$589,617		**$9,447,857**
	Revegetation		$330,834	$79,883	$4,880	$10,189	$23,828	$153,239	$70,208	$4,623	$0	$15,069	$42,810	$47,750	**$735,563**
	Other(c)		$2,673,599	$86,892	$0	$0	$0	$699,402	$0	$33,410	$7,421	$69,154	$0	$0	**$3,569,878**
	Subtotal, Direct Costs		**$8,878,184**	**$1,122,318**	**$56,522**	**$163,263**	**$323,121**	**$2,313,012**	**$75,291**	**$97,518**	**$7,421**	**$84,223**	**$632,427**	**$47,750**	**$13,753,299**
INDIRECT COSTS	Mobilization and Demobilization	3.8%	$337,371	$42,648	$2,148	$6,204	$12,279	$87,894	$2,861	$3,706	$282	$3,200	$24,032	$1,815	**$498,593**
	Contingencies	4.0%	$355,127	$44,893	$2,261	$6,531	$12,925	$92,520	$3,012	$3,901	$297	$3,369	$25,297	$1,910	**$524,835**
	Engineering Redesign Fee	2.5%	$221,955	$28,058	$1,413	$4,082	$8,078	$57,825	$1,882	$2,438	$186	$2,106	$15,811	$1,194	**$328,022**
	Contractor Profit and Overhead	15.0%	$1,331,728	$168,348	$8,478	$24,489	$48,468	$346,952	$11,294	$14,628	$1,113	$12,633	$94,864	$7,163	**$1,968,131**
	Project Management Fee	3.0%	$266,346	$33,670	$1,696	$4,898	$9,694	$69,390	$2,259	$2,926	$223	$2,527	$18,973	$1,433	**$393,626**
	State Procurement Cost	0.0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Indirect Percentage Sum =	28.3%													
	Subtotal, Indirect Costs		**$2,512,526**	**$317,616**	**$15,996**	**$46,204**	**$91,443**	**$654,582**	**$21,307**	**$27,598**	**$2,100**	**$23,835**	**$178,977**	**$13,513**	**$3,892,184**
TOTAL COST PER STOCKPILE			**$11,390,709**	**$1,439,934**	**$72,518**	**$209,467**	**$414,565**	**$2,967,594**	**$96,598**	**$125,116**	**$9,521**	**$108,058**	**$811,404**	**$61,263**	**$17,706,746**
TOTAL COST			**$17,645,483**												

(a) Includes disturbed area adjacent and north of the SWRDF
(b) Includes berm and fence disturbed area
(c) Other includes benches, channels, downdrains, plug and abandon wells, fence, berms, and reinforced concrete wall demolition.
(d) Cost includes reclaiming south buttress area and burying tailing pipelines in place.

Facility Characteristics

Facility	SWRDF(a)	Hanover Mountain Deposit(b)	No. 3 Stockpile(b)	Pearson-Barnes Mine Area	Low Grade WRF	MTI (d)	Haul and Exploration Roads	Surface Impoundments	Wells	Continental Pit(c)	Contingency Disturbance Areas	Borrow Areas
Reclaimed Acres	386.4	93.3	5.7	11.9	27.8	179.0	82.0	5.4	-	17.6	50.0	55.8
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
Cover Material (Load, haul, spread)	$5,614,570	$1,225,961	$62,278	$196,395	$381,780	$1,778,293	$0	$75,889	$0	$0	$625,420	$0
Regrade	$1,921,452	$0	$3,978	$0	$2,213	$95,363	$6,521	$429	$0	$0	$131,060	$0
Seed & Mulch	$424,460	$102,490	$6,261	$13,072	$30,571	$196,605	$90,077	$5,932	$0	$19,334	$54,925	$61,263
Other (c)	$3,430,228	$111,483	$0	$0	$0	$897,333	$0	$42,865	$9,521	$88,724	$0	$0
Capital Cost Totals	$11,390,709	$1,439,934	$72,518	$209,467	$414,565	$2,967,594	$96,598	$125,116	$9,521	$108,058	$811,404	$61,263
Capital Cost/Acre	$29,479	$15,433	$12,722	$17,602	$14,912	$16,579	$1,178	$23,170	-	$6,140	$16,228	$1,099
Capital Cost/Acre Cover	$14,530	$13,140	$10,926	$16,504	$13,733	$9,935	$0	$14,054	-	$0	$12,508	$0
Capital Cost/Acre Top/Outslope Adj	$4,973	$0	$698	$0	$80	$533	$80	$80	-	$0	$2,621	$0
Capital Cost/Acre Earthwork Tota	$19,503	$13,140	$11,624	$16,504	$13,813	$10,467	$80	$14,133	-	$0	$15,130	$217,350
Capital Cost/Acre Reveg	$1,099	$1,099	$1,099	$1,099	$1,100	$1,098	$1,099	$1,099	-	$1,099	$1,099	$16,922
Capital Cost/Acre Other	$8,877	$1,195	$0	$0	$0	$5,013	$0	$7,938	-	$5,041	$0	$82,126

(a) Includes disturbed area adjacent and north of the SWRDF
(b) Includes berm and fence disturbed area
(c) Other includes benches, channels, downdrains, plug and abandon wells, fence, berms, and reinforced concrete wall demolition.
(d) Cost includes reclaiming south buttress area and burying tailing pipelines in place.

Magnetite Tailings Impoundment Reclamation Cost Estimate

EOY 2023

General Information

Applicant	Cobre Mining Company Hanover, New Mexico 88041	
Disturbed Surface Area (acres)	62	
Type of Operation	Existing/Surface/Copper	
Current value before escalation and discounting	**$1,077,972**	
Based on Projected EOY 2019 Mine Plan		**Magnetite Tailings**

Demolition

Demo cost are addressed elsewhere.

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Material Handling Plan Summary Sheet

Item	Description	Location 1	Location 2	Total Haul/Push Distance (ft)	Grade (%)	Equipment
1100	Regrade Outslopes	Magnetite Tailings	-	250	see dozer	Cat D11T
1101	Regrade Top	Magnetite Tailings	-	300	see dozer	Cat D11T
1102	Dozer Assist	Magnetite Tailings Top	-	-	see dozer	Cat D11T
1103	Dozer Assist	Magnetite Tailings Outslopes	-	-	see dozer	Cat D11T
1200	Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top			992K
1201	Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes			992K
1202	Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	6,480	sse trucks	Cat 793 truck
1203	Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	6,480	sse trucks	Cat 793 truck
1300	Grade cover soil	Magnetite Tailings Top	-			Cat D11T
1301	Grade cover soil	Magnetite Tailings Outslopes	-			Cat D11T
1400	Off-Hwy Water Tanker Truck					6,000 gal
1401	Motor Grader					14M

Earthwork Quantity Worksheet

Item	Description	Location 1	Location 2	Area (ac)	Cover Depth (in)	Bank/stockpile Volume (bcy)	Swell Factor (%)	Loose/stockpile Volume (lcy)
1100	Regrade Outslopes	Magnetite Tailings	Outslopes			69,996	8%	75,596
1101	Regrade Top	Magnetite Tailings	Top			73,482	8%	79,360
1102	Dozer Assist	Magnetite Tailings Top	Top			256,126	8%	276,616
1103	Dozer Assist	Magnetite Tailings Outslopes	Outslopes			23,833	8%	25,739
1200	Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	57.2	36	256,126	8%	276,616
1201	Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	5.3	36	23,833	8%	25,739
1202	Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top			276,616	0%	276,616
1203	Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes			25,739	0%	25,739
1300	Grade cover soil	Magnetite Tailings Top	-	57.2		276,616	0%	276,616
1301	Grade cover soil	Magnetite Tailings Outslopes	-	5.3		25,739	0%	25,739
1801	Off-Hwy Water Tanker Truck							
1802	Motor Grader							

Productivity and Hours Required for Dozer Use---Earthmoving

Task Description	Location 1	Location 2	Equipment	Loose Volume (cy)	Productivity (cy/hr)	Total Task Time (hours)	PERFORMANCE FACTORS Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	Grade (%)
Regrade Outslopes	Magnetite Tailings	Outslopes	Cat D11T	75,596	1,247	61	1.0	1.67	4,185	1.20	250	1362	1.00	50	1	1	1	-33.3
Regrade Top	Magnetite Tailings	Top	Cat D11T	79,360	685	116	1.0	1.07	4,185	1.20	300	1164	1.00	50	1	1	1	-3.5
Dozer Assist	Magnetite Tailings Top	Top	Cat D11T	N/A	N/A	257	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	Magnetite Tailings Outslopes	Outslopes	Cat D11T	N/A	N/A	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Productivity and Hours Required for Dozer Use---Grading

PERFORMANCE FACTORS

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Area (acres)	Productivity (acres/hr)	Productivity (cy/hr)	Task Time (hours)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Effective Blade Width (feet)	Speed (miles/hr)	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	Grade (%)	Operator Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)
Grade cover soil	Magnetite Tailings Top	-	Cat D11T	276,616		-	2,017	137.2	1.2	1.1	3,300	1.20	-	-	50	1.00	1.00	1.00	-3.5	0.75	100	3002
Grade cover soil	Magnetite Tailings Outslopes	-	Cat D11T	25,739		-	3,126	8.2	1.2	1.7	3,300	1.20	-	-	50	1.00	1.00	1.00	-33.0	0.75	100	3002

Productivity and Hours Required for Ripper-Equipped Dozer Use

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Note: Ripping Currently Included in Revegetation Costs

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Productivity and Hours Required for Truck Use

<u>Truck-Loader Matching</u>
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

PERFORMANCE FACTORS

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Truck Cycle Time (min)	Optimum No. of Trucks	Productivity (cy/hr)	Task Time (hrs)	Struck Capacity (cy)	Heaped Capacity (cy)	Loader Cycles per Truck	Total Haul Distance (feet)	Haul Distance Segment 1 (feet)	Haul Distance Segment 2 (feet)	Haul Distance Segment 3 (feet)	Haul Grade Segment 1 (%)	Haul Grade Segment 2 (%)	Haul Grade Segment 3 (%)	Rolling Resistance (%)
Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	Cat 793 truck	276,616	7.2	2	2,324	257	126	169	12	6,480	2,310	1,940	2,230	-8.9%	1.5%	-4.0%	2.5%
Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	Cat 793 truck	25,739	15.0	2	1,118	24	126	169	12	6,480	2,310	1,940	2,230	-8.9%	1.5%	-4.0%	2.5%

*Cover material is assumed to be obtained from the North Overburden Stockpile for each facility, except for the suitable cover material to be sourced during excavation of the Reclaim Pond spillway, which will be applied to the MTI.

Productivity and Hours Required for Truck Use

Truck-Loader Matching
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

Task Description	Location 1	Location 2	Haul Distance Segment 1 (meters)	Haul Distance Segment 2 (meters)	Haul Distance Segment 3 (meters)	Haul Effective Grade Segment 1 (%)	Haul Effective Grade Segment 2 (%)	Haul Effective Grade Segment 3 (%)	Return Effective Grade Segment 1 (%)	Return Effective Grade Segment 2 (%)	Return Effective Grade Segment 3 (%)	Haul Time (min)
Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	704.1	591.3	679.7	-6%	4%	-2%	11%	1%	7%	2.5
Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	704.1	591.3	679.7	-6%	4%	-2%	11%	1%	7%	2.5

*Cover material is assumed to be obtained from the North Overburden Stockpile for each fac

Productivity and Hours Required for Truck Use

Truck-Loader Matching
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

Task Description	Location 1	Location 2	Return Time (min)	Loading Time (min)	Load/ Maneuver 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 cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	2.9	0.0	0.7	1.1	50	0.00110	0.00175	0.00110	0.00199	0.00111	0.00120
Haul cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	2.9	7.8	0.7	1.1	50	0.00110	0.00175	0.00110	0.00199	0.00111	0.00120

*Cover material is assumed to be obtained from the North Overburden Stockpile for each fac

Productivity for Front End Loader

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Net Bucket Capacity (cy)	Loader Cycle Time (min)	Productivity (cy/hr)	Task Time (hours)	PERFORMANCE FACTORS Rated Bucket Capacity (cy)	Bucket Fill Factor	Work Hour (min/hr)
Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Top	992K	276,616	14	0.65	1,077	257	16	0.875	50
Load cover soil	North OB Stockpile, OB-5 Stockpile	Magnetite Tailings Outslopes	992K	25,739	14	0.65	1,077	24	16	0.875	50

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Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units (Equipment)	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)
Dozers-Earthmoving											
Cat D11T	Regrade Outslopes	Magnetite Tailings	Outslopes	$414.50	$26.29	1	61	$26,717	69,996	cy	$0.38
Cat D11T	Regrade Top	Magnetite Tailings	Top	$414.50	$26.29	1	116	$51,068	73,482	cy	$0.69
Cat D11T	Dozer Assist	Magnetite Tailings Top	Top	$414.50	$26.29	1	257	$113,220	256,126	cy	$0.44
Cat D11T	Dozer Assist	Magnetite Tailings Outslopes	Outslopes	$414.50	$26.29	1	24	$10,535	23,833	cy	$0.44
Dozers-Grading											
Cat D11T	Grade cover soil	Magnetite Tailings Top	-	$414.50	$26.29	1	137.2	$60,464	276,615.7	cy	$0.22
Cat D11T	Grade cover soil	Magnetite Tailings Outslopes	-	$414.50	$26.29	1	8.2	$3,629	25,739.1	cy	$0.14
Loaders											
992K	Load cover soil	North OB Stockpile, OB-5 Stc	Magnetite Tailings Top	$294.35	$26.56	1	257	$82,428	276,616	cy	$0.30
992K	Load cover soil	North OB Stockpile, OB-5 Stc	Magnetite Tailings Outslopes	$294.35	$26.56	1	24	$7,670	25,739	cy	$0.30
Trucks											
Cat 793 truck	Haul cover soil	North OB Stockpile, OB-5 Stc	Magnetite Tailings Top	$478.45	$23.84	2	257	$258,031	276,616	cy	$0.93
Cat 793 truck	Haul cover soil	North OB Stockpile, OB-5 Stc	Magnetite Tailings Outslopes	$478.45	$23.84	2	24	$24,010	25,739	cy	$0.93
Water Truck and Grader											
Off-Hwy Water Tanker Truck	Magnetite Tailings			$86.99	$23.84	1	281	$31,116			
Motor Grader	Magnetite Tailings			$99.13	$26.29	1	281	$35,213			
							Magnetite Tailings	$704,102			
							Earthwork Direct Cost	**$704,102**			

EQUIPMENT

Equipment Description	Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Owning and Operating Cost (w/out fuel) ($/hr)	Fuel-Adjusted Own/Op Cost ($/hr)	Reference
Cat D11T	$29.75	$63.77	$350.73	$414.50	1
Cat D11T Bulldozer w/ multi shank ripper	$29.75	$63.77	$385.12	$448.89	1
Cat 793 truck	$47.76	$102.37	$376.08	$478.45	1
Cat 992K Loader	$25.63	$54.94	$239.41	$294.35	1
Cat 16M	$9.50	$20.37	$113.57	$133.94	1
Cat 14M	$8.29	$17.76	$81.37	$99.13	1
Off-Hwy Water Tanker Truck,6,000-gal.	$11.25	$24.12	$62.87	$86.99	1

FUEL

Oil Broker Quote	$ 2.14	per gallon	2

LABOR

Labor Description	NMDOL Type A Operator Group	NMDOL Type A Operator Classification	Nominal Total Rate ($/hr)	
Cat D11T Bulldozer	Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat 793 truck	Truck Driver III	Haul Truck	$23.84	4
Cat 992K Loader	Equipment Operator VI	Loader (over 10 cy)	$26.56	4
Cat 16M	Equipment Operator IV	Motor Grader	$26.29	4
Cat 14M	Equipment Operator IV	Motor Grader	$26.29	4
Off-Hwy Water Tanker Truck,6,000-gal.	Truck Driver III	N/A	$23.84	4

References
0.00
References
1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect cost is removed from the all-inclusi

Revegetation Costs

Description:

Plow; apply fertilizer, seed mix, mulch, and crimp mulch

Unit or Disturbance	Area* (acres)	Unit Cost** ($/acre)	Direct Cost ($)
Magnetite Tailings Top	57	$856	$48,933
Magnetite Tailings Outslopes	5	$856	$4,553
		Revegetation Direct Cost	**$53,487**

*Borrow Area reclamation included in Cobre_Stockpiles_Tails_Other_2014.xlsx

Rocky Mountain Reclamation Quote April, 2018 (before taxes)

Other Reclamation Activity Costs

Stockpiles Area	Activity	Quantity	Unit	Unit Cost ($/unit)	Direct Cost ($)	Reference	Description
Magnetite Tailings	Downdrain Length	420	ft	$5.57	$2,339	Appendix B.2.8	Excavate and waste 7.6 cy/lf material on slopes with D11T CD, 175-foot downslope excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 3 passes 1 mph.
Magnetite Tailings	Downdrain Gravel, Haul	441	cy	$1.86	$820	Appendix B.2.8	Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
Magnetite Tailings	Downdrain Gravel, Backfill	441	cy	$1.43	$631	Appendix B.2.8	Gravel Backfill, 980G loader, 150' haul
Magnetite Tailings	Downdrain Riprap, Haul	1,806	cy	$1.86	$3,359	Appendix B.2.8	Load & Haul Rock, Cat 992 Loader, 2-Cat 793 trucks, 3-mile RT
Magnetite Tailings	Downdrain Riprap, Backfill	1,806	cy	$1.43	$2,583	Appendix B.2.8	Gravel Backfill, 980G loader, 150' haul
Magnetite Tailings	Riprap	1,806	cy	$40.00	$72,246	TG McCauley Inc March 2018, D50=15", see notes on "0 Unit Costs" tab	
Magnetite Tailings	Gravel	441	cy	$1.43	$631	Appendix B.2.8	Gravel Backfill, 980G loader, 150' haul
				Other Direct Cost:	**$82,608**		

References
See Appendix B.2.8 for Channel, Bench, and Downdrain unit rate development.

Cobre Mining Company

Magnetite Tailings Reclamation

Based on Projected EOY 2019 Mine Plan

			Current Value
DIRECT COSTS	Facility and Structure Removal		$0
	Earthmoving		$704,102
	Revegetation		$53,487
	Other		$82,608
	Subtotal, Direct Costs		**$840,196**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$31,927.46
	Contingencies	4.0%	$33,608
	Engineering Redesign Fee	2.5%	$21,005
	Contractor Profit and Overhead	15.0%	$126,029
	Project Management Fee	3.0%	$25,206
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$237,776**
TOTAL COST			**$1,077,972**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Reclamation Summary **5/17/2018**

DIRECT COSTS			Magnetite Tailings
	Facility and Structure Removal		$0
	Earthmoving		$704,102
	Revegetation		$53,487
	Other[1]		$82,608
	Subtotal, Direct Costs		**$840,196**
INDIRECT COSTS	Mobilization and Demobilization	3.8%	$31,927
	Contingencies	4.0%	$33,608
	Engineering Redesign Fee	2.5%	$21,005
	Contractor Profit and Overhead	15.0%	$126,029
	Project Management Fee	3.0%	$25,206
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$237,776**
GROSS RECEIPTS TAX	Grant County (unincorporated areas)	0.0%	**$0**
	(applied to sum of indirect and direct costs)		
TOTAL COST PER FACILITY			**$1,077,972**

[1]Other includes: channels and downdrains

Facility Characteristics

5/17/2018

Facility	**Magnetite Tailings**
Reclaimed Acres	62.5
<u>Item</u>	Capital Cost
Cover Material (Load, haul, spread)	$803,564
Regrade	$99,798
Seed & Mulch	$68,623
Other[1]	$105,986
Capital Cost Totals	$1,077,972
Capital Cost/Acre	$17,248

Capital Cost/Acre Cover	$12,857
Capital Cost/Acre Top/Outslope Adjustment	$1,597
Capital Cost/Acre Earthwork Total	$14,454
Capital Cost/Acre Reveg	$1,098
Capital Cost/Acre Other	$1,696

[1]Other includes channels and downdrains

Demolition Reclamation Cost Estimate

EOY 2023

Demolition

Description	Building Information				Building Demolition		
	Dimensions (ft)				Quantity	Unit Cost	Direct Cost
	Length	Width	Height	Diameter	(cft)	($/unit)	($)
Mill Building #2	197	140	70	-	1930600	$0.25	$479,252
Thickener MCC	18.0	18	12	-	3888	$0.25	$965
Thickener MCC	12.0	22	15	-	3960	$0.25	$983
No. 2 Mill Stacker	820	20	15	-	246000	$0.25	$61,067
Stacker Hoist	28	23	18	-	11592	$0.25	$2,878
No. 2 Mill Secondary Crusher Building	36	38	50	-	68400	$0.25	$16,980
Concentrate Storage Tank	-	-	50	30	35343	$0.25	$8,774
Mill Building #1 and Concentrator	160	140	70		1568000	$0.25	$389,240
Ore Bin (large)	-	-	90	30	63617	$0.25	$15,792
Ore Bin (large)	-	-	90	30	63617	$0.25	$15,792
Ore Bin (small)	-	-	70	30	49480	$0.25	$12,283
Primary Crusher	70	50	60		210000	$0.25	$52,130
Scale House (Guard Shack)	10	10	10		1000	$0.25	$248
Small Truck Shop	102	40	20		81600	$0.25	$20,256
Substation No. 2	66	50	30		99000	$0.25	$24,576
Thickener Tank (100-ft diam.)	-	-	14	100	109956	$0.25	$27,295
Thickener Tank (60-ft diam.)	-	-	20	60	56549	$0.25	$14,038
Water Tank (on Hanover Mountain)	-	-	30	25	14726	$0.25	$3,656
Water Tank (on Hanover Mountain)	-	-	50	35	48106	$0.25	$11,942
Magnetic Separator	15	20	14	-	4200	$0.25	$1,043
Pump House and Shed for Thickener	10	10	14	-	1400	$0.25	$348

Demo Total Direct Cost **$1,159,537**

Data Sources:

Item	**Base Unit Cost $/unit**	**Units**	**Location Adjustment New Mexico Las Cruces**	**Adjusted Unit Cost $/unit**	**Means Line Item**	**Means Page**	**Description**
Structure Demolition 1	$0.29	cft	85.6%	$0.248	024116.13 0100	37	Structure Demolition Building demolition large urban projects inclues 20 mi. haul no foundation or dump fees mixture of types

Quantities from: Telesto Solutions Inc, *Closure/Closeout Plan Earthwork Update Summary Report Revision II* , Prepared for: Cobre Mining Company, January 2
R.S. Means Heavy Construction Cost Data, 32nd Annual Edition, 2018

Amount					Disposal Site	Miles	Solid Pickup[1] (per Ton)			Transportation[2] (Per Mile Per Load)			Location Adjustment[3]	Total Cost
CY	Drums	Tons	Loads	Origin			Min cost	Max cost	Ave cost	Min cost	Max cost	Ave cost		
750	2400	540	30	Fierro, NM	Phoenix, AZ	337	$190.00	$595.00	$392.50	$3.95	$7.25	$5.60	85.6%	$229,892

	Means Line Item	Means Page	Description
1.	028120.10 1120 and 1130	44	Solid Pickup
2.	028120.10 1260 and 1270	44	Transportation to disposal site, truckload = 80 drums or 25 cu yd or 18 tons
3.	85.6%		Location RS Means Heavy Construction Cost Data (32nd Annual Edition, 2018) Las Cruces, NM

Demolition

Soil Cover Depth ft: 3

Description	Building Information						
	Dimensions (ft)				Quantity	Unit Cost	Direct Cost
	Length	Width	Height	Diameter	(cy)	($/unit)	($)
Mill Building #2	197	140	70	-	3064	$1.76	$5,392
Thickener MCC	18	18	12	-	36	$1.76	$63
Thickener MCC	12	22	15	-	29	$1.76	$52
No. 2 Mill Stacker	820	20	15	-	1822	$1.76	$3,206
Stacker Hoist	28	23	18	-	72	$1.76	$126
No. 2 Mill Secondary Crusher Building	36	38	50	-	152	$1.76	$267
Concentrate Storage Tank	-	-	50	30	3927	$1.76	$6,910
Mill Building #1 and Concentrator	160	140	70	0	2489	$1.76	$4,379
Ore Bin (large)	-	-	90	30	7069	$1.76	$12,437
Ore Bin (large)	-	-	90	30	7069	$1.76	$12,437
Ore Bin (small)	-	-	70	30	5498	$1.76	$9,673
Primary Crusher	70	50	60	0	389	$1.76	$684
Scale House (Guard Shack)	10	10	10	0	11	$1.76	$20
Small Truck Shop	102	40	20	0	453	$1.76	$798
Substation No. 2	66	50	30	0	367	$1.76	$645
Thickener Tank (100-ft diam.)	-	-	14	100	12217	$1.76	$21,496
Thickener Tank (60-ft diam.)	-	-	20	60	6283	$1.76	$11,055
Water Tank (on Hanover Mountain)	-	-	30	25	1636	$1.76	$2,879
Water Tank (on Hanover Mountain)	-	-	50	35	5345	$1.76	$9,405
Magnetic Separator	15	20	14	-	33	$1.76	$59
Pump House and Shed for Thickener	10	10	14	-	11	$1.76	$20

Demolition Cover Direct Cost: **$102,002**

Data Sources:

Item	Unit Cost $/unit	Means Line Item	Means Page	Description
Load and Haul cover material	$1.76	Assume same unit cost to haul and spread cover as for No. 3 Stockpile		

Demolition

Description	Building Information				Area (acres)
	Dimensions (ft)				
	Length	Width	Height	Diameter	
Mill Building #2	140	140	70	-	0.450
Thickener MCC	18	18	12	-	0.007
Thickener MCC	22	22	15	-	0.011
No. 2 Mill Stacker	20	20	15	-	0.009
Stacker Hoist	23	23	18	-	0.012
No. 2 Mill Secondary Crusher Building	38	38	50	-	0.033
Concentrate Storage Tank	-	-	50	30	0.005
Mill Building #1 and Concentrator	140	140	70	0	0.450
Ore Bin (large)	-	-	90	30	0.005
Ore Bin (large)	-	-	90	30	0.005
Ore Bin (small)	-	-	70	30	0.005
Primary Crusher	50	50	60	0	0.057
Scale House (Guard Shack)	10	10	10	0	0.002
Small Truck Shop	40	40	20	0	0.037
Substation No. 2	50	50	30	0	0.057
Thickener Tank (100-ft diam.)	-	-	14	100	0.057
Thickener Tank (60-ft diam.)	-	-	20	60	0.021
Water Tank (on Hanover Mountain)	-	-	30	25	0.004
Water Tank (on Hanover Mountain)	-	-	50	35	0.007
Magnetic Separator	20	20	14	-	0.009
Pump House and Shed for Thickener	10	10	14	-	0.002

Revegetation Area:	1.248	acres
Revegetation unit cost:	$856	$/acre
Demolition Reveg Direct Cost:	**$1,068**	

Data Sources:
Rocky Mountain Reclamation Quote April, 2018 (before taxes)

Reclamation Summary

Cobre Mining Company

Building Demolition
Based on Projected EOY 2019 Mine Plan

			Current Value
DIRECT COSTS	Facility and Structure Removal		$1,389,430
	Ripping & Revegetation		$1,068
	Cover		$102,002
	Subtotal, Direct Costs		**$1,492,500**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$56,715
	Contingencies	4.0%	$59,700
	Engineering Redesign Fee	2.5%	$37,313
	Contractor Profit and Overhead	15.0%	$223,875
	Project Management Fee	3.0%	$44,775
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$422,378**
TOTAL COST			**$1,914,878**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

R024119-10 Demolition Defined

Whole Building Demolition - Demolition of the whole building with no concern for any particular building element, component, or material type being demolished. This type of demolition is accomplished with large pieces of construction equipment that break up the structure, load it into trucks and haul it to a disposal site, but disposal or dump fees are not included. Demolition of below-grade foundation elements, such as footings, foundation walls, grade beams, slabs on grade, etc., is not included. Certain mechanical equipment containing flammable liquids or ozone-depleting refrigerants, electric lighting elements, communication equipment components, and other building elements may contain hazardous waste, and must be removed, either selectively or carefully, as hazardous waste before the building can be demolished.

Foundation Demolition - Demolition of below-grade foundation footings, foundation walls, grade beams, and slabs on grade. This type of demolition is accomplished by hand or pneumatic hand tools, and does not include saw cutting, or handling, loading, hauling, or disposal of the debris.

Gutting - Removal of building interior finishes and electrical/mechanical systems down to the load-bearing and sub-floor elements of the rough building frame, with no concern for any particular building element, component, or material type being demolished. This type of demolition is accomplished by hand or pneumatic hand tools, and includes loading into trucks, but not hauling, disposal or dump fees, scaffolding, or shoring. Certain mechanical equipment containing flammable liquids or ozone-depleting refrigerants, electric lighting elements, communication equipment components, and other building elements may contain hazardous waste, and must be removed, either selectively or carefully, as hazardous waste, before the building is gutted.

Selective Demolition - Demolition of a selected building element, component, or finish, with some concern for surrounding or adjacent elements, components, or finishes (see the first Subdivision (s) at the beginning of appropriate Divisions). This type of demolition is accomplished by hand or pneumatic hand tools, and does not include handling, loading, storing, hauling, or disposal of the debris, scaffolding, or shoring. "Gutting" methods may be used in order to save time, but damage that is caused to surrounding or adjacent elements, components, or finishes may have to be repaired at a later time.

Careful Removal - Removal of a piece of service equipment, building element or component, or material type, with great concern for both the removed item and surrounding or adjacent elements, components or finishes. The purpose of careful removal may be to protect the removed item for later re-use, preserve a higher salvage value of the removed item, or replace an item while taking care to protect surrounding or adjacent elements, components, connections, or finishes from cosmetic and/or structural damage. An approximation of the time required to perform this type of removal is 1/3 to 1/2 the time it would take to install a new item of like kind. This type of removal is accomplished by hand or pneumatic hand tools, and does not include loading, hauling, or storing the removed item, scaffolding, shoring, or lifting equipment.

Cutout Demolition - Demolition of a small quantity of floor, wall, roof, or other assembly, with concern for the appearance and structural integrity of the surrounding materials. This type of demolition is accomplished by hand or pneumatic hand tools, and does not include saw cutting, handling, loading, hauling, or disposal of debris, scaffolding, or shoring.

Rubbish Handling - Work activities that involve handling, loading or hauling of debris. Generally, the cost of rubbish handling must be added to the cost of all types of demolition, with the exception of whole building demolition.

Minor Site Demolition - Demolition of site elements outside the footprint of a building. This type of demolition is accomplished by hand or pneumatic hand tools, or with larger pieces of construction equipment, and may include loading a removed item onto a truck (check the Crew for equipment used). It does not include saw cutting, hauling or disposal of debris, and, sometimes, handling or loading.

R024119-20 Dumpsters

Dumpster rental costs on construction sites are presented in two ways.

The cost per week rental includes the delivery of the dumpster; its pulling or emptying once per week, and its final removal. The assumption is made that the dumpster contractor could choose to empty a dumpster by simply bringing in an empty unit and removing the full one. These costs also include the disposal of the materials in the dumpster.

The Alternate Pricing can be used when actual planned conditions are not approximated by the weekly numbers. For example, these lines can be used when a dumpster is needed for 4 weeks and will need to be emptied 2 or 3 times per week. Conversely the Alternate Pricing lines can be used when a dumpster will be rented for several weeks or months but needs to be emptied only a few times over this period.

R024119-30 Rubbish Handling Chutes

To correctly estimate the cost of rubbish handling chute systems, the individual components must be priced separately. First choose the size of the system; a 30-inch diameter chute is quite common, but the sizes range from 18 to 36 inches in diameter. The 30-inch chute comes in a standard weight and two thinner weights. The thinner weight chutes are sometimes chosen for cost savings, but they are more easily damaged.

There are several types of major chute pieces that make up the chute system. The first component to consider is the top chute section (top intake hopper) where the material is dropped into the chute at the highest point. After determining the top chute, the intermediate chute pieces called the regular chute sections are priced. Next, the number of chute control door sections (intermediate intake hoppers) must be determined. In the more complex systems, a chute control door section is provided at each floor level. The last major component to consider is bolt down frames; these are usually provided at every other floor level.

There are a number of accessories to consider for safe operation and control. There are covers for the top chute and the chute door sections. The top chute can have a trough that allows for better loading of the chute. For the safest operation, a chute warning light system can be added that will warn the other chute intake locations not to load while another is being used. There are dust control devices that spray a water mist to keep down the dust as the debris is loaded into a Dumpster. There are special breakaway cords that are used to prevent damage to the chute if the Dumpster is removed without disconnecting from the chute. There are chute liners that can be installed to protect the chute structure from physical damage from rough abrasive materials. Warning signs can be posted at each floor level that is provided with a chute control door section.

In summary, a complete rubbish handling chute system will include one top section, several intermediate regular sections, several intermediate control door (intake hopper) sections and bolt down frames at every other floor level starting with the top floor. If so desired, the system can also include covers and a light warning system for a safer operation. The bottom of the chute should always be above the Dumpster and should be tied off with a breakaway cord to the Dumpster.

Operations & Maintenance Reclamation Cost Estimate

Vegetation Maintenance Costs

Location	Total Area (acres)	Reclamation Complete	Veg Maintenance Complete	# yrs veg Maint.	Percent loss per year	Quantity	Unit	Unit Cost* ($/unit)	Item Cost ($)	Description
Stockpiles and Tailings	971	0	11	12	2%	19.4	acres	$891	$207,672	2% of veg fails every year for 12 years.
Building Demolition	1.25	0	11	12	2%	0.02	acres	$891	$267	2% of veg fails every year for 12 years.

Vegetation Maintenance Total Direct Cost: $207,939
Vegetation Maintenance Total Cost (with indirects): $256,388

Notes:
Reclamation Start Date: Dec-19

Rocky Mountain Reclamation Quote April, 2018 (before taxes)
891 $/acre

Operations & Maintenance

Overall Site

EROSION CONTROL AND MONITORING[1]

	Years 0-12	Years 13-39	Years 40-99	
Base:	$3,860.57	$3,860.57	$3,860.57	$/day
Time:	12	4	1	day/yr
Annual:	$46,326.87	$15,442.29	$3,860.57	$/yr

ROAD MAINTENANCE [2]

	Years 0-19	Years 20-39	Years 40-99	
Base:	$7,421.08	$7,421.08	$7,421.08	$/month
Time:	4	2	1	months/yr
Annual:	$29,684.33	$14,842.16	$7,421.08	$/yr

Year	Annual Current Cost ($)		Year	Annual Current Cost ($)		Total Reclaimed Area per Year (acres)	Percent Reclaimed
0	$0	Weighted based on total reclaimed area	0	$0	Weighted based on total reclaimed area	0	0%
1	$0	Weighted based on total reclaimed area	1	$0	Weighted based on total reclaimed area	0	0%
2	$7,721	Weighted based on total reclaimed area	2	$4,947	Weighted based on total reclaimed area	162	17%
3	$15,442	Weighted based on total reclaimed area	3	$9,895	Weighted based on total reclaimed area	324	33%
4	$23,163	Weighted based on total reclaimed area	4	$14,842	Weighted based on total reclaimed area	486	50%
5	$30,885	Weighted based on total reclaimed area	5	$19,790	Weighted based on total reclaimed area	648	67%
6	$38,606	Weighted based on total reclaimed area	6	$24,737	Weighted based on total reclaimed area	810	83%
7	$46,327	Weighted based on total reclaimed area	7	$29,684	Weighted based on total reclaimed area	972	100%
8	$46,327		8	$29,684			100%
9	$46,327		9	$29,684			100%
10	$46,327		10	$29,684			100%
11	$46,327		11	$29,684			100%
12	$46,327		12	$29,684			100%
13	$15,442		13	$29,684			
14	$15,442		14	$29,684			
15	$15,442		15	$29,684			
16	$15,442		16	$29,684			
17	$15,442		17	$29,684			
18	$15,442		18	$29,684			
19	$15,442		19	$29,684			
20	$15,442		20	$14,842			
21	$15,442		21	$14,842			
22	$15,442		22	$14,842			
23	$15,442		23	$14,842			
24	$15,442		24	$14,842			
25	$15,442		25	$14,842			
26	$15,442		26	$14,842			
27	$15,442		27	$14,842			
28	$15,442		28	$14,842			
29	$15,442		29	$14,842			
30	$15,442		30	$14,842			
31	$15,442		31	$14,842			
32	$15,442		32	$14,842			
33	$15,442		33	$14,842			
34	$15,442		34	$14,842			
35	$15,442		35	$14,842			
36	$15,442		36	$14,842			
37	$15,442		37	$14,842			
38	$15,442		38	$14,842			
39	$15,442		39	$14,842			
40	$3,861		40	$7,421			
41	$3,861		41	$7,421			
42	$3,861		42	$7,421			
43	$3,861		43	$7,421			
44	$3,861		44	$7,421			
45	$3,861		45	$7,421			
46	$3,861		46	$7,421			
47	$3,861		47	$7,421			
48	$3,861		48	$7,421			
49	$3,861		49	$7,421			
50	$3,861		50	$7,421			
51	$3,861		51	$7,421			
52	$3,861		52	$7,421			
53	$3,861		53	$7,421			
54	$3,861		54	$7,421			
55	$3,861		55	$7,421			
56	$3,861		56	$7,421			
57	$3,861		57	$7,421			
58	$3,861		58	$7,421			
59	$3,861		59	$7,421			
60	$3,861		60	$7,421			
61	$3,861		61	$7,421			
62	$3,861		62	$7,421			
63	$3,861		63	$7,421			
64	$3,861		64	$7,421			
65	$3,861		65	$7,421			
66	$3,861		66	$7,421			
67	$3,861		67	$7,421			
68	$3,861		68	$7,421			
69	$3,861		69	$7,421			
70	$3,861		70	$7,421			
71	$3,861		71	$7,421			
72	$3,861		72	$7,421			
73	$3,861		73	$7,421			
74	$3,861		74	$7,421			
75	$3,861		75	$7,421			
76	$3,861		76	$7,421			
77	$3,861		77	$7,421			
78	$3,861		78	$7,421			
79	$3,861		79	$7,421			
80	$3,861		80	$7,421			
81	$3,861		81	$7,421			
82	$3,861		82	$7,421			

Operations & Maintenance
Overall Site

EROSION CONTROL AND MONITORING[1]

	Years 0-12	Years 13-39	Years 40-99	
Base:	$3,860.57	$3,860.57	$3,860.57	$/day
Time:	12	4	1	day/yr
Annual:	$46,326.87	$15,442.29	$3,860.57	$/yr

ROAD MAINTENANCE [2]

	Years 0-19	Years 20-39	Years 40-99	
Base:	$7,421.08	$7,421.08	$7,421.08	$/month
Time:	4	2	1	months/yr
Annual:	$29,684.33	$14,842.16	$7,421.08	$/yr

Year	Annual Current Cost ($)	Year	Annual Current Cost ($)	Total Reclaimed Area per Year (acres)	Percent Reclaimed
83	$3,861	83	$7,421		
84	$3,861	84	$7,421		
85	$3,861	85	$7,421		
86	$3,861	86	$7,421		
87	$3,861	87	$7,421		
88	$3,861	88	$7,421		
89	$3,861	89	$7,421		
90	$3,861	90	$7,421		
91	$3,861	91	$7,421		
92	$3,861	92	$7,421		
93	$3,861	93	$7,421		
94	$3,861	94	$7,421		
95	$3,861	95	$7,421		
96	$3,861	96	$7,421		
97	$3,861	97	$7,421		
98	$3,861	98	$7,421		
99	$3,861	99	$7,421		
SubTotal Costs (with indirects):	$1,042,355		$1,202,215		

O&M Total Costs (with indirects): $2,244,570

[1] Erosion Control
Modified Crew B-13A (1 Labor Foreman, 2 laborers, 2 equip. operators (med.), 2 truck drivers (heavy), 1 crawler loader (4 cy), 2 dump trucks (8 cy, 220 HP)
RS Means Heavy Construction Cost Data (28th Annual Edition, 2014)

	#	$/hour	$/day
Labor Foreman (outside)	1	$23.48	$187.84
Laborers	2	$22.73	$363.68
Equipment Operators lmed.l	1	$26.56	$212.48
Truck Drivers (heavy)	2	$23.84	$381.44
		$/hour	$/day
Loader,980G	1	$81.48	$651.84
Dump Trucks, Cat730	2	$83.36	$1,333.76

Subtotal $3,131 $/day

Total Direct Cost $3,131 $/day
Indirect Cost Percentage 23.30%
Total Cost $3,861 $/day

[2] Road Maintenance Crew
Equipment - Equipment Watch Version 6.14.0B
Labor - NM Department of Labor Type H (Heavy Engineering) labor rates.
See Attachments for rate development.

	Operating Cost ($/hr)	Labor Rate ($/hr)	Subtotal 24 hrs/month ($/month)
Cat 14M Motor Grader	$107.79	$26.29	$3,217.92
6,000-gal Water Truck	$92.86	$23.84	$2,800.80

Total Direct Cost $6,019 $/month
Indirect Cost Percentage 23.30%
Total Cost $7,421 $/month

Cobre Mining Company

Operations and Maintenance
Based on Projected EOY 2019 Mine Plan

			Current Value
DIRECT COSTS	Facility and Structure Removal		$0
	Earthmoving		$0
	Revegetation		$207,939
	Other		$1,820,413
	Subtotal, Direct Costs		**$2,028,352**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$77,077
	Contingencies	4.0%	$81,134
	Engineering Redesign Fee	2.5%	$50,709
	Contractor Profit and Overhead	10.0%	$202,835
	Project Management Fee	3.0%	$60,851
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	23.3%	
	Subtotal, Indirect Costs		**$472,606**
TOTAL COST			**$2,500,958**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Earthwork O&M Cost Summary				
Period (years)	Erosion Control	Road Maintenance	Revegetation Maintenance	Total (Current Year $)
Overall Site				
0 to 19	$501,874	$460,107	$256,388	$1,218,370
20 to 39	$308,846	$296,843	$0	$605,689
40 to 99	$231,634	$445,265	$0	$676,899
Totals	**$1,042,355**	**$1,202,215**	**$256,388**	**$2,500,958**
CHR*				
0 to 11	$65,630	-	$26,364	$91,994
Totals	**$1,107,985**	**$1,202,215**	**$282,752**	**$2,592,952**

*From Cobre_CHR_RCE_03102016_NOBS_20180519.xlsx

Total Earthwork O&M Cost: Direct/Indirect by time period				
		Direct	Indirect	Total
Overall Site				
0 to 19		$988,134	$230,235	$1,218,370
20 to 39		$491,232	$114,457	$605,689
40 to 99		$548,986	$127,914	$676,899
Totals		**$2,028,352**	**$472,606**	**$2,500,958**
CHR[2]				
0 to 11		$74,610	$17,384	$91,994
Totals		**$2,102,962**	**$489,990**	**$2,592,952**

Water Management Unit Rates and Reclamation Cost Estimate

Water Treatment Unit Costs

	Activity	Base[1] Unit Cost $/unit	Units	Scaled Cost Las Cruces 85.6%[2]	Means Line Item	Means Page	Reference
1	Utility Pole Demo	$214.50	ea	$183.61	02 41 13.80 0100	36	Professional Judgment 15 to 30 gpm - includes pump control, control panel, installation, and flow meter.
2	Cross Arm Demo	$93.00	ea	$79.61	02 41 13.80 0300	36	Professional Judgment 50 gpm - includes pump control, control panel, installation, and flow meter.
3	Wood Electrical Utility Poles a.)	$696.5	ea	$596	33 71 16.33 6020	399	Professional Judgment 100 to 700 gpm - includes pump control, control panel, installation, and flow meter.
4	Utility Pole Installation b.)	$1,259	ea	$1,078	33 71 16.23 6010	398	Professional Judgment 800 to 2000 gpm - includes pump control, control panel, installation, and flow meter.
5	Utility Pole Installation c.)	$1.95	ea	$1.67	33 71 16.33 9000	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 3/4"-4" diameter
6	Utility Pole Installation d.)	$335.00	ea	$287	33 71 16.33 7600	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 6"-8" diameter
7	Electrical Wiring Installation a.)	$579.00	wire mi	$496	33 71 39.13 0110	402	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 10"-18" diameter
8	Electrical Wiring Installation b.)	$15,295.00	wire mi	$13,093	33 71 39.13 0150	402	Selective Demo, utility poles, wood, 20'-30' high
9	Electrical Wiring Installation c.)	$309.00	wire mi	$265	33 71 39.13 0810	403	Selective Demo, cross arms, wood, 4'-6' long
10	Potential Transformers	$5,261.00	ea	$4,503	33 71 26.26 4100	402	Steel Pipe Schedule 40, black 24" diameter (221113.48 1210) without coupling and hanger
11	Pipe Removal	$1.95	lf	$1.67	02 41 13.38-1600	29	Membrane lining, 2X60 mil thick
12	Pipe Removal	$2.73	lf	$2.34	02 41 13.38-1700	29	Assume similar to 10' high 33 degree slope concrete retaining wall, cast concrete reinforced concrete cantilever, including excavation, backfill & reinforced.
13	Pipe Removal	$4.53	lf	$3.88	02 41 13.38-1800	29	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 4" diameter
14	Excavation of Soil	$8.28	cy	$7.088	G1030 120 1600	498	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 6" diameter
15	Reservoir Liners HDPE	$2.74	sf	$2.34544	31 05 19.53 1200	218	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 8" diameter
16	Small Concrete Dam	$92,125	ea	$78,859	32 32 13.10 3100	323	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 10" diameter
17	Water Treatment Tank	$295,500	ea	$252,948	33 16 23.13 1000	358	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 12" diameter
18	Pump	$10,000	ea	$10,298.21	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 14" diameter
19	Pump	$15,000	ea	$15,447.32	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 16" diameter
20	Pump	$25,000	ea	$25,745.53	-	-	250,000 gallon steel tank, not including foundation., height/diameter Less than 1
21	Pump	$30,000	ea	$30,894.63	-	-	Digging holes in rock
22	Water Supply Piping	$8.81	lf	$7.54	33 14 13.35 0100	352	Wood, class 1 type C, CCA/ACA-treated, 30' high, excludes excavation, backfill and cast-in-place concrete
23	Water Supply Piping	$12.29	lf	$10.52	33 14 13.35 0200	352	Cross arms 4' long, includes hardware and insulators
24	Water Supply Piping	$16.74	lf	$14.33	33 14 13.35 0300	352	Disposal of pole and hardware surplus material, assumes 100 feet of wire per pole
25	Water Supply Piping	$19.93	lf	$17.06	33 14 13.35 0400	352	13 to 26 kV
26	Water Supply Piping	$22.73	lf	$19.46	33 14 13.35 0500	352	Material handling and spotting-conductors, primary circuits
27	Water Supply Piping	$33.55	lf	$28.72	33 14 13.35 0600	352	Conductors, per wire, 210-636 kcmil
28	Water Supply Piping	$41.15	lf	$35.22	33 14 13.35 0700	352	Disposal of surplus material, high voltage conductors
29	Facility Water Distribution Piping	$218.35	lf	$187	22 11 13.48 1780 and 1210	168	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mi round trip. This value removes the overhead and profit (34% based on RS Means Crews O&P markup)
30	Electric Rate	$0.0502	kWh	0.0502	-	-	Industrial rate date looked up 3/01/2018 (http://www.electricitylocal.com/states/new-mexico/silver-city/) Subtracting indirect costs
31	Pump Removal Cost	$5,000	ea	$5,149.11	-	-	Engineering Judgment
32	Electric Panel Cost	$10,000	ea	$10,298.21	-	-	Engineering Judgment
33	Diesel Fuel Cost ($/gal)	$2.350	gal	$2.350	-	-	Griffin Propane verbal Quote, Silver City, NM (March, 2018) less indirect cost of 17% .
34	Environmental Sampler	$60	hr	$61.79	-	-	Engineering Judgment
35	Environmental Sampling Reviewer	$70	hr	$72.09	-	-	Engineering Judgment
36	Environmental Sampling	$239	sample	$239.32	-	-	23 Constituents. Energy Laboratories, Inc., Quote March 2018 (www.energylab.com).
37	Shipping Environmental Sampling	$59.83	cooler	$59.83	-	-	Overnight FedEx $70 for a 10 lb. package 30”x18”x18” Silver City, NM to Casper, WY Energy Labs

38 Description Notes:

39 1) Overhead and Profit are added in with the indirect costs.

40 2) City Cost Index Las Cruces-Total 85.6% (weighted average) R.S. Means Heavy Construction Cost Data, 32nd Annual Edition, 2018, pg. 21.

41 3) Griffin's Propane verbal quote March 12, 2018 of $ 2.75/gal from which the indirect costs are then subtracted.

42 4) https://edzarenski.com/2016/10/24/construction-inflation-index-tables-2017/ Inflation Adjustment 2014 to 2018 1.0298

Water Management Cost Estimate

Variables

Description	**Variable**
2018 RSMeans NM Discount Rate	0.856
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
Spreadsheet Year (2014)	-6
Reclamation Start Year (2020)	0
Reclamation Finished	5
Vegetation Established Assume stormwater released	12

Ponds / 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 ($/ea)**	**Direct Cost New and Replacement ($)**	**Direct Cost Maintenance Ponds Closed Post Closure ($/yr)**	**Direct Cost Maintenance Ponds Closed Post Closure ($)**	**Direct Cost ($)**
SWRF Dam 1 (181-2003-Dam 1)	concrete dar	1,116,800	5,530	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
SWRF Dam 2 (181-2003-Dam 2)	concrete dar	827,700	4,098	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
SWRF Dam 3 (181-2003-Dam 3)	concrete dar	2,925,300	14,485	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
Decant Pond #4	HDPE lined	972,500	4,815.310	0.62	19	25	12	5	1	$138,064	$138,064	$2,071	$26,922	$164,986
Upper Creek Containment Pond #1	HDPE lined	1,879,200	9,304.813	1.29	0	6	12	-	0	$285,575	$0	$4,284	$55,687	$55,687
Grape Gulch Pond #3	HDPE lined	911,600	4,513.765	0.38	29	35	12	0	1	$88,311	$88,311	$1,325	$17,221	$105,532
Blackman's Seep (Pond #2)	unlined	25,000	123.787	-	29	35	9	0	1	$292	$292	$4.39	$43.87	$336
Surge Tank***	steel	352,500	1,745.395	-	49	55	12	0	1	$252,948	$252,948	$3,794	$49,325	$302,273
Magnetite Seepage Pond	HDPE lined	9,600	47.534	0.20	29	35	12	0	1	$40,979	$40,979	$615	$7,991	$48,970
East WRF Containment	concrete	900,000	4,456.328	0.50	-1	5	12	-	0	$112,696	$0	$1,690	$21,976	$21,976
									Direct Annual Costs:	-	-	$17,332	-	-
									Direct Cost Subtotals:	-	$520,595	-	$225,298	**$745,893**

*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.

Water Management Cost Estimate

$$H_f = \frac{10.44 Q^{1.85}}{C^{1.85} D_i^{4.865}}$$

Pumps

From	To	Number	Age Today (yr)	Age at Reclamation (yr)	Removal Year (yr)	First Replacement Year (yr)	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	0	1	1760	6650	6719	61	130	82	61	120.9	0	$61,789
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	2	15	21	12	0	1	1940	6613	6715	54	156	109	81	48.7	0	$61,789
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	2	15	21	12	0	1	940	6556	6745	11	200	68	51	96.9	0	$51,491
Decant Pond #4	Booster Pump 2	2	24	30	12	0	1	3000	6688	6700	1	13	14	10	0	18001800	$51,491
Booster Pump 2	Surge Tank	2	24	30	12	0	1	3000	6700	6925	10	235	254	189	0	0	$51,491
Decant Pond #4	Reclaim Pond	2	24	30	5	0	1	1760	6688	7000	31	343	218	162	0	0	$61,789
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	1	24	30	5	0	1	100	6670	6695	0	25	1	1	0	146643	$15,447
Magnetite Seepage Pond	Decant Pond #4	2	24	30	12	0	1	100	6695	6750	7	62	2	2	13.1	0	$30,895
Estrada Seep	Decant Pond #4	2	9	15	5	5	1	45	6575	6688	19	132	2	2	0	762541	$20,596
Union Hill Adit Seep	Decant Pond #4	2	9	15	5	5	1	30	6575	6688	96	209	2	2	0	169454	$20,596
Upper Creek Containment Pond #1	Surge Tank	2	24	30	12	0	1	1980	6810	6925	358	473	338	252	53.7	0	$61,789
Grape Gulch Pond #3	Surge Tank	2	24	30	12	0	1	1100	6775	6925	14	164	65	49	6.5	0	$61,789
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	1	24	30	9	0	1	125	6775	6810	0	35	2	1	0	0	$15,447
Surge Tank	Reclaim Pond	2	10	16	9	4	1	3497	6925	7000	26	101	128	95	0	0	$61,789
Reclaim Pond	Surge Tank	1	10	16	5	4	1	1240	7000	7010	46	56	25	19	316.1	0	$30,895
East WRF Containment	Decant Pond #4	2	-1	5	12	-	0	2000	6560	6688	70	198	143	106	69.8	423634	$20,596
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)

From	To	Post Closure Pre Completed Reclamation (Through Reclamation Year 5)					Post Closure Post Completed Reclamation (Reclamation Year 6 to 12)										
		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 ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**	**Direct Cost Electricity and Fuel ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 3 (181-2003-Dam 3)	5,821,936	55.1	3,381	170	1,018	305,888	3	178	$9	$62	$61,789	$927	$12,049	$10,298	$84,136	$1,080
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	2,345,147	20.1	1,636	82	492	123,216	1	86	$4	$30	$61,789	$927	$12,049	$10,298	$84,136	$523
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	12,833,300	227.5	11,520	578	3,468	8,412,249	149	7,552	$379	$2,652	$51,491	$772	$10,041	$10,298	$71,830	$6,120
Decant Pond #4	Booster Pump 2	23,496,119	130.5	1,317	66	397	5,494,319	31	308	$15	$108	$51,491	$772	$10,041	$10,298	$71,830	$505
Booster Pump 2	Surge Tank	23,496,119	130.5	24,734	1,241	7,446	23,496,119	131	24,734	$1,241	$8,687	$51,491	$772	$10,041	$10,298	$71,830	$16,132
Decant Pond #4	Reclaim Pond	0	0.0	0	0	0	0	0	0	$0	$0	$61,789	$927	$5,561	$10,298	$77,649	$0
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	146,643	24.4	17	1	5	146,643	24	17	$1	$0	$15,447	$232	$1,390	$5,149	$21,987	$5
Magnetite Seepage Pond	Decant Pond #4	777,473	129.6	216	11	65	179,787	30	50	$3	$18	$30,895	$463	$6,024	$10,298	$47,217	$82
Estrada Seep	Decant Pond #4	762,541	282.4	450	23	135	0	0	0	$0	$0	$20,596	$309	$1,854	$10,298	$32,748	$135
Union Hill Adit Seep	Decant Pond #4	169,454	94.1	159	8	48	0	0	0	$0	$0	$20,596	$309	$1,854	$10,298	$32,748	$48
Upper Creek Containment Pond #1	Surge Tank	2,585,922	21.8	5,485	275	1,651	135,866	1	288	$14	$101	$61,789	$927	$12,049	$10,298	$84,136	$1,752
Grape Gulch Pond #3	Surge Tank	313,007	4.7	231	12	69	16,446	0	12	$1	$4	$61,789	$927	$12,049	$10,298	$84,136	$74
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	0	0.0	0	0	0	0	0	0	$0	$0	$15,447	$232	$2,317	$5,149	$22,914	$0
Surge Tank	Reclaim Pond	0	0.0	0	0	0	0	0	0	$0	$0	$61,789	$927	$9,268	$10,298	$81,356	$0
Reclaim Pond	Surge Tank	15,221,786	204.6	-	481	2,885	799,763	11	25	$1	$0	$30,895	$463	$2,781	$5,149	$38,824	$2,885
East WRF Containment	Decant Pond #4	3,784,851	31.5	3,359	169	1,011	176,601	1	157	$8	$55	$0	$309	$4,016	$10,298	$14,315	$1,066
tailings pipeline flushing																$0	$0
Mill No 1	Tailings Impoundment Top	5,764,479	22.2	4,865								$244				$244	$0
Mill No 2	Tailings Impoundment Top	6,800,790	26.2	1,928								$97				$97	$0
	Direct Annual Costs:	-	-	-	$3,115	-	-	-	-	$1,676	-	-	$10,195	-	-	-	-
	Direct Cost Subtotals:	-	-	-	-	$18,691	-	-	-	-	$11,717	$659,426.27	-	$113,383.30	$149,324.06	**$922,134**	**$30,408.18**

Water Management Cost Estimate

Pipelines

From	To	Material	Length (ft)	Inside Diameter (in)	Age Today (yr)	Age at Reclamation (yr)	Removal Year (yr)	Reclamation Replacement Year (yr)	Number of Replacements	Direct Cost New and Replacement ($/ft)	Direct Cost Removal ($/ft)	Direct Cost New and Replacement ($/ea)	**Direct Cost New and Replacement ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 3 (181-2003-Dam 3)	HDPE	4,466	10	15	21	12	-	0	$17.06	$3.32	$76,190	$0	$762	$9,905	$14,824	$24,728.71
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	HDPE	3,300	10	15	21	12	-	0	$17.06	$3.32	$56,298	$0	$563	$7,319	$10,954	$18,272.44
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	HDPE	220	6	15	21	12	-	0	$10.52	$2.00	$2,314	$0	$23	$301	$440	$740.96
Decant Pond #4	Booster Pump 2	HDPE	100	15	24	30	12	-	0	$35.22	$3.32	$3,522	$0	$35	$458	$332	$789.85
Booster Pump 2	Surge Tank	HDPE	1,936	15	24	30	12	-	0	$35.22	$3.32	$68,194	$0	$682	$8,865	$6,426	$15,291.43
Decant Pond #4	Reclaim Pond	HDPE	5,502	12	24	30	5	-	0	$19.46	$3.32	$107,052	$0	$1,071	$6,423	$18,263	$24,685.86
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	HDPE	200	5	24	30	5	-	0	$10.52	$2.00	$2,104	$0	$21	$126	$400	$526.32
Magnetite Seepage Pond	Decant Pond #4	HDPE	1,188	4	24	30	12	-	0	$7.54	$1.43	$8,959	$0	$90	$1,165	$1,697	$2,862.14
Estrada Seep	Decant Pond #4	HDPE	3,470	3	24	30	5	-	0	$7.54	$1.43	$26,169	$0	$262	$1,570	$4,958	$6,528.17
Union Hill Adit Seep	Decant Pond #4	HDPE	5,250	2	24	30	5	-	0	$7.54	$1.43	$39,592	$0	$396	$2,376	$7,501	$9,876.91
Upper Creek Containment Pond #1	Surge Tank	HDPE	1,770	6	24	30	12	-	0	$10.52	$2.00	$18,621	$0	$186	$2,421	$3,541	$5,961.36
Upper Creek Containment Pond #1	Surge Tank	HDPE	1,770	8	24	30	12	-	0	$14.33	$2.00	$25,363	$0	$254	$3,297	$3,541	$6,837.86
Grape Gulch Pond #3	Surge Tank	HDPE	861	8	24	30	12	-	0	$14.33	$2.00	$12,338	$0	$123	$1,604	$1,722	$3,326.21
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	HDPE	100	5	24	30	9	-	0	$10.52	$2.00	$1,052	$0	$11	$105	$200	$305.24
Surge Tank	Bullfrog pipeline *	HDPE	31,850	8	7	13	12	-	0	$14.33	-	$456,393	$0	$4,564	$59,331	$0	$59,331.05
Surge Tank	Reclaim Pond	HDPE	3,923	15	24	30	9	-	0	$28.72	$3.32	$112,664	$0	$1,127	$11,266	$13,022	$24,287.98
Reclaim Pond	Surge Tank	HDPE	3,855	9	24	30	5	-	0	$14.33	$3.32	$55,240	$0	$552	$3,314	$12,796	$16,110.28
East WRF Containment	Decant Pond #4	HDPE	4,073	10	3	9	12	-	0	$17.06	$3.32	$69,486	$0	$695	$9,033	$13,519	$22,552.63
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:	-	$11,416	-	-	-
												Direct Cost Subtotals:	$0	-	$128,879	$114,136	**$243,015**

*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 Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 2 (181-2003-Dam 2)	1,166	13	12.0	$25,510.38	$3,059.13	2	$9,007	$20,596	$58,173	$873	$11,343.69	$3,422	$14,766
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	3,300	34	12.0	$66,719.46	$8,657.91	2	$9,007	$20,596	$104,981	$1,575	$20,471.22	$8,949	$29,421
SWRF Dam 3 (181-2003-Dam 3)	Road	220	4	12.0	$7,849.35	$577.19	2	$9,007	$20,596	$38,030	$570	$7,415.81	$1,053	$8,469
Decant Pond #4	Surge Tank	2,036	22	12.0	$43,171.41	$5,341.67	2	$9,007	$20,596	$78,116	$1,172	$15,232.68	$5,791	$21,024
Upper Creek Containment Pond #1, Grape Gulch Pond #3, and Blackman's Seep (Pond #2)	Office Area	582	7	12.0	$13,736.36	$1,526.94	1	$4,503	$10,298	$30,065	$451	$5,862.66	$1,843	$7,705
Surge Tank	Upper Creek Containment Pond 1	1,770	19	12.0	$37,284.40	$4,643.79	1	$4,503	$10,298	$56,730	$851	$11,062.31	$5,001	$16,063
Magnetite Tailings Seepage Pond	Decant Pond #4	1,188	13	5.0	$25,510.38	$3,116.85	1	$4,503	$10,298	$43,429	$651	$3,908.60	$3,422	$7,330
Estrada Seep	Road	500	6	5.0	$11,774.02	$1,311.80	1	$4,503	$10,298	$27,887	$418	$2,509.87	$1,579	$4,089
Union Hill Adit Seep	Road	727	9	5.0	$17,661.03	$1,907.36	1	$4,503	$10,298	$34,370	$516	$3,093.30	$2,369	$5,462
East WRF Containment	Decant Pond #4	4,582	47	12.0	$92,229.84	$12,021.37	1	$4,503	$10,298	$119,053	$1,786	$23,215.30	$12,371	$35,587
Office Area	Road	2,327	25	12.0	$49,058.43	$6,105.13	1	$4,503	$10,298	$69,965	$1,049	$13,643.21	$6,581	$20,224
									Direct Annual Costs:	-	$9,912		-	-
									Direct Cost Subtotals:	-	-	$117,758.66	$52,380.78	**$170,139**

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	$ 60	$ 9	$ 239	$ 248	1.0	0.5	$ 60	0.1	$ 70	$ 100	$ 348

[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	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	$ 348	$ 9,744
5 - 12		1			4			2		7	2	$ 348	$ 4,872
12-99			1			4			2	7	1	$ 348	$ 2,436
												Total Cost Years 0-99	**$ 297,192**

Energy Labs Unit Rates:
23 Constituents. Energy Laboratories, Inc., Quote March 2018 (www.energylab.com).

Alkalinity Total as CaCO3	$ 10.00
Anions by Ion Chromatography	$ 30.00
Chloride	
Fluoride	
Sulfate	
Total Dissolved Solids	$ 20.00
Nitrogen - Nitrate+Nitrite as N	$ 45.00
Metals by ICP/ICPMS, total	$ 160.00
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

Capital Indirect Costs Percentage	28.3%
O&M Indirect Costs Percentage	17%
Electricity, Fuel, and Environmental Sampling Indirect Costs Percentage	17%

PONDS & TANKS			PUMPS					PIPELINES				ELECTRICAL INFRASTRUCTURE			ENVIROMENTAL SAMPLING		
Year	Capital Annual Cost	O&M Annual Cost ($)	Year	Capital Annual Cost	Removal Annual Cost	Electricity and Fuel Annual Cost ($)	O&M Annual Cost ($)	Year	Capital Annual Cost	Removal Annual Cost	Maintenance Annual Cost ($)	Year	Removal Annual Cost	Maintenance Annual Cost ($)	Year	Annual Cost ($)	Total Cash Flow ($)
0	$490,787	$20,278	0	$674,280	$0	$3,645	$11,928	0	$0	$0	$13,356	0	$0	$11,597	0	$11,400	$1,237,272
1	$0	$20,278	1	$0	$0	$3,645	$11,928	1	$0	$0	$13,356	1	$0	$11,597	1	$11,400	$72,205
2	$0	$20,278	2	$0	$0	$3,645	$11,928	2	$0	$0	$13,356	2	$0	$11,597	2	$11,400	$72,205
3	$0	$20,278	3	$0	$0	$3,645	$11,928	3	$0	$0	$13,356	3	$0	$11,597	3	$11,400	$72,205
4	$0	$20,278	4	$118,913	$0	$3,645	$11,928	4	$0	$0	$13,356	4	$0	$11,597	4	$11,400	$191,118
5	$177,136	$20,278	5	$52,850	$52,850	$3,645	$11,928	5	$0	$56,347	$13,356	5	$9,456	$11,597	5	$5,700	$415,144
6	$0	$20,278	6	$0	$0	$1,958	$9,308	6	$0	$0	$10,663	6	$0	$9,742	6	$5,700	$57,650
7	$0	$20,278	7	$0	$0	$1,958	$9,308	7	$0	$0	$10,663	7	$0	$9,742	7	$5,700	$57,650
8	$0	$20,278	8	$0	$0	$1,958	$9,308	8	$0	$0	$10,663	8	$0	$9,742	8	$5,700	$57,650
9	$0	$20,278	9	$0	$19,819	$1,958	$9,308	9	$0	$16,963	$10,663	9	$0	$9,742	9	$5,700	$94,432
10	$0	$20,273	10	$0	$0	$1,958	$7,952	10	$0	$0	$9,333	10	$0	$9,742	10	$5,700	$54,959
11	$0	$20,273	11	$0	$0	$1,958	$7,952	11	$0	$0	$9,333	11	$0	$9,742	11	$5,700	$54,959
12	$0	$20,273	12	$0	$118,913	$1,958	$7,952	12	$0	$73,126	$9,333	12	$57,749	$9,742	12	$2,850	$301,897
13	$0	$0	13	$0	$0	$0	$0	13	$0	$0	$0	13	$0	$0	13	$2,850	$2,850
14	$0	$0	14	$0	$0	$0	$0	14	$0	$0	$0	14	$0	$0	14	$2,850	$2,850
15	$0	$0	15	$0	$0	$0	$0	15	$0	$0	$0	15	$0	$0	15	$2,850	$2,850
16	$0	$0	16	$0	$0	$0	$0	16	$0	$0	$0	16	$0	$0	16	$2,850	$2,850
17	$0	$0	17	$0	$0	$0	$0	17	$0	$0	$0	17	$0	$0	17	$2,850	$2,850
18	$0	$0	18	$0	$0	$0	$0	18	$0	$0	$0	18	$0	$0	18	$2,850	$2,850
19	$0	$0	19	$0	$0	$0	$0	19	$0	$0	$0	19	$0	$0	19	$2,850	$2,850
20	$0	$0	20	$0	$0	$0	$0	20	$0	$0	$0	20	$0	$0	20	$2,850	$2,850
21	$0	$0	21	$0	$0	$0	$0	21	$0	$0	$0	21	$0	$0	21	$2,850	$2,850
22	$0	$0	22	$0	$0	$0	$0	22	$0	$0	$0	22	$0	$0	22	$2,850	$2,850
23	$0	$0	23	$0	$0	$0	$0	23	$0	$0	$0	23	$0	$0	23	$2,850	$2,850
24	$0	$0	24	$0	$0	$0	$0	24	$0	$0	$0	24	$0	$0	24	$2,850	$2,850
25	$0	$0	25	$0	$0	$0	$0	25	$0	$0	$0	25	$0	$0	25	$2,850	$2,850
26	$0	$0	26	$0	$0	$0	$0	26	$0	$0	$0	26	$0	$0	26	$2,850	$2,850
27	$0	$0	27	$0	$0	$0	$0	27	$0	$0	$0	27	$0	$0	27	$2,850	$2,850
28	$0	$0	28	$0	$0	$0	$0	28	$0	$0	$0	28	$0	$0	28	$2,850	$2,850
29	$0	$0	29	$0	$0	$0	$0	29	$0	$0	$0	29	$0	$0	29	$2,850	$2,850
30	$0	$0	30	$0	$0	$0	$0	30	$0	$0	$0	30	$0	$0	30	$2,850	$2,850
31	$0	$0	31	$0	$0	$0	$0	31	$0	$0	$0	31	$0	$0	31	$2,850	$2,850
32	$0	$0	32	$0	$0	$0	$0	32	$0	$0	$0	32	$0	$0	32	$2,850	$2,850
33	$0	$0	33	$0	$0	$0	$0	33	$0	$0	$0	33	$0	$0	33	$2,850	$2,850
34	$0	$0	34	$0	$0	$0	$0	34	$0	$0	$0	34	$0	$0	34	$2,850	$2,850
35	$0	$0	35	$0	$0	$0	$0	35	$0	$0	$0	35	$0	$0	35	$2,850	$2,850
36	$0	$0	36	$0	$0	$0	$0	36	$0	$0	$0	36	$0	$0	36	$2,850	$2,850
37	$0	$0	37	$0	$0	$0	$0	37	$0	$0	$0	37	$0	$0	37	$2,850	$2,850
38	$0	$0	38	$0	$0	$0	$0	38	$0	$0	$0	38	$0	$0	38	$2,850	$2,850
39	$0	$0	39	$0	$0	$0	$0	39	$0	$0	$0	39	$0	$0	39	$2,850	$2,850
40	$0	$0	40	$0	$0	$0	$0	40	$0	$0	$0	40	$0	$0	40	$2,850	$2,850
41	$0	$0	41	$0	$0	$0	$0	41	$0	$0	$0	41	$0	$0	41	$2,850	$2,850
42	$0	$0	42	$0	$0	$0	$0	42	$0	$0	$0	42	$0	$0	42	$2,850	$2,850
43	$0	$0	43	$0	$0	$0	$0	43	$0	$0	$0	43	$0	$0	43	$2,850	$2,850
44	$0	$0	44	$0	$0	$0	$0	44	$0	$0	$0	44	$0	$0	44	$2,850	$2,850
45	$0	$0	45	$0	$0	$0	$0	45	$0	$0	$0	45	$0	$0	45	$2,850	$2,850
46	$0	$0	46	$0	$0	$0	$0	46	$0	$0	$0	46	$0	$0	46	$2,850	$2,850
47	$0	$0	47	$0	$0	$0	$0	47	$0	$0	$0	47	$0	$0	47	$2,850	$2,850
48	$0	$0	48	$0	$0	$0	$0	48	$0	$0	$0	48	$0	$0	48	$2,850	$2,850
49	$0	$0	49	$0	$0	$0	$0	49	$0	$0	$0	49	$0	$0	49	$2,850	$2,850
50	$0	$0	50	$0	$0	$0	$0	50	$0	$0	$0	50	$0	$0	50	$2,850	$2,850
51	$0	$0	51	$0	$0	$0	$0	51	$0	$0	$0	51	$0	$0	51	$2,850	$2,850
52	$0	$0	52	$0	$0	$0	$0	52	$0	$0	$0	52	$0	$0	52	$2,850	$2,850
53	$0	$0	53	$0	$0	$0	$0	53	$0	$0	$0	53	$0	$0	53	$2,850	$2,850
54	$0	$0	54	$0	$0	$0	$0	54	$0	$0	$0	54	$0	$0	54	$2,850	$2,850
55	$0	$0	55	$0	$0	$0	$0	55	$0	$0	$0	55	$0	$0	55	$2,850	$2,850
56	$0	$0	56	$0	$0	$0	$0	56	$0	$0	$0	56	$0	$0	56	$2,850	$2,850
57	$0	$0	57	$0	$0	$0	$0	57	$0	$0	$0	57	$0	$0	57	$2,850	$2,850
58	$0	$0	58	$0	$0	$0	$0	58	$0	$0	$0	58	$0	$0	58	$2,850	$2,850
59	$0	$0	59	$0	$0	$0	$0	59	$0	$0	$0	59	$0	$0	59	$2,850	$2,850

Water Management Cash Flow

Capital Indirect Costs Percentage	28.3%
O&M Indirect Costs Percentage	17%
Electricity, Fuel, and Environmental Sampling Indirect Costs Percentage	17%

	PONDS & TANKS		PUMPS				PIPELINES			ELECTRICAL INFRASTRUCTURE		ENVIROMENTAL SAMPLING	
Year	Capital Annual Cost	O&M Annual Cost ($)	Capital Annual Cost	Removal Annual Cost	Electricity and Fuel Annual Cost ($)	O&M Annual Cost ($)	Capital Annual Cost	Removal Annual Cost	Maintenance Annual Cost ($)	Removal Annual Cost	Maintenance Annual Cost ($)	Annual Cost ($)	Total Cash Flow ($)
60	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
61	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
62	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
63	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
64	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
65	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
66	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
67	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
68	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
70	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
71	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
72	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
73	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
74	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
75	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
76	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
77	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
78	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
79	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
80	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
81	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
82	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
83	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
84	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
85	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
86	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
87	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
88	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
89	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
90	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
91	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
92	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
93	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
94	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
95	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
96	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
97	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
98	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
99	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,850	$2,850
Total Cost	$667,923	$263,599	$846,044	$191,583	$35,578	$132,658	$0	$146,437	$150,789	$67,205	$137,778	$347,715	$2,987,307
al Direct Cost	$520,595	$225,298	$659,426	$149,324	$30,408	$113,383	$0	$114,136	$128,879	$52,381	$117,759	$297,192	-

Total Cost	**$2,987,307**
Total Direct Cost	**$2,408,782**

Water Management Summary

Cobre Mining Company

Based on Projected 2019 Mine Plan			Current Value
DIRECT COSTS			
	Capital		**$1,495,862**
	Operations and Maintenance		**$585,319**
Capital			
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$56,843
	Contingencies	4.0%	$59,834
	Engineering Redesign Fee	2.5%	$37,397
	Contractor Profit and Overhead	15.0%	$224,379
	Project Management Fee	3.0%	$44,876
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$423,329**
Operations and Maintenance			
INDIRECT COSTS[1]	Mobilization and Demobilization	0.0%	$0
	Contingencies	4.0%	$23,413
	Engineering Redesign Fee	0.0%	$0
	Contractor Profit and Overhead	10.0%	$58,532
	Project Management Fee	3.0%	$17,560
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	17.0%	
	Subtotal, Indirect Costs		**$99,504**
ELECTRICITY, FUEL, AND SAMPLING			**$383,292**
TOTAL COST			**$2,987,307**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Water Management Summary

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement		**28.3%**	
Ponds and Tanks	$520,594.94	$147,328	$667,923
Pumps	$659,426.27	$186,618	$846,044
Pipelines	$0.00	$0	$0
Electrical	$0.00	$0	$0
Subtotal	**$1,180,021.20**	**$333,946**	**$1,513,967**
Removal[1]		**28.3%**	
Pumps	$149,324.06	$42,259	$191,583
Pipelines	$114,136.15	$32,301	$146,437
Electrical	$52,380.78	$14,824	$67,205
Subtotal	**$315,840.98**	**$89,384**	**$405,225**
Operations and Maintenance		**17%**	
Ponds and Tanks	$225,298.15	$38,301	$263,599
Pumps	$113,383.30	$19,275	$132,658
Pipelines	$128,879.24	$21,909	$150,788
Electrical Infrastructure	$117,758.66	$20,019	$137,778
Materials		**17%**	
Electricity and Fuel	$30,408.18	$5,169	$35,578
Environmental Sampling	$297,192.00	$50,523	$347,715
Subtotal	**$912,919.54**	**$155,196**	**$1,068,116**
Total Estimated Cost	**$2,408,781.72**	**$579,000**	**$2,987,308**

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

Cobre Haul Road Reclamation Cost Estimate

EOY 2023

General Information

Applicant	Cobre Mining Company Hanover, New Mexico 88401	
Disturbed Surface Area (acres)	100	
Type of Operation	Existing/Surface/Copper	
Current value	**$555,764**	**Cobre Haul Road**

Facility and Structure Modification

Item	Activity	Quantity	Unit	Unit Cost ($/unit)	Item Cost ($)	Reference	Means Line Item	Description
Corrugated Metal Culverts Removal	Culvert north of highway 152 crossing	883	ft	$10.64	$9,395	R.S. Means	024113.40-0190	Excludes excavation, CMP steel 48" to 60"
CHR	Wildlife Friendly Livestock Fence Perimeter Modification	38,700	ft	$0.24	$9,351	Engineering Judgment	-	Replace half staples/clips, add flagging or other markers or other wildlife friendly modifications, and replace or crimp 2 of the 4 to 5 strands of barb wire. This updated estimate relies on quotes available from Alberqurque 2013 Barb wire fence average installation based on ProMatcher cost reports and University of Iowa Study on fencing costs, and no longer calculates separate overhead and profit (estimated at 28.3%), individual labor rate ($25.34/ hr at 1 hour/100 feet of fence) or materials.

Facility and Structure Modification Total Direct Cost: $18,746

Data Sources:
RS Means Heavy Construction Cost Data (32nd Annual Edition 2018)

Location adjustment:
New Mexico Las Cruces
85.6%

Material Handling Plan Summary Sheet

Item	Description	Location 1	Location 2	Total Haul/Push Distance (ft)	Grade (%)	Equipment
1100	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1	-	47	see dozer	D11T
1101	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1 BLM Managed Land	-	47	see dozer	D11T
1102	Dozer Assist	CHR Outslopes Pullback with Excavator to 2.5:1	CHR Road Surface	-	see dozer	D11T
1103	Dozer Assist	CHR Outslopes Pullback to 2.5:1	1 dozer CHR Road Surafce, 1 dozer CHR slope	-	see dozer	D11T
1104	Dozer Assist	CHR Outslopes Pullback to 2:1	1 dozer CHR Road Surafce, 1 dozer CHR slope	-	see dozer	D11T
1105	Dozer Assist	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	1 dozer CHR Road Surafce, 1 dozer CHR slope	-	see dozer	D11T
1106	Dozer Assist	Hanover Creek and Forest Service Road Crossing Spanning Arch	1 dozer CHR Road Surafce, 1 dozer CHR slope	-	see dozer	D11T
1200	Excavate/Pullback Material	CHR Outslopes Pullback with Excavator to 2.5:1	-			Hitachi ZAXES 200LC-3
1201	Excavate Fill	Hanover Creek and Forest Service Road Crossing Spanning Arch	-			Hitachi ZAXES 200LC-3
1202	Excavate Concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	-			Hitachi ZAXES 200LC-3
1300	Load pullback material	CHR Outslopes Pullback to 2.5:1	-			992K
1301	Load pullback material	CHR Outslopes Pullback to 2:1	-			992K
1302	Load pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	-			992K
1400	Haul excavated soil	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	5,280	see Trucks	Cat 793 truck
1401	Haul concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	5,280	see Trucks	Cat 793 truck
1402	Haul pullback material	CHR Outslopes Pullback to 2.5:1	CHR Road Surface	2,640	see Trucks	Cat 793 truck
1403	Haul pullback material	CHR Outslopes Pullback to 2:1	CHR Road Surface	2,640	see Trucks	Cat 793 truck
1404	Haul pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	CHR Road Surface	2,640	see Trucks	Cat 793 truck
1500	Grade surface	CHR footprint	-			16M
1501	Grade surface	CHR footprint BLM Managed Land	-			16M
1600	Off-Hwy Water Tanker Truck					6,000 gal

Earthwork Quantity Worksheet

Item	Description	Location 1	Location 2	Area (ac)	Bank/stockpile Volume (bcy)	Swell Factor (%)	Loose/stockpile Volume (lcy)
1100	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1	-		21,419	15%	24,632
1101	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1 BLM Managed Land	-		2,806	15%	3,227
1102	Dozer Assist	CHR Outslopes Pullback with Excavator to 2.5:1	CHR Road Surface		28,322	15%	32,571
1103	Dozer Assist	CHR Outslopes Pullback to 2.5:1	1 dozer CHR Road Surafce, 1 dozer CHR slope		27,862	15%	32,041
1104	Dozer Assist	CHR Outslopes Pullback to 2:1	1 dozer CHR Road Surafce, 1 dozer CHR slope		67,453	15%	77,571
1105	Dozer Assist	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	1 dozer CHR Road Surafce, 1 dozer CHR slope		8,125	15%	9,344
1106	Dozer Assist	Hanover Creek and Forest Service Road Crossing Spanning Arch	1 dozer CHR Road Surafce, 1 dozer CHR slope		5,731	15%	6,591
1200	Excavate/Pullback Material	CHR Outslopes Pullback with Excavator to 2.5:1	-		28,322	15%	32,571
1201	Excavate Fill	Hanover Creek and Forest Service Road Crossing Spanning Arch	-		5,731	15%	6,591
1202	Excavate Concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	-		672	60%	1,076
1300	Load pullback material	CHR Outslopes Pullback to 2.5:1	-		27,862	15%	32,041
1301	Load pullback material	CHR Outslopes Pullback to 2:1	-		67,453	15%	77,571
1302	Load pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	-		8,125	15%	9,344
1400	Haul excavated soil	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface		5,731	15%	6,591
1401	Haul concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface		672	60%	1,076
1402	Haul pullback material	CHR Outslopes Pullback to 2.5:1	CHR Road Surface		27,862	15%	32,041
1403	Haul pullback material	CHR Outslopes Pullback to 2:1	CHR Road Surface		67,453	15%	77,571
1404	Haul pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	CHR Road Surface		8,125	15%	9,344
1500	Grade surface	CHR footprint	-	91			
1501	Grade surface	CHR footprint BLM Managed Land	-	9			
1600	Off-Hwy Water Tanker Truck						

Productivity and Hours Required for Dozer Use---Earthmoving

							PERFORMANCE FACTORS											
Task Description	Location 1	Location 2	Equipment	Loose Volume (cy)	Productivity (cy/hr)	Total Task Time* (hours)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	Grade (%)
Pushdown Outslope	CHR Outslopes Pushdown 2.5:1	-	D11T	24,632	7,223	3	1.0	1.80	3,300	1.20	47	5758	1.00	50	1.00	1.00	1.00	-40.0
Pushdown Outslope	CHR Outslopes Pushdown 2.5:1 BLM Managed Land	-	D11T	3,227	7,223	0	1.0	1.80	3,300	1.20	47	5758	1.00	50	1.00	1.00	1.00	-40.0
Dozer Assist	CHR Outslopes Pullback with Excavator to 2.5:1	CHR Road Surface	D11T	32,571	2,051	16	1.0	0.98	3,300	1.20	100	3002	1.00	50	1.00	1.00	1.00	1.0
Dozer Assist	CHR Outslopes Pullback to 2.5:1	1 dozer CHR Road Surafce, 1 dozer CHR slope	D11T	N/A	N/A	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	CHR Outslopes Pullback to 2:1	1 dozer CHR Road Surafce, 1 dozer CHR slope	D11T	N/A	N/A	72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	1 dozer CHR Road Surafce, 1 dozer CHR slope	D11T	N/A	N/A	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer Assist	Hanover Creek and Forest Service Road Crossing Spanning Arch	1 dozer CHR Road Surafce, 1 dozer CHR slope	D11T	6,591	2,051	3	1.0	0.98	3,300	1.20	100	3002	1.00	50	1.00	1.00	1.00	1.0

Productivity and Hours Required for Dozer Use---Grading

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Area (acres)	Productivity (acres/hr)	Productivity (cy/hr)	Task Time (hours)	PERFORMANCE FACTORS Material	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade	Effective Blade Width (feet)	Speed (miles/hr)	Work Hour (min/hr)	Visibility	Elevation	Direct Drive Trans.	Grade (%)	Operator	Maximum Push Distance (feet)	Normal Production (cy/hr)
Grade surface	CHR footprint	-	16M	-	91	2.5		37	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	1.0	0.75	-	
Grade surface	CHR footprint BLM Managed Land	-	16M	-	9	2.5		4	1.0	1.0	3,300	1.2	16	2.50	50	1	1	1	1.0	0.75	-	

*Push distances: Assumed 100 feet.

Productivity and Hours Required for
Ripper-Equipped Dozer Use

Note: Scarifying/Ripping Covered Areas Currently Included in Revegetation Costs

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Productivity and Hours Required for Hydraulic Excavator

Task Description	Location 1	Equipment	Volume (cy)	Net Bucket Capacity (cy)	Cycle Time* (min)	Productivity (cy/hr)	Task Time (hours)	PERFORMANCE FACTORS Heaped Bucket Capacity (cy)	Bucket Fill Factor	Soil Weight (lb/cy)	Load Bucket (min)	Swing Loaded (min)	Dump Bucket (min)	Swing Empty (min)	Efficiency Factor	Work Hour (min/hr)
Excavate/Pullback Material	CHR Outslopes Pullback with Excavator to 2.5:1	Hitachi ZAXES 200LC-3	32,571	1.00	0.23	196	166	1.18	0.85	3,300	0.09	0.06	0.03	0.05	0.9	50
Excavate Fill	Hanover Creek and Forest Service Road Crossing Spanning Arch	Hitachi ZAXES 200LC-3	6,591	1.00	0.23	196	34	1.18	0.85	3,300	0.09	0.06	0.03	0.05	0.9	50
Excavate Concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	Hitachi ZAXES 200LC-3	1,076	1.00	0.25	181	6	1.18	0.85	4,050	0.11	0.06	0.03	0.05	0.9	50

*Sum of Load, Swing, Dump, Swing of Bucket

Productivity and Hours Required for Truck Use

Truck-Loader Matching
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

PERFORMANCE FACTORS

Task Description	Location 1*	Location 2	Equipment	Volume (cy)	Truck Cycle Time (min)	Optimum No. of Trucks	Productivity (cy/hr)	Task Time (hrs)	Struck Capacity (cy)	Heaped Capacity (cy)	Loader or Excavator Cycles per Truck	Total Haul Distance (feet)	Haul Distance Segment 1 (feet)	Haul Distance Segment 2 (feet)	Haul Distance Segment 3 (feet)	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)
Haul excavated soil	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	Cat 793 truck	6,591	48.9	1	172	38	126	169	168	5,280	5,280	-	-	7.0%	-	-	2.5%	1,609	0	0
Haul concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	Cat 793 truck	1,076	52.2	1	161	7	126	169	168	5,280	5,280	-	-	7.0%	-	-	2.5%	1,609	0	0
Haul pullback material	CHR Outslopes Pullback to 2.5:1	CHR Road Surface	Cat 793 truck	32,041	13.8	2	1,216	30	126	169	12	2,640	2,640	-	-	7.0%	-	-	2.5%	805	0	0
Haul pullback material	CHR Outslopes Pullback to 2:1	CHR Road Surface	Cat 793 truck	77,571	13.8	2	1,216	72	126	169	12	2,640	2,640	-	-	7.0%	-	-	2.5%	805	0	0
Haul pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	CHR Road Surface	Cat 793 truck	9,344	13.8	2	1,216	9	126	169	12	2,640	2,640	-	-	7.0%	-	-	2.5%	805	0	0

Productivity and Hours Required for Truck Use

<u>Truck-Loader Matching</u>
Truck Loading Height (empty), Cat 777F - 14'7"
Loader Dump Clearance, Cat 992G - 15'3"

Task Description	Location 1*	Location 2	Haul Effective Grade Segment 1 (%)	Haul Effective Grade Segment 2 (%)	Haul Effective Grade Segment 3 (%)	Return Effective Grade Segment 1 (%)	Return Effective Grade Segment 2 (%)	Return Effective Grade Segment 3 (%)	Haul Time (min)	Return Time (min)	Loading Time (min)	Load/ Maneuver 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 excavated soil	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	10%	0%	0%	0%	0%	0%	6.7	1.8	38.6	0.7	1.1	50	0.00414	0.00110	0.00110	0.00110	0.00110	0.00110
Haul concrete	Hanover Creek and Forest Service Road Crossing Spanning Arch	CHR Road Surface	10%	0%	0%	0%	0%	0%	6.7	1.8	42.0	0.7	1.1	50	0.00414	0.00110	0.00110	0.00110	0.00110	0.00110
Haul pullback material	CHR Outslopes Pullback to 2.5:1	CHR Road Surface	10%	0%	0%	0%	0%	0%	3.3	0.9	7.8	0.7	1.1	50	0.00414	0.00110	0.00110	0.00110	0.00110	0.00110
Haul pullback material	CHR Outslopes Pullback to 2:1	CHR Road Surface	10%	0%	0%	0%	0%	0%	3.3	0.9	7.8	0.7	1.1	50	0.00414	0.00110	0.00110	0.00110	0.00110	0.00110
Haul pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed Land	CHR Road Surface	10%	0%	0%	0%	0%	0%	3.3	0.9	7.8	0.7	1.1	50	0.00414	0.00110	0.00110	0.00110	0.00110	0.00110

Productivity for Front End Loader

									PERFORMANCE FACTORS		
Task Description	Location 1	Location 2	Equipment	Volume (cy)	Net Bucket Capacity (cy)	Loader Cycle Time (min)	Productivity (cy/hr)	Task Time (hours)	Rated Bucket Capacity (cy)	Bucket Fill Factor	Work Hour (min/hr)
Load pullback material	CHR Outslopes Pullback to 2.5:1	-	992K	32,041	14	0.65	1,077	30	16	0.875	50
Load pullback material	CHR Outslopes Pullback to 2:1	-	992K	77,571	14	0.65	1,077	72	16	0.875	50
Load pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managec	-	992K	9,344	14	0.65	1,077	9	16	0.875	50

Productivity and Hours Required for Scraper Use

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Productivity and Hours Required for Motor grader Use---Grading

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Summary Calculation of Earthmoving Costs

Equipment Type	Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Labor Cost ($/hr)	Number of Units (Equipment)	Time Req'd (hrs)	Direct Cost ($)	Total Production	Prod. Unit	Unit Cost ($/unit)
Dozers-Earthmoving											
Cat D11T	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1	-	$414.50	$26.29	1	3.4	$1,503	24,632	cy	0.06
Cat D11T	Pushdown Outslope	CHR Outslopes Pushdown 2.5:1 BLM Managed l	-	$414.50	$26.29	1	0.4	$197	3,227	cy	0.06
Cat D11T	Dozer Assist	CHR Outslopes Pullback with Excavator to 2.5:1	CHR Road Surface	$414.50	$26.29	1	15.9	$7,001	32,571	cy	0.21
Cat D11T	Dozer Assist	CHR Outslopes Pullback to 2.5:1	1 dozer CHR Road Sura	$414.50	$26.29	2	29.8	$26,229	32,041	cy	0.82
Cat D11T	Dozer Assist	CHR Outslopes Pullback to 2:1	1 dozer CHR Road Sura	$414.50	$26.29	2	72.0	$63,500	77,571	cy	0.82
Cat D11T	Dozer Assist	CHR Outslopes Pullback to 2.5:1 BLM Managed	1 dozer CHR Road Sura	$414.50	$26.29	2	8.7	$7,649	9,344	cy	0.82
Cat D11T	Dozer Assist	Hanover Creek and Forest Service Road Crossin	1 dozer CHR Road Sura	$414.50	$26.29	2	3.2	$2,833	6,591	cy	0.43
Dozers-Grading											
Cat 16M	Grade surface	CHR footprint	-	$133.94	$26.29	1	36.6	$5,871	91.0	ac	64.51
Cat 16M	Grade surface	CHR footprint BLM Managed Land	-	$133.94	$26.29	1	3.6	$581	9.0	ac	64.51
Excavators											
Hitachi ZAXES 200LC-3	Excavate/Pullback Material	CHR Outslopes Pullback with Excavator to 2.5:1	-	$62.57	$28.37	1	166	$15,094	32,571	cy	0.46
Hitachi ZAXES 200LC-3	Excavate Fill	Hanover Creek and Forest Service Road Crossin	-	$62.57	$28.37	1	34	$3,054	6,591	cy	0.46
Hitachi ZAXES 200LC-3	Excavate Concrete	Hanover Creek and Forest Service Road Crossin	-	$62.57	$28.37	1	6	$542	1,076	cy	0.50
Loaders											
992K	Load pullback material	CHR Outslopes Pullback to 2.5:1	-	$294.35	$23.84	1	30	$9,467	32,041	cy	0.30
992K	Load pullback material	CHR Outslopes Pullback to 2:1	-	$294.35	$23.84	1	72	$22,919	77,571	cy	0.30
992K	Load pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed	-	$294.35	$23.84	1	9	$2,761	9,344	cy	0.30
Trucks											
Cat 793 truck	Haul excavated soil	Hanover Creek and Forest Service Road Crossin	CHR Road Surface	$478.45	$23.84	1	38	$19,201	6,591	cy	2.91
Cat 793 truck	Haul concrete	Hanover Creek and Forest Service Road Crossin	CHR Road Surface	$478.45	$23.84	1	7	$3,349	1,076	cy	3.11
Cat 793 truck	Haul pullback material	CHR Outslopes Pullback to 2.5:1	CHR Road Surface	$478.45	$23.84	2	30	$29,888	32,041	cy	0.93
Cat 793 truck	Haul pullback material	CHR Outslopes Pullback to 2:1	CHR Road Surface	$478.45	$23.84	2	72	$72,359	77,571	cy	0.93
Cat 793 truck	Haul pullback material	CHR Outslopes Pullback to 2.5:1 BLM Managed	CHR Road Surface	$478.45	$23.84	2	9	$8,716	9,344	cy	0.93
Water Truck and Grader											
Off-Hwy Water Tanker Truck,6,000-gal.				$86.99	$23.84	1	102	$11,281			
Cat 14M				$99.13	$26.29	1	102	$12,766			
Off-Hwy Water Tanker Truck,6,000-gal.				$86.99	$23.84	1	9	$962			
Cat 14M				$99.13	$26.29	1	9	$1,088			

*Assume there is a water truck running 1 hour twice a day when the dozers are running over an 8 hour work day.

Hanover Creek and Forest Service Road Crossing Spanning Arch Demolition	$28,980
Regrade Outslopes	$247,961
Regrade Outslopes BLM Managed Land	$19,322
Grade Surface CHR	$5,871
Grade Surface CHR BLM Managed Land	$581
Water Truck/grader	$24,046
Water Truck/grader BLM Managed Land	$2,050
Earthwork Direct Cost	**$328,810**

EQUIPMENT

Equipment Description	Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Owning and Operating Cost (w/out fuel) ($/hr)	Fuel-Adjusted Own/Op Cost ($/hr)	Reference
Cat D11T	29.8	$63.77	$350.73	$414.50	1
Cat D11T Bulldozer w/ multi shank ripper	29.8	$63.77	$385.12	$448.89	1
Hitachi ZAXES 200LC-3	6.7	$14.31	$48.26	$62.57	1
Cat 793 truck	47.8	$102.37	$376.08	$478.45	1
Cat 992K Loader	25.6	$54.94	$239.41	$294.35	1
Cat 16M Motor Grader	9.5	20.37	113.57	$133.94	1
Cat 14M	8.3	$17.76	$81.37	$99.13	1
Off-Hwy Water Tanker Truck,6,000-gal.	11.3	$24.12	$62.87	$86.99	1

FUEL

Oil Broker Quote	$ 2.14	per gallon	2

LABOR

Labor Description	NMDOL Type A Operator Group	NMDOL Type A Operator Classification	Nominal Total Rate ($/hr)	
Cat D11T CD Bulldozer	Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Cat D11T Bulldozer w/ multi shank ripper	Equipment Operator IV	Bulldozer (mult. Units)	$26.29	4
Hitachi ZAXES 200LC-3	Equipment Operator VII	Bulldozer (mult. Units)	$28.37	4
Cat 793 truck	Truck Driver III	Haul Truck	$23.84	4
Cat 992K Loader	Equipment Operator VI	Loader (over 10 cy)	$26.29	4
Cat 16M	Equipment Operator IV	Motor Grader	$26.29	4
Cat 14M	Equipment Operator IV	Motor Grader	$23.84	4
Off-Hwy Water Tanker Truck,6,000-gal.	Truck Driver III	N/A		

References
1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect cost is removed from the all-inclus
3. https://www.electricitylocal.com/states/new-mexico/silver-city/
4. Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2018 labor rates.

Revegetation Costs

Description:

Chiseling or ripping, scarifying, disking, rangeland drill seeding, mulching, crimping, mobilization.

Unit or Disturbance	(acres)	Unit Cost ($/acre)	Direct Cost ($)
CHR footprint	91	$856	$77,914
CHR footprint BLM Managed Land	9	$856	$7,706
		Revegetation Direct Cost	**$85,620**

Rocky Mountain Reclamation Quote April, 2018 (before taxes)

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Reclamation Summary

Cobre Mining Company

Cobre Haul Road

			Current Value
DIRECT COSTS	Facility and Structure Modification		$18,746
	Earthmoving		$328,810
	Revegetation		$85,620
	Other		$0
	Subtotal, Direct Costs		**$433,176**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$16,461
	Contingencies	4.0%	$17,327
	Engineering Redesign Fee	2.5%	$10,829
	Contractor Profit and Overhead	15.0%	$64,976
	Project Management Fee	3.0%	$12,995
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$122,589**
TOTAL COST			**$555,764**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Vegetation Maintenance Costs

Activity	Total Area (acres)	# yrs veg Maint.	% loss per year	Quantity	Unit	Unit Cost* ($/unit)	Item Cost ($)
CHR footprint	91	12	2%	1.8	acres	$891	$19,458
CHR footprint BLM Managed Land	9.0	12	2%	0.2	acres	$891	$1,924

Veg Maintenance Total Direct Cost: $21,382
Veg Maintenance Total with Indirect Cost: $26,364

*Rocky Mountain Reclamation Quote April, 2018 (before taxes), $1099/acre minus 23.3% indirect costs. 1098.5
Quote includes cost for scarifying (ripping) surface. $ 891 ($/acre)

Operations & Maintenance

EROSION CONTROL [1]

	Year 1	Years 2-11	
Base:	$3,861	$3,861	$/day
Time:	6	1	day/yr
Annual:	$23,163	$3,861	$/yr

Year	Annual Current Cost ($)
0	$23,163
1	$3,861
2	$3,861
3	$3,861
4	$3,861
5	$3,861
6	$3,861
7	$3,861
8	$3,861
9	$3,861
10	$3,861
11	$3,861
Total	$65,629.73

[1] Erosion Control
Modified Crew B-13A (1 Labor Foreman, 2 laborers, 1 equip. operators (med.), 2 truck drivers (heavy), 1 crawler loader (4 cy), 2 dump trucks (8 cy, 220 HP)
RS Means Heavy Construction Cost Data (28th Annual Edition, 2014)

	#	**$/hour**	**$/day**
Labor Foreman (outside)	1	$ 23.48	$ 187.84
Laborers	2	$ 22.73	$ 363.68
Equipment Operators med.	1	$ 26.56	$ 212.48
Truck Drivers (heavy)	2	$ 23.84	$ 381.44
		$/hour	$/day
Loader,980G	1	$ 81.48	$ 651.84
Dump Trucks, Cat730	2	$ 83.36	$ 1,333.76

Subtotal	$3,131	$/day
Total Direct Cost	$3,131	$/day
Indirect Cost Percentage	23.30%	
Total Cost	$3,861	$/day

Cobre Mining Company

Cobre Haul Road

			Current Value
DIRECT COSTS	Facility and Structure Removal		$0
	Earthmoving		$0
	Vegetation		$0
	Other		$74,610
	Subtotal, Direct Costs		**$74,610**
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$2,835
	Contingencies	4.0%	$2,984
	Engineering Redesign Fee	2.5%	$1,865
	Contractor Profit and Overhead	10.0%	$7,461
	Project Management Fee	3.0%	$2,238
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	23.3%	
	Subtotal, Indirect Costs		**$17,384**
TOTAL COST			**$91,994**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs 28.3%	Total Cost
Capital			
Hanover Creek and Forest Service Road Crossing Spanning Arch Demolition	$28,980	$8,201	$37,181
Regrade Outslopes	$247,961	$70,173	$318,134
Regrade Outslopes BLM Managed Land	$19,322	$5,468	$24,791
Grade Surface CHR	$5,871	$1,661	$7,532
Grade Surface CHR BLM Managed Land	$581	$164	$745
Water Truck/grader	$24,046	$6,805	$30,851
Water Truck/grader BLM Managed Land	$2,050	$580	$2,630
Revegetation CHR	$77,914	$22,050	$99,964
Revegetation BLM Managed Land	$7,706	$2,181	$9,887
CMP Culvert Removal	$9,395	$2,659	$12,054
Wildlife Friendly Fence Perimeter Modification[2]	$9,351	$2,646	$11,997
Total Capital Cost	$433,176	$122,589	$555,764
Operations and Maintenance			
		23.3%	
Veg Maintenance CHR	$19,458	$4,534	$23,991
Veg Maintenance CHR BLM Land	$1,924	$448	$2,373
Erosion Control CHR[1]	$48,437	$11,286	$59,723
Erosion Control BLM Land[1]	$4,790	$1,116	$5,907
Total Operations and Maintenance	$74,610	$17,384	$91,994

CHR	$471,412	$130,015	$601,427
CHR BLM Land[3]	$36,373	$9,958	$46,331
Total Current Dollar Cost	**$507,785**	**$139,973**	**$647,758**

[1] Erosion Control was calculated for the CHR; the costs for BLM land were broken out based on percentage of BLM Land. Note that the total on Sheet #19 includes indirect costs and is equal to the total erosion control cost listed in this table.

[2] $0.30/foot 38,700 feet of fence; Replace half staples/clips, add flagging or other markers or other wildlife friendly modifications, and replace or crimp 2 of the 4 to 5 strands of barb wire. Labor rate of $25.34/ hr at 1 hour/100 feet of fence; remaining cost is materials.

[3] The estimated reclamation cost for BLM managed lands is broken out for no other purpose except to show the relative costs between private and public land. Financial assurance posted by Cobre will be based upon regulation and terms negotiated with MMD and BLM.

Facility Characteristics

	EOY 2023
EOY 2023 Reclaimed Area	100
Item	**Capital Cost**
Cover Material (Load, [illegible]	$41,758
Regrade	$342,924
Seed & Mulch	$109,850
Other	$61,232
Capital Cost Totals	**$555,764**
Capital Cost/Acre	**$5,558**

APPENDIX B.2
SUPPORTING DOCUMENTATION

Appendix B.2.1

Production and Misc. Calculation Documentation

EQUATIONS USED IN CAPITAL COST SPREADSHEET

Sheet #4 Earthwork:

$$Bank\ Volume\ (bcy) = Area\ (acre) * Cover\ Depth\ (in) * \frac{43560(ft^2/acre)}{12(in/ft)*27(ft^3/cy)}$$

$$Loose\ or\ Stockpile\ Volume\ (lcy) = Bank\ or\ stockpile\ Volume\ (cy) * [1 + Swell\ Factor]$$

Sheet #5 Dozer:

$$\text{Normal Production } (cy/hr) = 159372.008958 * \text{Maximum Push Distance } (ft)^{-0.862481}$$
$$\text{(Caterpillar Performance Handbook Edition 42 D11T CD page1-53)}$$

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

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

$$Grade\ (Dozing\ Factor) = -0.02 * Grade\ (\%) + 1$$
$$(Curve\ Fit\ Cat\ Handbook\ Ed\ 44\quad 19-55)$$

Sheet #6 Grading:

Grade Surface:

$$Grade\ (Dozing\ Factor) = -0.02 * Grade\ (\%) + 1$$
$$(Curve\ Fit\ Cat\ Handbook\ Ed\ 44\quad 19-55)$$

$$\text{Productivity } (acre/hr) = Speed\ (mi/hr) * \frac{5280\ (ft/mi) * Effective\ Blade\ Width\ (ft)}{43560\ (ft^2/acre)} * \frac{Work\ Hour\ (\min/hr)}{60\ (\min/hr)}$$
$$* Operator * Material * Grade\ Factor * \frac{2300(lbs/cy)}{Soil\ Weight\ (lbs/cy)} * \text{Prod}.\ Method * Visibility * Elev. * Drive\ Trans.$$

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

Grade Cover:

$$\text{D11T CD Normal Production } (cy/hr) = 159372.008958 * \text{Maximum Push Distance } (ft)^{-0.862481}$$
$$(\textit{Curve Fit Cat Handbook Ed } 42 \quad 1-53)$$

$$Grade\ (Dozing\ Factor) = -0.02 * Grade\ (\%) + 1$$
$$(\textit{Curve Fit Cat Handbook Ed } 44 \quad 19-55)$$

$$\text{Productivity } (cy/hr) = Normal \text{ Production } (cy/hr) * \frac{Work\ Hour\ (\text{min}/hr)}{60\ (\text{min}/hr)} * Operator * Material * Grade\ Factor$$
$$* \frac{2300\ (lbs/cy)}{Soil\ Weight\ (lbs/cy)} * \text{Production } Method * Visibility * Elevation * DriveTrans$$

$$Task\ Time(hr) = \frac{\text{Area or Volume}}{\text{Productivity}}$$

Sheet #7 Ripper:

$$Ripper\ Width\ (ft) = \frac{Pocket\ Spacing\ (in)}{12\ (in/ft)}$$

$$1000\ ft\ Passes/Acre = \frac{43560\ (ft^2/acre)}{Ripper\ Length\ (ft) * Ripper\ Width\ (ft)}$$

$$Volume\ (cy) = Area\ (acres) * 43560\ (ft^2/acre) * \frac{Ripper\ Penetration\ (in)}{12\ (in/ft) * 27\ (ft^3/cy)}$$

$$Productivity\ (acres/hr) = \frac{Work\ Hour\ (\text{min}/hr)}{\left[\left(\dfrac{Ripper\ Lenth\ (ft)}{5280\ (ft/mi) * \dfrac{Speed\ (mi/hr)}{60\ (\text{min}/hr)}}\right) + Turn\ Time\ (\text{min}/pass)\right] * 1000\ ft\ Passes/acre}$$

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

Sheet #8 Excavator NOT USED:

Sheet #9 Trucks:

Calculations refer to 777F haul truck. It was determined that speeds are not significantly different from the 793 haul truck so no changes have been made to formulas in Sheet #9.

$$Total\ Haul\ \text{Distance}\ (ft) = \sum Segment\ Haul\ \text{Distance}\ (ft)$$
$$Haul\ \text{Distance}\ Segment\ (m) = Haul\ \text{Distance}\ (ft) * 0.3048\ (m/\ ft)$$
$$Haul\ Effective\ Grade\ (\%) = \left(Haul\ Grade\ (\%) + Rolling\text{Resistance}\ (\%)\right)(unless < 0\ then\ 0)$$
$$\text{Return}\ Effective\ Grade\ (\%) = \left(Rolling\text{Resistance}\ (\%) - Haul\ Grade\ (\%)\right)(unless < 0\ then\ 0)$$

$$777F\ Segment\ Travel\ Time\ Loaded\ (\text{min}/\ m) =$$
$$-1.6825 * Haul\ Effective\ Grade\ Segment\ (\%)^{3} + 0.4592 * Haul\ Effective\ Grade\ Segement\ (\%)^{2}$$
$$+ 0.0079 * Haul\ Effective\ Grade\ Segment\ (\%) + 0.0009$$
$$777F\ Segment\ Travel\ Time\ Empty\ (\text{min}/\ m) =$$
$$-6.2135 * \text{Return E}ffective\ Grade\ Segment\ (\%)^{4} + 1.0448 * \text{Return E}ffective\ Grade\ Segment\ (\%)^{3} + 0.1016 * \text{Return}\ Effe$$
$$-0.0035 * \text{Return}\ Effective\ Grade\ Segement\ (\%) + 0.0009$$
$$(Curve\ Fit\ Cat\ Handbook\ Ed\ 41\ \ 9-42)$$

$$Loader\ (cycles/truck) = Maximum\left[\frac{Struck\ Capacity\ (cy)}{Loader\ Net\ Bucket\ Capacity\ (cy)}, \frac{Heaped\ Capacity\ (cy)}{Loader\ Net\ Bucket\ Capacity\ (cy)}\right]$$

$$Haul\ Time\ (\text{min}) = \sum\left(Segment\ Travel\ Time\ Loaded\ (\text{min}/\ m) * Segment\ Haul\ Dist\ (m)\right)$$
$$\text{Return}\ Time\ (\text{min}) = \sum\left(Segment\ Travel\ Time\ Empty\ (\text{min}/\ m) * Segment\ Haul\ Dist\ (m)\right)$$
$$Loading\ Time\ (\text{min}) = Loader\ Cycle\ Time\ (\text{min}) * Loader\ (cycles/truck)$$

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

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

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

Sheet #10 Loader:

992K Truck Loader

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

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

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

Sheet #11 Scraper NOT USED

Sheet #13 Earth Sum:

$$Direct\ Cost\ (\$) = \left[Owning\ \&\ Operating\ Cost\ (\$/hr) + Labor\ Cost\ (\$/hr)\right] * \text{TimeRequired } (hr) * \text{Number of Units of Equipment}$$

$$Unit\ Cost\ (\$/unit) = \frac{Direct\ Cost\ (\$)}{Total\ \text{Production } (unit)}$$

$$Earthwork\ Total\ Direct\ Cost\ (\$) = \sum Total\ Cost\ (\$)$$

Sheet #14 Reveg:

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

$$\text{Reveg Total Direct Cost } (\$) = \sum\ Direct\ Costs\ (\$)$$

Sheet #15 Other:

$$Unit\ Cost\ (\$/unit) = Unadjusted\ Cost\ (\$/unit) * \frac{Location\ Adjustment\ (\%)}{100}$$

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

$$Other\ Total\ Direct\ Cost\ (\$) = \sum Current\ Item\ Cost\ (\$)$$

Sheet #16 & 17 Sum:

$$\begin{aligned} Subtotal\ Direct\ Cost\ (\$) &= \text{Earthwork Total Direct Cost } (\$) \\ &+ \text{Reveg Total Direct Cost}(\$) + \text{Other Total DirectCost } (\$) \end{aligned}$$

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

$$Total\ Cost\ (\$) = Subtotal\ Direct\ Cost\ (\$) + Subtotal\ Indirect\ Cost\ (\$)$$

OPTIMIZATION EQUATIONS:

Each Equation for number of trucks (n) from 2 to 25.

Productivity Sheet:

$$\begin{aligned} &Productivity\ (cy/hr) = \\ &\quad Work\ Hour\ (\text{min}/hr) * Loader\ (cycle/truck) * Loader\ Net\ Buckter\ Cap\ (cy) * \frac{Number\ of\ Trucks[n]}{Truck\ Cycle\ Time\ (\text{min})} \end{aligned}$$

Time Sheet:

$$Time\ (hr) = Maximum\left(\frac{Volume\ (cy)}{Productivity\ (cy/hr)},\ Laoder\ Task\ Time\ (hr)\right)$$

Truck Cost Sheet:

$$Truck\ Cost\ (\$) = \\ Time\ (hr) * Number\ of\ Trucks[n] * \left(Owning\ \&\ Operating\ Cost\ (\$/hr) + Labor\ Cost\ (\$/hr)\right)$$

Loader Cost Sheet:

$$Loader\ Cost\ \ for\ Number\ of\ Trucks[n]\ (\$) = \\ Time\ (hr) * \left(Owning\ \&\ Operating\ Cost\ (\$/hr) + Labor\ Cost\ (\$/hr)\right)$$

Total Cost Sheet:

$$Total\ Cost\ Number\ of\ Trucks[n]\ (\$) = Truck\ Cost\ (\$) + Loader\ Cost\ (\$)$$

$$Minimum\ Cost = Minimum\ (Total\ Cost\ \ for\ Number\ of\ Trucks[n](\$))$$

Optimum Number of Trucks:

$$\begin{aligned} & Number\ of\ Trucks[n] = \\ & \quad when\ \left(\ Minimum\ Cost\ (\$) >= Total\ Cost\ \ for\ Number\ of\ Trucks[n]\right) \\ & \quad then\ Number\ of\ Trucks[n] \\ & \quad else\ 0 \end{aligned}$$

$$Optimum\ Number\ of\ Trucks = \sum_{n=2}^{25} Number\ of\ Trucks[n]$$

WATER TRUCK AND GRADER DATA FROM TYRONE:

Water Truck		
Row Labels	**Average of Duration Min**	**Average of Duration Hr**
4/18/2017 0:00	695.28	11.59
4/19/2017 0:00	518.39	8.64
4/20/2017 0:00	291.41	4.86
4/21/2017 0:00	233.89	3.90
4/22/2017 0:00	330.05	5.50
4/23/2017 0:00	200.71	3.34
4/24/2017 0:00	382.43	6.37
4/25/2017 0:00	202.24	3.37
4/26/2017 0:00	268.24	4.47
4/27/2017 0:00	514.92	8.58
4/28/2017 0:00	325.58	5.43
4/29/2017 0:00	331.60	5.53
4/30/2017 0:00	659.40	10.99
5/1/2017 0:00	705.98	11.77
5/2/2017 0:00	230.81	3.85
5/3/2017 0:00	461.68	7.69
5/4/2017 0:00	467.07	7.78
5/5/2017 0:00	470.86	7.85
5/6/2017 0:00	706.67	11.78
5/7/2017 0:00	443.10	7.39
5/8/2017 0:00	698.03	11.63
5/9/2017 0:00	349.35	5.82
5/10/2017 0:00	462.81	7.71
5/11/2017 0:00	696.73	11.61
5/12/2017 0:00	353.59	5.89
5/13/2017 0:00	698.33	11.64
5/14/2017 0:00	696.75	11.61
5/15/2017 0:00	652.90	10.88
5/16/2017 0:00	346.92	5.78
5/17/2017 0:00	342.36	5.71
5/18/2017 0:00	1.81	0.03
5/19/2017 0:00	207.18	3.45
5/21/2017 0:00	404.37	6.74
5/22/2017 0:00	292.39	4.87
5/23/2017 0:00	527.75	8.80
5/24/2017 0:00	651.89	10.87
5/25/2017 0:00	691.07	11.52
5/26/2017 0:00	477.33	7.96
5/27/2017 0:00	357.94	5.97
5/28/2017 0:00	354.56	5.91
5/29/2017 0:00	260.51	4.34
5/30/2017 0:00	337.40	5.62
5/31/2017 0:00	677.89	11.30
6/1/2017 0:00	699.70	11.66
6/2/2017 0:00	649.56	10.83
6/3/2017 0:00	335.03	5.58
6/4/2017 0:00	446.52	7.44
6/5/2017 0:00	447.30	7.45
6/6/2017 0:00	185.96	3.10
6/7/2017 0:00	101.75	1.70
6/8/2017 0:00	398.88	6.65
6/9/2017 0:00	313.80	5.23
6/10/2017 0:00	314.52	5.24
6/11/2017 0:00	254.88	4.25
6/12/2017 0:00	287.91	4.80
6/13/2017 0:00	402.94	6.72
6/14/2017 0:00	469.57	7.83
6/15/2017 0:00	672.43	11.21
6/16/2017 0:00	390.23	6.50
6/17/2017 0:00	103.78	1.73
6/18/2017 0:00	570.19	9.50
6/19/2017 0:00	696.47	11.61
6/20/2017 0:00	312.88	5.22
6/21/2017 0:00	514.83	8.58
6/22/2017 0:00	204.73	3.41
6/23/2017 0:00	443.86	7.40
6/24/2017 0:00	329.19	5.49
6/25/2017 0:00	295.48	4.92
6/26/2017 0:00	459.31	7.66
6/27/2017 0:00	342.37	5.71

Water Truck Totals		
Period	Minutes	Hours
Q2 2017	372.19	6.20
Q3 2017	361.84	6.03
Q4 2017	314.77	5.25
Q1 2018	282.18	4.70
Totals	332.78	5.55

6/28/2017 0:00	418.72	6.98
6/29/2017 0:00	335.00	5.58
6/30/2017 0:00	352.45	5.87
7/1/2017 0:00	353.69	5.89
7/2/2017 0:00	420.94	7.02
7/3/2017 0:00	693.90	11.57
7/4/2017 0:00	474.37	7.91
7/5/2017 0:00	677.71	11.30
7/6/2017 0:00	260.15	4.34
7/7/2017 0:00	379.97	6.33
7/8/2017 0:00	350.45	5.84
7/9/2017 0:00	227.39	3.79
7/10/2017 0:00	644.25	10.74
7/11/2017 0:00	347.96	5.80
7/13/2017 0:00	672.83	11.21
7/14/2017 0:00	433.20	7.22
7/15/2017 0:00	238.64	3.98
7/16/2017 0:00	275.83	4.60
7/17/2017 0:00	197.67	3.29
7/18/2017 0:00	472.76	7.88
7/19/2017 0:00	93.32	1.56
7/25/2017 0:00	355.00	5.92
7/26/2017 0:00	232.99	3.88
7/27/2017 0:00	347.45	5.79
7/28/2017 0:00	353.18	5.89
7/31/2017 0:00	181.80	3.03
8/2/2017 0:00	350.39	5.84
8/3/2017 0:00	705.98	11.77
8/4/2017 0:00	481.67	8.03
8/5/2017 0:00	269.97	4.50
8/6/2017 0:00	459.71	7.66
8/7/2017 0:00	217.28	3.62
8/8/2017 0:00	702.88	11.72
8/9/2017 0:00	349.28	5.82
8/10/2017 0:00	214.87	3.58
8/11/2017 0:00	176.85	2.95
8/14/2017 0:00	448.32	7.47
8/15/2017 0:00	180.03	3.00
8/16/2017 0:00	294.55	4.91
8/17/2017 0:00	673.79	11.23
8/18/2017 0:00	704.67	11.74
8/19/2017 0:00	619.97	10.33
8/20/2017 0:00	716.33	11.94
8/21/2017 0:00	331.76	5.53
8/22/2017 0:00	291.75	4.86
8/23/2017 0:00	508.85	8.48
8/26/2017 0:00	430.82	7.18
8/28/2017 0:00	422.55	7.04
8/29/2017 0:00	283.23	4.72
8/30/2017 0:00	461.86	7.70
8/31/2017 0:00	329.02	5.48
9/1/2017 0:00	95.55	1.59
9/2/2017 0:00	262.62	4.38
9/3/2017 0:00	460.97	7.68
9/4/2017 0:00	477.78	7.96
9/5/2017 0:00	469.91	7.83
9/6/2017 0:00	652.28	10.87
9/7/2017 0:00	688.68	11.48
9/8/2017 0:00	326.57	5.44
9/9/2017 0:00	573.25	9.55
9/11/2017 0:00	561.92	9.37
9/12/2017 0:00	463.88	7.73
9/13/2017 0:00	591.02	9.85
9/14/2017 0:00	349.47	5.82
9/15/2017 0:00	419.66	6.99
9/16/2017 0:00	199.67	3.33
9/17/2017 0:00	411.63	6.86
9/18/2017 0:00	166.68	2.78
9/19/2017 0:00	297.65	4.96
9/20/2017 0:00	677.53	11.29
9/21/2017 0:00	431.86	7.20
9/22/2017 0:00	405.79	6.76
9/23/2017 0:00	677.68	11.29
9/24/2017 0:00	234.28	3.90

9/25/2017 0:00	689.03	11.48
9/26/2017 0:00	393.31	6.56
9/27/2017 0:00	664.05	11.07
9/28/2017 0:00	318.45	5.31
9/29/2017 0:00	569.63	9.49
9/30/2017 0:00	114.60	1.91
10/1/2017 0:00	333.56	5.56
10/2/2017 0:00	459.62	7.66
10/3/2017 0:00	447.56	7.46
10/4/2017 0:00	286.40	4.77
10/5/2017 0:00	266.00	4.43
10/6/2017 0:00	319.45	5.32
10/7/2017 0:00	217.40	3.62
10/8/2017 0:00	448.75	7.48
10/9/2017 0:00	438.65	7.31
10/10/2017 0:00	646.77	10.78
10/11/2017 0:00	280.24	4.67
10/12/2017 0:00	503.87	8.40
10/13/2017 0:00	415.80	6.93
10/14/2017 0:00	286.00	4.77
10/15/2017 0:00	285.51	4.76
10/16/2017 0:00	428.16	7.14
10/17/2017 0:00	666.85	11.11
10/18/2017 0:00	347.93	5.80
10/19/2017 0:00	470.94	7.85
10/20/2017 0:00	278.37	4.64
10/21/2017 0:00	345.34	5.76
10/22/2017 0:00	454.08	7.57
10/23/2017 0:00	233.15	3.89
10/24/2017 0:00	693.67	11.56
10/25/2017 0:00	348.35	5.81
10/26/2017 0:00	566.54	9.44
10/27/2017 0:00	251.51	4.19
10/28/2017 0:00	256.96	4.28
10/29/2017 0:00	197.37	3.29
10/30/2017 0:00	415.02	6.92
10/31/2017 0:00	258.28	4.30
11/1/2017 0:00	322.37	5.37
11/2/2017 0:00	385.14	6.42
11/3/2017 0:00	290.10	4.84
11/4/2017 0:00	238.24	3.97
11/5/2017 0:00	180.71	3.01
11/6/2017 0:00	148.28	2.47
11/7/2017 0:00	248.02	4.13
11/8/2017 0:00	246.37	4.11
11/9/2017 0:00	208.24	3.47
11/10/2017 0:00	265.09	4.42
11/11/2017 0:00	468.42	7.81
11/12/2017 0:00	235.31	3.92
11/13/2017 0:00	489.86	8.16
11/14/2017 0:00	398.95	6.65
11/15/2017 0:00	443.29	7.39
11/16/2017 0:00	299.06	4.98
11/17/2017 0:00	195.56	3.26
11/18/2017 0:00	418.37	6.97
11/19/2017 0:00	147.38	2.46
11/20/2017 0:00	168.03	2.80
11/21/2017 0:00	283.33	4.72
11/22/2017 0:00	414.04	6.90
11/23/2017 0:00	327.85	5.46
11/24/2017 0:00	261.67	4.36
11/25/2017 0:00	224.26	3.74
11/26/2017 0:00	408.29	6.81
11/27/2017 0:00	520.86	8.68
11/28/2017 0:00	284.50	4.74
11/29/2017 0:00	85.99	1.43
11/30/2017 0:00	459.04	7.65
12/1/2017 0:00	689.75	11.50
12/2/2017 0:00	346.24	5.77
12/3/2017 0:00	286.34	4.77
12/4/2017 0:00	450.51	7.51
12/5/2017 0:00	440.94	7.35
12/6/2017 0:00	450.21	7.50
12/7/2017 0:00	274.15	4.57

12/9/2017 0:00	123.70	2.06
12/10/2017 0:00	385.08	6.42
12/11/2017 0:00	291.06	4.85
12/12/2017 0:00	368.36	6.14
12/13/2017 0:00	252.65	4.21
12/14/2017 0:00	347.16	5.79
12/15/2017 0:00	696.60	11.61
12/16/2017 0:00	690.07	11.50
12/22/2017 0:00	625.00	10.42
12/23/2017 0:00	328.09	5.47
12/25/2017 0:00	322.08	5.37
12/26/2017 0:00	98.73	1.65
12/27/2017 0:00	458.77	7.65
12/28/2017 0:00	704.22	11.74
12/29/2017 0:00	653.10	10.89
12/31/2017 0:00	98.62	1.64
1/1/2018 0:00	182.06	3.03
1/2/2018 0:00	336.94	5.62
1/3/2018 0:00	136.03	2.27
1/4/2018 0:00	225.08	3.75
1/5/2018 0:00	327.98	5.47
1/6/2018 0:00	220.19	3.67
1/7/2018 0:00	287.72	4.80
1/8/2018 0:00	463.07	7.72
1/9/2018 0:00	191.91	3.20
1/14/2018 0:00	76.47	1.27
1/15/2018 0:00	347.21	5.79
1/17/2018 0:00	95.20	1.59
1/19/2018 0:00	198.00	3.30
1/20/2018 0:00	353.77	5.90
1/24/2018 0:00	478.19	7.97
1/25/2018 0:00	381.99	6.37
1/26/2018 0:00	353.07	5.88
1/29/2018 0:00	517.88	8.63
1/30/2018 0:00	436.56	7.28
1/31/2018 0:00	257.83	4.30
2/1/2018 0:00	664.70	11.08
2/2/2018 0:00	181.82	3.03
2/3/2018 0:00	249.61	4.16
2/4/2018 0:00	226.63	3.78
2/5/2018 0:00	240.72	4.01
2/6/2018 0:00	463.14	7.72
2/7/2018 0:00	261.94	4.37
2/9/2018 0:00	661.57	11.03
2/10/2018 0:00	52.63	0.88
2/11/2018 0:00	217.64	3.63
2/12/2018 0:00	335.14	5.59
2/13/2018 0:00	660.33	11.01
2/14/2018 0:00	195.59	3.26
2/17/2018 0:00	16.75	0.28
2/21/2018 0:00	341.24	5.69
2/22/2018 0:00	531.03	8.85
2/23/2018 0:00	29.08	0.49
2/24/2018 0:00	349.65	5.83
2/25/2018 0:00	702.17	11.70
2/26/2018 0:00	302.20	5.04
2/27/2018 0:00	340.67	5.68
3/1/2018 0:00	181.37	3.02
3/2/2018 0:00	331.31	5.52
3/3/2018 0:00	14.35	0.24
3/4/2018 0:00	90.84	1.51
3/5/2018 0:00	672.77	11.21
3/6/2018 0:00	286.80	4.78
3/7/2018 0:00	322.93	5.38
3/8/2018 0:00	285.48	4.76
3/9/2018 0:00	226.22	3.77
3/10/2018 0:00	712.35	11.87
3/11/2018 0:00	700.52	11.68
3/13/2018 0:00	230.05	3.83
3/14/2018 0:00	445.72	7.43
3/15/2018 0:00	459.96	7.67
3/16/2018 0:00	346.69	5.78
3/17/2018 0:00	268.13	4.47
3/18/2018 0:00	451.46	7.52

3/19/2018 0:00	355.92	5.93
3/20/2018 0:00	695.80	11.60
3/21/2018 0:00	236.63	3.94
3/22/2018 0:00	284.36	4.74
3/23/2018 0:00	192.05	3.20
3/24/2018 0:00	695.07	11.58
3/25/2018 0:00	579.73	9.66
3/26/2018 0:00	687.70	11.46
3/27/2018 0:00	560.18	9.34
3/28/2018 0:00	78.53	1.31
3/29/2018 0:00	133.14	2.22
3/30/2018 0:00	271.06	4.52
3/31/2018 0:00	252.44	4.21
4/1/2018 0:00	351.31	5.86
4/2/2018 0:00	224.16	3.74
4/3/2018 0:00	277.54	4.63
4/4/2018 0:00	661.90	11.03
4/5/2018 0:00	463.73	7.73
4/6/2018 0:00	398.56	6.64
4/7/2018 0:00	703.34	11.72
4/8/2018 0:00	347.54	5.79
4/9/2018 0:00	193.67	3.23
4/10/2018 0:00	323.72	5.40
4/11/2018 0:00	298.08	4.97
4/12/2018 0:00	682.90	11.38
4/13/2018 0:00	472.28	7.87
4/14/2018 0:00	430.10	7.17
4/15/2018 0:00	172.19	2.87
4/16/2018 0:00	328.04	5.47
4/17/2018 0:00	189.73	3.16
Average	**332.78**	**5.55**

Grader

Row Labels	Average of Duration (min)	Average of Duration (Hrs)
4/18/2017 0:00	350.35	5.84
4/19/2017 0:00	227.57	3.79
4/20/2017 0:00	291.54	4.86
4/21/2017 0:00	251.04	4.18
4/22/2017 0:00	300.15	5.00
4/23/2017 0:00	361.30	6.02
4/24/2017 0:00	431.76	7.20
4/25/2017 0:00	425.46	7.09
4/26/2017 0:00	275.94	4.60
4/27/2017 0:00	188.86	3.15
4/29/2017 0:00	693.25	11.55
4/30/2017 0:00	332.96	5.55
5/1/2017 0:00	273.69	4.56
5/3/2017 0:00	301.43	5.02
5/4/2017 0:00	586.87	9.78
5/5/2017 0:00	414.94	6.92
5/6/2017 0:00	659.18	10.99
5/7/2017 0:00	310.45	5.17
5/8/2017 0:00	324.24	5.40
5/9/2017 0:00	202.61	3.38
5/10/2017 0:00	101.71	1.70
5/11/2017 0:00	553.88	9.23
5/12/2017 0:00	462.37	7.71
5/13/2017 0:00	512.54	8.54
5/14/2017 0:00	696.17	11.60
5/15/2017 0:00	570.67	9.51
5/17/2017 0:00	130.54	2.18
5/19/2017 0:00	214.80	3.58
5/20/2017 0:00	401.52	6.69
5/21/2017 0:00	347.98	5.80
5/22/2017 0:00	375.32	6.26
5/23/2017 0:00	540.68	9.01
5/24/2017 0:00	341.28	5.69
5/25/2017 0:00	369.06	6.15
5/26/2017 0:00	355.10	5.92
5/27/2017 0:00	178.75	2.98
5/28/2017 0:00	360.83	6.01
5/29/2017 0:00	588.19	9.80
5/30/2017 0:00	660.06	11.00
5/31/2017 0:00	450.99	7.52
6/1/2017 0:00	684.04	11.40
6/3/2017 0:00	349.24	5.82
6/4/2017 0:00	586.05	9.77
6/6/2017 0:00	264.95	4.42
6/7/2017 0:00	274.56	4.58
6/8/2017 0:00	404.04	6.73
6/9/2017 0:00	124.39	2.07
6/10/2017 0:00	150.12	2.50
6/11/2017 0:00	252.62	4.21
6/12/2017 0:00	655.75	10.93
6/13/2017 0:00	103.07	1.72
6/14/2017 0:00	321.56	5.36
6/16/2017 0:00	408.32	6.81
6/17/2017 0:00	700.58	11.68
6/18/2017 0:00	691.30	11.52
6/19/2017 0:00	397.74	6.63
6/20/2017 0:00	433.63	7.23
6/21/2017 0:00	354.43	5.91
6/22/2017 0:00	240.44	4.01
6/23/2017 0:00	169.96	2.83
6/24/2017 0:00	438.21	7.30
6/25/2017 0:00	424.26	7.07
6/26/2017 0:00	373.16	6.22
6/27/2017 0:00	469.45	7.82
6/28/2017 0:00	108.42	1.81

Motor Grader (Blade)		
Period	Minutes	Hours
Q2 2017	335.90	5.60
Q3 2017	314.34	5.24
Q4 2017	298.65	4.98
Q1 2018	286.16	4.77
Total	306.71	5.11

6/29/2017 0:00	202.28	3.37
6/30/2017 0:00	705.72	11.76
7/2/2017 0:00	477.75	7.96
7/3/2017 0:00	462.43	7.71
7/4/2017 0:00	446.18	7.44
7/5/2017 0:00	335.46	5.59
7/6/2017 0:00	269.60	4.49
7/7/2017 0:00	435.92	7.27
7/9/2017 0:00	678.13	11.30
7/11/2017 0:00	687.18	11.45
7/12/2017 0:00	381.88	6.36
7/13/2017 0:00	673.52	11.23
7/14/2017 0:00	199.04	3.32
7/15/2017 0:00	153.88	2.56
7/16/2017 0:00	698.20	11.64
7/17/2017 0:00	248.35	4.14
7/18/2017 0:00	228.04	3.80
7/19/2017 0:00	388.48	6.47
7/20/2017 0:00	459.86	7.66
7/21/2017 0:00	392.37	6.54
7/22/2017 0:00	310.20	5.17
7/23/2017 0:00	228.29	3.81
7/24/2017 0:00	220.10	3.67
7/25/2017 0:00	344.31	5.74
7/26/2017 0:00	332.07	5.53
7/27/2017 0:00	514.27	8.57
7/28/2017 0:00	305.01	5.08
7/29/2017 0:00	290.83	4.85
7/30/2017 0:00	432.10	7.20
7/31/2017 0:00	270.33	4.51
8/1/2017 0:00	155.75	2.60
8/2/2017 0:00	447.63	7.46
8/3/2017 0:00	709.18	11.82
8/4/2017 0:00	184.49	3.07
8/5/2017 0:00	220.80	3.68
8/6/2017 0:00	303.05	5.05
8/7/2017 0:00	339.12	5.65
8/9/2017 0:00	699.58	11.66
8/10/2017 0:00	361.20	6.02
8/11/2017 0:00	260.21	4.34
8/12/2017 0:00	361.72	6.03
8/13/2017 0:00	340.41	5.67
8/14/2017 0:00	398.42	6.64
8/15/2017 0:00	512.00	8.53
8/16/2017 0:00	127.77	2.13
8/17/2017 0:00	286.08	4.77
8/18/2017 0:00	352.38	5.87
8/19/2017 0:00	241.85	4.03
8/20/2017 0:00	406.61	6.78
8/21/2017 0:00	118.86	1.98
8/22/2017 0:00	190.70	3.18
8/23/2017 0:00	220.18	3.67
8/24/2017 0:00	222.21	3.70
8/25/2017 0:00	265.04	4.42
8/26/2017 0:00	507.68	8.46
8/27/2017 0:00	396.60	6.61
8/28/2017 0:00	252.64	4.21
8/29/2017 0:00	354.06	5.90
8/30/2017 0:00	360.31	6.01
8/31/2017 0:00	609.73	10.16
9/1/2017 0:00	492.57	8.21
9/2/2017 0:00	310.52	5.18
9/3/2017 0:00	489.42	8.16
9/4/2017 0:00	186.51	3.11
9/5/2017 0:00	469.16	7.82
9/6/2017 0:00	567.83	9.46
9/7/2017 0:00	203.52	3.39
9/8/2017 0:00	117.99	1.97
9/9/2017 0:00	394.58	6.58

9/10/2017 0:00	336.72	5.61
9/11/2017 0:00	272.27	4.54
9/12/2017 0:00	232.15	3.87
9/13/2017 0:00	218.47	3.64
9/14/2017 0:00	349.35	5.82
9/15/2017 0:00	300.25	5.00
9/16/2017 0:00	149.56	2.49
9/17/2017 0:00	117.60	1.96
9/18/2017 0:00	218.81	3.65
9/19/2017 0:00	223.18	3.72
9/20/2017 0:00	409.21	6.82
9/21/2017 0:00	210.94	3.52
9/22/2017 0:00	331.22	5.52
9/23/2017 0:00	251.19	4.19
9/24/2017 0:00	229.84	3.83
9/25/2017 0:00	457.93	7.63
9/26/2017 0:00	420.38	7.01
9/27/2017 0:00	387.62	6.46
9/28/2017 0:00	659.09	10.98
9/29/2017 0:00	371.04	6.18
9/30/2017 0:00	208.48	3.47
10/1/2017 0:00	291.95	4.87
10/2/2017 0:00	389.50	6.49
10/3/2017 0:00	184.27	3.07
10/4/2017 0:00	445.00	7.42
10/5/2017 0:00	568.80	9.48
10/6/2017 0:00	51.37	0.86
10/7/2017 0:00	268.80	4.48
10/8/2017 0:00	222.88	3.72
10/9/2017 0:00	661.62	11.03
10/10/2017 0:00	271.94	4.53
10/11/2017 0:00	324.12	5.40
10/12/2017 0:00	284.70	4.74
10/13/2017 0:00	167.90	2.80
10/15/2017 0:00	682.88	11.38
10/16/2017 0:00	369.13	6.15
10/17/2017 0:00	351.72	5.86
10/18/2017 0:00	251.28	4.19
10/19/2017 0:00	278.52	4.64
10/20/2017 0:00	244.78	4.08
10/21/2017 0:00	244.71	4.08
10/22/2017 0:00	687.33	11.46
10/23/2017 0:00	349.80	5.83
10/24/2017 0:00	347.98	5.80
10/25/2017 0:00	466.46	7.77
10/26/2017 0:00	480.69	8.01
10/27/2017 0:00	234.82	3.91
10/28/2017 0:00	310.43	5.17
10/29/2017 0:00	618.53	10.31
10/30/2017 0:00	282.06	4.70
10/31/2017 0:00	256.06	4.27
11/1/2017 0:00	143.64	2.39
11/2/2017 0:00	332.36	5.54
11/3/2017 0:00	231.17	3.85
11/6/2017 0:00	390.78	6.51
11/7/2017 0:00	275.94	4.60
11/8/2017 0:00	663.58	11.06
11/9/2017 0:00	334.41	5.57
11/10/2017 0:00	343.10	5.72
11/12/2017 0:00	200.07	3.33
11/13/2017 0:00	165.39	2.76
11/14/2017 0:00	244.75	4.08
11/15/2017 0:00	454.31	7.57
11/16/2017 0:00	506.30	8.44
11/17/2017 0:00	160.14	2.67
11/18/2017 0:00	186.10	3.10
11/19/2017 0:00	249.98	4.17
11/20/2017 0:00	206.58	3.44
11/21/2017 0:00	180.20	3.00

11/22/2017 0:00	257.58	4.29
11/24/2017 0:00	224.39	3.74
11/25/2017 0:00	241.69	4.03
11/26/2017 0:00	167.47	2.79
11/27/2017 0:00	451.35	7.52
11/28/2017 0:00	371.87	6.20
11/29/2017 0:00	326.83	5.45
11/30/2017 0:00	461.56	7.69
12/1/2017 0:00	689.57	11.49
12/2/2017 0:00	231.13	3.85
12/3/2017 0:00	493.35	8.22
12/4/2017 0:00	659.47	10.99
12/5/2017 0:00	692.99	11.55
12/6/2017 0:00	258.19	4.30
12/7/2017 0:00	686.04	11.43
12/10/2017 0:00	163.52	2.73
12/11/2017 0:00	62.29	1.04
12/12/2017 0:00	109.67	1.83
12/13/2017 0:00	299.29	4.99
12/15/2017 0:00	695.18	11.59
12/16/2017 0:00	452.83	7.55
12/17/2017 0:00	256.97	4.28
12/18/2017 0:00	311.83	5.20
12/19/2017 0:00	145.46	2.42
12/20/2017 0:00	635.77	10.60
12/21/2017 0:00	379.16	6.32
12/22/2017 0:00	440.19	7.34
12/23/2017 0:00	577.83	9.63
12/24/2017 0:00	323.70	5.40
12/25/2017 0:00	644.68	10.75
12/26/2017 0:00	248.19	4.14
12/27/2017 0:00	453.17	7.55
12/28/2017 0:00	278.67	4.64
12/29/2017 0:00	288.73	4.81
12/30/2017 0:00	34.76	0.58
12/31/2017 0:00	25.49	0.43
1/1/2018 0:00	201.84	3.36
1/2/2018 0:00	341.87	5.70
1/4/2018 0:00	353.75	5.90
1/5/2018 0:00	399.97	6.67
1/6/2018 0:00	100.67	1.68
1/7/2018 0:00	125.46	2.09
1/8/2018 0:00	50.48	0.84
1/9/2018 0:00	416.72	6.95
1/10/2018 0:00	284.10	4.74
1/12/2018 0:00	616.68	10.28
1/13/2018 0:00	138.15	2.30
1/15/2018 0:00	446.40	7.44
1/16/2018 0:00	309.97	5.17
1/18/2018 0:00	318.57	5.31
1/19/2018 0:00	165.14	2.75
1/20/2018 0:00	309.33	5.16
1/21/2018 0:00	87.15	1.45
1/22/2018 0:00	236.26	3.94
1/23/2018 0:00	179.52	2.99
1/24/2018 0:00	190.98	3.18
1/25/2018 0:00	287.96	4.80
1/26/2018 0:00	185.72	3.10
1/27/2018 0:00	270.90	4.52
1/28/2018 0:00	239.16	3.99
1/29/2018 0:00	232.84	3.88
1/31/2018 0:00	237.39	3.96
2/1/2018 0:00	386.03	6.43
2/3/2018 0:00	148.08	2.47
2/4/2018 0:00	510.88	8.52
2/6/2018 0:00	164.39	2.74
2/7/2018 0:00	302.85	5.05
2/8/2018 0:00	310.77	5.18
2/9/2018 0:00	371.90	6.20

2/10/2018 0:00	225.20	3.75
2/11/2018 0:00	681.38	11.36
2/12/2018 0:00	198.20	3.30
2/13/2018 0:00	275.00	4.58
2/14/2018 0:00	295.72	4.93
2/15/2018 0:00	289.19	4.82
2/16/2018 0:00	158.71	2.65
2/17/2018 0:00	421.55	7.03
2/18/2018 0:00	402.58	6.71
2/19/2018 0:00	291.18	4.85
2/20/2018 0:00	309.00	5.15
2/21/2018 0:00	240.90	4.02
2/22/2018 0:00	158.56	2.64
2/23/2018 0:00	286.76	4.78
2/25/2018 0:00	299.08	4.99
2/26/2018 0:00	572.80	9.55
2/27/2018 0:00	232.73	3.88
2/28/2018 0:00	331.59	5.53
3/1/2018 0:00	167.85	2.80
3/2/2018 0:00	447.53	7.46
3/3/2018 0:00	327.52	5.46
3/4/2018 0:00	342.51	5.71
3/5/2018 0:00	447.90	7.47
3/6/2018 0:00	344.52	5.74
3/7/2018 0:00	632.50	10.54
3/8/2018 0:00	309.26	5.15
3/9/2018 0:00	287.65	4.79
3/10/2018 0:00	696.72	11.61
3/11/2018 0:00	521.74	8.70
3/12/2018 0:00	658.90	10.98
3/13/2018 0:00	412.33	6.87
3/14/2018 0:00	364.83	6.08
3/15/2018 0:00	233.28	3.89
3/16/2018 0:00	151.90	2.53
3/17/2018 0:00	494.33	8.24
3/18/2018 0:00	573.96	9.57
3/19/2018 0:00	710.80	11.85
3/20/2018 0:00	698.68	11.65
3/21/2018 0:00	239.17	3.99
3/22/2018 0:00	298.30	4.97
3/23/2018 0:00	319.31	5.32
3/24/2018 0:00	236.02	3.93
3/25/2018 0:00	238.47	3.97
3/26/2018 0:00	339.06	5.65
3/27/2018 0:00	6.28	0.11
3/28/2018 0:00	493.82	8.23
3/29/2018 0:00	193.19	3.22
3/30/2018 0:00	530.86	8.85
3/31/2018 0:00	199.61	3.33
4/2/2018 0:00	271.65	4.53
4/3/2018 0:00	251.00	4.18
4/4/2018 0:00	500.85	8.35
4/5/2018 0:00	172.77	2.88
4/6/2018 0:00	705.53	11.76
4/8/2018 0:00	157.95	2.63
4/9/2018 0:00	164.08	2.74
4/10/2018 0:00	38.93	0.65
4/12/2018 0:00	211.84	3.53
4/13/2018 0:00	353.91	5.90
4/14/2018 0:00	363.11	6.05
4/15/2018 0:00	236.92	3.95
4/16/2018 0:00	244.62	4.08
4/17/2018 0:00	269.91	4.50
Average	**306.71**	**5.11**

Appendix B.2.2

NMDOL
Labor Rates

LABOR RATES

Labor	Equipment	Group	Base rate[1]	Fringes[1]	Apprentice Rate[1]	Subtotal
Power Equipment Operator	Front End Loaders	VI	$20.15	$5.74	$0.67	$26.56
Power Equipment Operator	Dozer	IV	$19.88	$5.74	$0.67	$26.29
Power Equipment Operator	Motor Grader (Rough)	IV	$19.88	$5.74	$0.67	$26.29
Power Equipment Operator	Mechanic	V	$19.98	$5.74	$0.67	$26.39
Truck Drivers	Haul Trucks	III	$16.00	$7.17	$0.67	$23.84
Laborers	Forman	II	$17.51	$5.30	$0.67	$23.48
Laborers	Laborer	I	$16.76	$5.30	$0.67	$22.73

1. Base Rate, Fringes, Apprentice Rate	https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2018.pdf	

Appendix B.2.3

EquipmentWatch Sheets

www.equipmentwatch.com

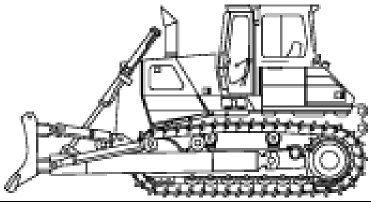
All prices shown in US$

Custom Cost Evaluator

May 4, 2018

Caterpillar D11T
Standard Crawler Dozers

Size Class:
520 HP & Over
Weight:
208,885 lbs.



Configuration for D11T

Operator Protection	**EROPS**	Dozer Type	**U Blade**
Net Horsepower	**850 hp**	Power Mode	**Diesel**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$116.51/hr	$109.64/hr	-5.9%
Cost of Facilities Capital (CFC)	$23.92/hr	$20.17/hr	-15.7%
Overhead	$59.40/hr	$0.00/hr	-100%
Overhaul Labor	$17.07/hr	$6.44/hr	-62.3%
Overhaul Parts	$102.61/hr	$85.56/hr	-16.6%
Total Hourly Ownership Cost:	**$319.51/hr**	**$221.81/hr**	**-30.6%**

User Defined Adjustments: Annual Overhead ($83,160.00 -> $1.00) Annual Use Hours (1,400hrs -> 1,679hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$19.99/hr	$7.54/hr	-62.3%
Field Parts	$99.94/hr	$83.34/hr	-16.6%
Ground Engaging Component (GEC)	$16.66/hr	$13.89/hr	-16.6%
Tire	$0.00/hr	-	-
Electrical/Fuel	$76.46/hr	$63.77/hr	-16.6%
Lube	$24.15/hr	-	-
Total Operating Ownership Cost:	**$237.20/hr**	**$192.69/hr**	**-18.8%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$319.51/hr	$221.81/hr	-30.6%
Hourly Operating Costs	$237.20/hr	$192.69/hr	-18.8%
Total Hourly Cost	**$556.71**	**$414.50/hr**	**-25.5%**

Revised Date: 1st Half 2018

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

EquipmentWatch

www.equipmentwatch.com

All prices shown in US$

Custom Cost Evaluator

May 4, 2018

Miscellaneous MSR-700+HAP
Crawler Tractor Multi-Shank Rippers

Size Class:
260 HP & Over
Weight:
N/A

Configuration for MSR-700+HAP

Engine Horsepower	**700 & Over**	Number of Shanks	**3**
Ripper Type	**Adj. Parallelogram**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$17.49/hr	$16.60/hr	-5.1%
Cost of Facilities Capital (CFC)	$1.60/hr	$1.31/hr	-18.1%
Overhead	$4.06/hr	$0.00/hr	-100%
Overhaul Labor	$2.72/hr	$0.98/hr	-64%
Overhaul Parts	$5.69/hr	$4.50/hr	-20.9%
Total Hourly Ownership Cost:	**$31.56/hr**	**$23.39/hr**	**-25.9%**

User Defined Adjustments: Annual Overhead ($5,214.74 -> $1.00) Annual Use Hours (1,285hrs -> 1,623hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$4.99/hr	$1.79/hr	-64.1%
Field Parts	$5.73/hr	$4.53/hr	-20.9%
Ground Engaging Component (GEC)	$4.77/hr	$3.78/hr	-20.8%
Tire	$0.00/hr	-	-
Electrical/Fuel	$0.00/hr	-	-
Lube	$0.90/hr	-	-
Total Operating Ownership Cost:	**$16.39/hr**	**$11.00/hr**	**-32.9%**

User Defined Adjustments: Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$31.56/hr	$23.39/hr	-25.9%
Hourly Operating Costs	$16.39/hr	$11.00/hr	-32.9%
Total Hourly Cost	**$47.95**	**$34.39/hr**	**-28.3%**

Revised Date: 1st Half 2018

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

EquipmentWatch

www.equipmentwatch.com

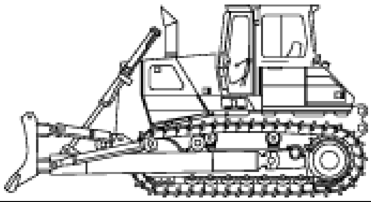
All prices shown in US$

Custom Cost Evaluator

May 4, 2018

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)	$9.46/hr	$7.98/hr	-15.6%
Overhead	$41.28/hr	$0.00/hr	-100%
Overhaul Labor	$17.07/hr	$6.44/hr	-62.3%
Overhaul Parts	$40.59/hr	$33.84/hr	-16.6%
Total Hourly Ownership Cost:	**$153.89/hr**	**$91.06/hr**	**-40.8%**

User Defined Adjustments: Annual Overhead ($57,796.85 -> $1.00) Annual Use Hours (1,400hrs -> 1,679hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$19.99/hr	$7.54/hr	-62.3%
Field Parts	$39.53/hr	$32.96/hr	-16.6%
Ground Engaging Component (GEC)	$6.59/hr	$5.49/hr	-16.7%
Tire	$0.00/hr	-	-
Electrical/Fuel	$36.88/hr	$30.76/hr	-16.6%
Lube	$10.21/hr	-	-
Total Operating Ownership Cost:	**$113.20/hr**	**$86.96/hr**	**-23.2%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$153.89/hr	$91.06/hr	-40.8%
Hourly Operating Costs	$113.20/hr	$86.96/hr	-23.2%
Total Hourly Cost	**$267.09**	**$178.02/hr**	**-33.3%**

Revised Date: 1st Half 2018

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EquipmentWatch

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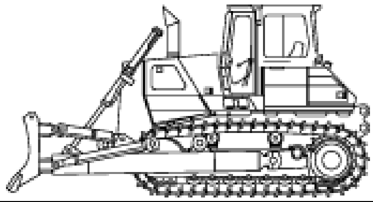
Custom Cost Evaluator

May 4, 2018

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)	$5.38/hr	$4.39/hr	-18.4%
Overhead	$15.32/hr	$0.00/hr	-100%
Overhaul Labor	$9.75/hr	$3.55/hr	-63.6%
Overhaul Parts	$17.88/hr	$14.39/hr	-19.5%
Total Hourly Ownership Cost:	**$74.44/hr**	**$46.76/hr**	**-37.2%**

User Defined Adjustments: Annual Overhead ($19,692.47 -> $1.00) Annual Use Hours (1,285hrs -> 1,597hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.02/hr	$4.38/hr	-63.6%
Field Parts	$17.33/hr	$13.94/hr	-19.6%
Ground Engaging Component (GEC)	$2.89/hr	$2.32/hr	-19.7%
Tire	$0.00/hr	-	-
Electrical/Fuel	$20.05/hr	$16.72/hr	-16.6%
Lube	$4.74/hr	-	-
Total Operating Ownership Cost:	**$57.03/hr**	**$42.10/hr**	**-26.2%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$74.44/hr	$46.76/hr	-37.2%
Hourly Operating Costs	$57.03/hr	$42.10/hr	-26.2%
Total Hourly Cost	**$131.47**	**$88.86/hr**	**-32.4%**

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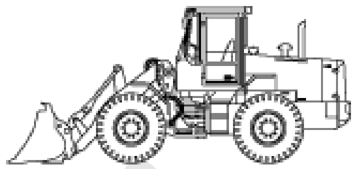
May 4, 2018

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	$111.16/hr	$103.81/hr	-6.6%
Cost of Facilities Capital (CFC)	$22.59/hr	$18.90/hr	-16.3%
Overhead	$59.32/hr	$0.00/hr	-100%
Overhaul Labor	$10.08/hr	$3.77/hr	-62.6%
Overhaul Parts	$30.19/hr	$24.92/hr	-17.5%
Total Hourly Ownership Cost:	**$233.34/hr**	**$151.40/hr**	**-35.1%**

User Defined Adjustments: Annual Overhead ($85,710.31 -> $1.00) Annual Use Hours (1,445hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.30/hr	$4.60/hr	-62.6%
Field Parts	$33.31/hr	$27.49/hr	-17.5%
Ground Engaging Component (GEC)	$4.54/hr	$3.74/hr	-17.6%
Tire	$32.69/hr	-	-
Electrical/Fuel	$65.87/hr	$54.94/hr	-16.6%
Lube	$19.49/hr	-	-
Total Operating Ownership Cost:	**$168.20/hr**	**$142.95/hr**	**-15%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$233.34/hr	$151.40/hr	-35.1%
Hourly Operating Costs	$168.20/hr	$142.95/hr	-15%
Total Hourly Cost	**$401.54**	**$294.35/hr**	**-26.7%**

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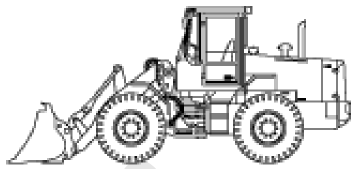
All prices shown in US$

Custom Cost Evaluator

May 14, 2018

Caterpillar 980G
4-Wd Articulated Wheel Loaders

Size Class:
275 - 349 HP
Weight:
65,078 lbs.



Configuration for 980G

Power Mode	**Diesel**	Net Horsepower	**300 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**7.5 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$21.61/hr	$20.15/hr	-6.8%
Cost of Facilities Capital (CFC)	$4.70/hr	$3.97/hr	-15.5%
Overhead	$2.80/hr	$0.00/hr	-100%
Overhaul Labor	$10.08/hr	$3.80/hr	-62.3%
Overhaul Parts	$6.28/hr	$5.24/hr	-16.6%
Total Hourly Ownership Cost:	**$45.47/hr**	**$33.16/hr**	**-27.1%**

User Defined Adjustments: Annual Overhead ($4,050.81 -> $1.00) Annual Use Hours (1,445hrs -> 1,734hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.30/hr	$4.64/hr	-62.3%
Field Parts	$6.93/hr	$5.78/hr	-16.6%
Ground Engaging Component (GEC)	$0.94/hr	$0.79/hr	-16%
Tire	$5.78/hr	-	-
Electrical/Fuel	$24.67/hr	$20.58/hr	-16.6%
Lube	$5.15/hr	-	-
Total Operating Ownership Cost:	**$55.77/hr**	**$42.72/hr**	**-23.4%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$45.47/hr	$33.16/hr	-27.1%
Hourly Operating Costs	$55.77/hr	$42.72/hr	-23.4%
Total Hourly Cost	**$101.24**	**$75.88/hr**	**-25%**

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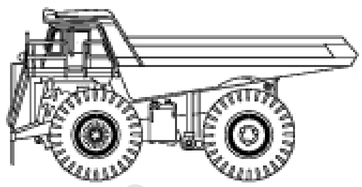
May 4, 2018

Komatsu HD1500-5 (disc. 2008)
Mechanical Drive Rear Dumps

Size Class:
105 - 139 MTons
Weight:
221,481 lbs.



Configuration for HD1500-5 (disc. 2008)

Body Capacity (Struck--Heaped)	**71 cu yd - 102 cu yd**	Power Mode	**Diesel**
Net Horsepower	**1406 hp**	Rated Payload	**136 mt**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$53.84/hr	$50.71/hr	-5.8%
Cost of Facilities Capital (CFC)	$10.53/hr	$9.60/hr	-8.8%
Overhead	$24.81/hr	$0.00/hr	-100%
Overhaul Labor	$35.45/hr	$14.52/hr	-59%
Overhaul Parts	$26.74/hr	$24.20/hr	-9.5%
Total Hourly Ownership Cost:	**$151.37/hr**	**$99.03/hr**	**-34.6%**

User Defined Adjustments: Annual Overhead ($45,902.04 -> $1.00) Annual Use Hours (1,850hrs -> 2,044hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$20.48/hr	$8.39/hr	-59%
Field Parts	$11.34/hr	$10.26/hr	-9.5%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$24.53/hr	-	-
Electrical/Fuel	$72.27/hr	$60.27/hr	-16.6%
Lube	$17.93/hr	-	-
Total Operating Ownership Cost:	**$146.55/hr**	**$121.38/hr**	**-17.2%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$151.37/hr	$99.03/hr	-34.6%
Hourly Operating Costs	$146.55/hr	$121.38/hr	-17.2%
Total Hourly Cost	**$297.92**	**$220.41/hr**	**-26%**

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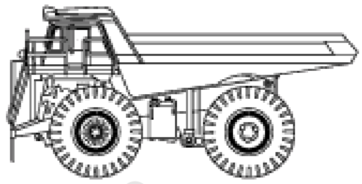
May 4, 2018

Caterpillar 797B (disc. 2009)
Mechanical Drive Rear Dumps

Size Class:
200 MTons & Over
Weight:
575,660 lbs.



Configuration for 797B (disc. 2009)

Net Horsepower	**3370 hp**	Power Mode	**Diesel**
Rated Payload	**380 mt**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$231.35/hr	$217.88/hr	-5.8%
Cost of Facilities Capital (CFC)	$45.22/hr	$41.88/hr	-7.4%
Overhead	$106.61/hr	$0.00/hr	-100%
Overhaul Labor	$35.45/hr	$14.77/hr	-58.3%
Overhaul Parts	$108.72/hr	$100.06/hr	-8%
Total Hourly Ownership Cost:	**$527.35/hr**	**$374.59/hr**	**-29%**

User Defined Adjustments: Annual Overhead ($197,225.00 -> $1.00) Annual Use Hours (1,850hrs -> 2,010hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$20.48/hr	$8.53/hr	-58.3%
Field Parts	$49.79/hr	$45.82/hr	-8%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$99.75/hr	-	-
Electrical/Fuel	$173.22/hr	$144.47/hr	-16.6%
Lube	$63.32/hr	-	-
Total Operating Ownership Cost:	**$406.56/hr**	**$361.89/hr**	**-11%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$527.35/hr	$374.59/hr	-29%
Hourly Operating Costs	$406.56/hr	$361.89/hr	-11%
Total Hourly Cost	**$933.91**	**$736.48/hr**	**-21.1%**

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May 4, 2018

Miscellaneous 6000 330
Off-Highway Water Tanker Trucks

Size Class:
300 - 399 HP
Weight:
54,400 lbs.

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)	$4.03/hr	$3.50/hr	-13.2%
Overhead	$7.31/hr	$0.00/hr	-100%
Overhaul Labor	$8.94/hr	$3.47/hr	-61.2%
Overhaul Parts	$5.85/hr	$5.01/hr	-14.4%
Total Hourly Ownership Cost:	**$49.03/hr**	**$33.41/hr**	**-31.9%**

User Defined Adjustments: Annual Overhead ($10,969.00 -> $1.00) Annual Use Hours (1,500hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$21.96/hr	$8.52/hr	-61.2%
Field Parts	$10.69/hr	$9.16/hr	-14.3%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$6.42/hr	-	-
Electrical/Fuel	$28.92/hr	$24.12/hr	-16.6%
Lube	$5.36/hr	-	-
Total Operating Ownership Cost:	**$73.35/hr**	**$53.58/hr**	**-27%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$49.03/hr	$33.41/hr	-31.9%
Hourly Operating Costs	$73.35/hr	$53.58/hr	-27%
Total Hourly Cost	**$122.38**	**$86.99/hr**	**-28.9%**

Revised Date: 1st Half 2018

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EquipmentWatch

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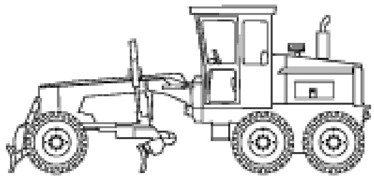
May 4, 2018

Caterpillar 14M
Articulated Frame Graders

Size Class:
250 HP & Over
Weight:
46,796 lbs.



Configuration for 14M

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)	$6.77/hr	$5.70/hr	-15.8%
Overhead	$19.15/hr	$0.00/hr	-100%
Overhaul Labor	$7.49/hr	$2.83/hr	-62.2%
Overhaul Parts	$17.11/hr	$14.26/hr	-16.7%
Total Hourly Ownership Cost:	**$80.68/hr**	**$51.04/hr**	**-36.7%**

User Defined Adjustments: Annual Overhead ($26,805.07 -> $1.00) Annual Use Hours (1,400hrs -> 1,680hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$6.25/hr	$2.36/hr	-62.2%
Field Parts	$16.59/hr	$13.83/hr	-16.6%
Ground Engaging Component (GEC)	$1.38/hr	$1.15/hr	-16.7%
Tire	$7.00/hr	-	-
Electrical/Fuel	$21.30/hr	$17.76/hr	-16.6%
Lube	$5.99/hr	-	-
Total Operating Ownership Cost:	**$58.51/hr**	**$48.09/hr**	**-17.8%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$80.68/hr	$51.04/hr	-36.7%
Hourly Operating Costs	$58.51/hr	$48.09/hr	-17.8%
Total Hourly Cost	**$139.19**	**$99.13/hr**	**-28.8%**

Revised Date: 1st Half 2018

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EquipmentWatch

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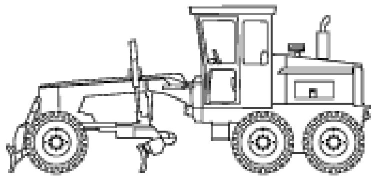
May 4, 2018

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)	$9.80/hr	$8.08/hr	-17.6%
Overhead	$21.14/hr	$0.00/hr	-100%
Overhaul Labor	$7.49/hr	$2.76/hr	-63.2%
Overhaul Parts	$24.76/hr	$20.18/hr	-18.5%
Total Hourly Ownership Cost:	**$106.85/hr**	**$71.91/hr**	**-32.7%**

User Defined Adjustments: Annual Overhead ($29,594.62 -> $1.00) Annual Use Hours (1,400hrs -> 1,718hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$6.25/hr	$2.30/hr	-63.2%
Field Parts	$24.01/hr	$19.57/hr	-18.5%
Ground Engaging Component (GEC)	$2.00/hr	$1.63/hr	-18.5%
Tire	$10.13/hr	-	-
Electrical/Fuel	$24.43/hr	$20.37/hr	-16.6%
Lube	$8.03/hr	-	-
Total Operating Ownership Cost:	**$74.85/hr**	**$62.03/hr**	**-17.1%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$106.85/hr	$71.91/hr	-32.7%
Hourly Operating Costs	$74.85/hr	$62.03/hr	-17.1%
Total Hourly Cost	**$181.70**	**$133.94/hr**	**-26.3%**

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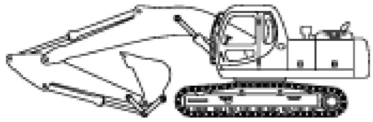
May 4, 2018

Hitachi ZAXIS 200LC-3
Crawler Mounted Hydraulic Excavators



Size Class:
21.1 - 24.0 MTons
Weight:
47,015 lbs.

Configuration for ZAXIS 200LC-3

Bucket Capacity - Heaped	**1.19 cu yd**	Power Mode	**Diesel**
Net Horsepower	**159 hp**	Operating Weight	**21.3 mt**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$19.06/hr	$17.85/hr	-6.3%
Cost of Facilities Capital (CFC)	$3.19/hr	$2.63/hr	-17.6%
Overhead	$6.63/hr	$0.00/hr	-100%
Overhaul Labor	$11.70/hr	$4.29/hr	-63.3%
Overhaul Parts	$8.21/hr	$6.65/hr	-19%
Total Hourly Ownership Cost:	**$48.79/hr**	**$31.42/hr**	**-35.6%**

User Defined Adjustments: Annual Overhead ($8,588.26 -> $1.00) Annual Use Hours (1,295hrs -> 1,599hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$14.18/hr	$5.20/hr	-63.3%
Field Parts	$8.39/hr	$6.79/hr	-19.1%
Ground Engaging Component (GEC)	$1.34/hr	$1.09/hr	-18.7%
Tire	$0.00/hr	-	-
Electrical/Fuel	$17.16/hr	$14.31/hr	-16.6%
Lube	$3.76/hr	-	-
Total Operating Ownership Cost:	**$44.83/hr**	**$31.15/hr**	**-30.5%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.1434) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$48.79/hr	$31.42/hr	-35.6%
Hourly Operating Costs	$44.83/hr	$31.15/hr	-30.5%
Total Hourly Cost	**$93.62**	**$62.57/hr**	**-33.2%**

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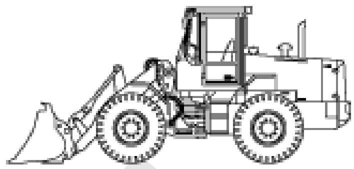
Custom Cost Evaluator

May 4, 2018

Caterpillar 980G
4-Wd Articulated Wheel Loaders

Size Class:
275 - 349 HP
Weight:
65,078 lbs.



Configuration for 980G

Power Mode	**Diesel**	Net Horsepower	**300 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**7.5 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$21.61/hr	$20.15/hr	-6.8%
Cost of Facilities Capital (CFC)	$4.70/hr	-	-
Overhead	$2.80/hr	$0.00/hr	-100%
Overhaul Labor	$10.08/hr	$4.57/hr	-54.7%
Overhaul Parts	$6.28/hr	-	-
Total Hourly Ownership Cost:	**$45.47/hr**	**$35.70/hr**	**-21.5%**

User Defined Adjustments: Annual Overhead ($4,050.81 -> $1.00) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.30/hr	$5.57/hr	-54.7%
Field Parts	$6.93/hr	-	-
Ground Engaging Component (GEC)	$0.94/hr	-	-
Tire	$5.78/hr	-	-
Electrical/Fuel	$24.67/hr	$21.41/hr	-13.2%
Lube	$5.15/hr	-	-
Total Operating Ownership Cost:	**$55.77/hr**	**$45.78/hr**	**-17.9%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.23) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$45.47/hr	$35.70/hr	-21.5%
Hourly Operating Costs	$55.77/hr	$45.78/hr	-17.9%
Total Hourly Cost	**$101.24**	**$81.48/hr**	**-19.5%**

Revised Date: 1st Half 2018

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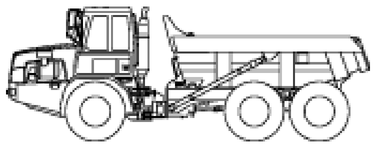
Custom Cost Evaluator

May 4, 2018

Caterpillar 730
Articulated Rear Dumps



Size Class:
26 - 29 MTons
Weight:
50,376 lbs.

Configuration for 730

Rated Payload	**28.1 mt**	Net Horsepower	**317 hp**
Power Mode	**Diesel**	Body Capacity (Struck--Heaped)	**16.9 cu yd - 22.1 cu yd**
Axle Configuration	**6 X 6**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$25.62/hr	$24.13/hr	-5.8%
Cost of Facilities Capital (CFC)	$4.25/hr	-	-
Overhead	$9.51/hr	$0.00/hr	-100%
Overhaul Labor	$15.75/hr	$7.13/hr	-54.7%
Overhaul Parts	$9.08/hr	-	-
Total Hourly Ownership Cost:	**$64.21/hr**	**$44.59/hr**	**-30.6%**

User Defined Adjustments: Annual Overhead ($17,589.97 -> $1.00) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.45/hr	$5.63/hr	-54.8%
Field Parts	$5.61/hr	-	-
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$7.49/hr	-	-
Electrical/Fuel	$16.29/hr	$14.14/hr	-13.2%
Lube	$5.90/hr	-	-
Total Operating Ownership Cost:	**$47.74/hr**	**$38.77/hr**	**-18.8%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.23) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$64.21/hr	$44.59/hr	-30.6%
Hourly Operating Costs	$47.74/hr	$38.77/hr	-18.8%
Total Hourly Cost	**$111.95**	**$83.36/hr**	**-25.5%**

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May 4, 2018

Miscellaneous 6000 330
Off-Highway Water Tanker Trucks

Size Class:
300 - 399 HP
Weight:
54,400 lbs.

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)	$4.03/hr	-	-
Overhead	$7.31/hr	$0.00/hr	-100%
Overhaul Labor	$8.94/hr	$4.05/hr	-54.7%
Overhaul Parts	$5.85/hr	-	-
Total Hourly Ownership Cost:	**$49.03/hr**	**$35.36/hr**	**-27.9%**

User Defined Adjustments: Annual Overhead ($10,969.00 -> $1.00) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$21.96/hr	$9.94/hr	-54.7%
Field Parts	$10.69/hr	-	-
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$6.42/hr	-	-
Electrical/Fuel	$28.92/hr	$25.09/hr	-13.2%
Lube	$5.36/hr	-	-
Total Operating Ownership Cost:	**$73.35/hr**	**$57.50/hr**	**-21.6%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.23) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$49.03/hr	$35.36/hr	-27.9%
Hourly Operating Costs	$73.35/hr	$57.50/hr	-21.6%
Total Hourly Cost	**$122.38**	**$92.86/hr**	**-24.1%**

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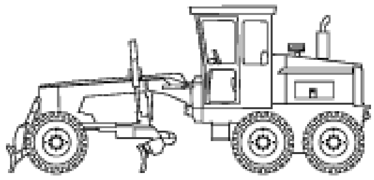
Custom Cost Evaluator

May 4, 2018

Caterpillar 14M
Articulated Frame Graders



Size Class:
250 HP & Over
Weight:
46,796 lbs.

Configuration for 14M

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)	$6.77/hr	-	-
Overhead	$19.15/hr	$0.00/hr	-100%
Overhaul Labor	$7.49/hr	$3.39/hr	-54.7%
Overhaul Parts	$17.11/hr	-	-
Total Hourly Ownership Cost:	**$80.68/hr**	**$55.52/hr**	**-31.2%**

User Defined Adjustments: Annual Overhead ($26,805.07 -> $1.00) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$6.25/hr	$2.83/hr	-54.7%
Field Parts	$16.59/hr	-	-
Ground Engaging Component (GEC)	$1.38/hr	-	-
Tire	$7.00/hr	-	-
Electrical/Fuel	$21.30/hr	$18.48/hr	-13.2%
Lube	$5.99/hr	-	-
Total Operating Ownership Cost:	**$58.51/hr**	**$52.27/hr**	**-10.7%**

User Defined Adjustments: Diesel Cost (2.57 -> 2.23) Mechanics Wage ($58.29 -> $26.39)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$80.68/hr	$55.52/hr	-31.2%
Hourly Operating Costs	$58.51/hr	$52.27/hr	-10.7%
Total Hourly Cost	**$139.19**	**$107.79/hr**	**-22.6%**

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Appendix B.2.4

RSMeans Sheets

GORDIAN®

2018

32nd annual edition

Heavy Construction Costs
with RSMeans data

02 41 13 – Selective Site Demolition

02 41 13.33 Railtrack Removal		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
3800	Turnouts using new bolts and spikes	B-14	1	48	Ea.		2,025	310	2,335	3,425

02 41 13.34 Selective Demolition, Utility Materials

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SELECTIVE DEMOLITION, UTILITY MATERIALS** R024119-10									
0015	Excludes excavation									
0020	See other utility items in Section 02 41 13.33									
0100	Fire hydrant extensions	B-20	14	1.714	Ea.		76.50		76.50	117
0200	Precast utility boxes up to 8′ x 14′ x 7′	B-13	2	28			1,225	295	1,520	2,175
0300	Handholes and meter pits	B-6	2	12			525	156	681	965
0400	Utility valves 4″-12″	B-20	4	6			268		268	410
0500	14″-24″	B-21	2	14			650	65	715	1,050

02 41 13.36 Selective Demolition, Utility Valves and Accessories

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SELECTIVE DEMOLITION, UTILITY VALVES & ACCESSORIES**									
0015	Excludes excavation									
0100	Utility valves 4″-12″ diam.	B-20	4	6	Ea.		268		268	410
0200	14″-24″ diam.	B-21	2	14			650	65	715	1,050
0300	Crosses 4″-12″ diam.	B-20	8	3			134		134	205
0400	14″-24″ diam.	B-21	4	7			325	32.50	357.50	530
0500	Utility cut-in valves 4″-12″ diam.	B-20	20	1.200			53.50		53.50	82
0600	Curb boxes	"	20	1.200			53.50		53.50	82

02 41 13.38 Selective Demo., Water & Sewer Piping & Fittings

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SELECTIVE DEMOLITION, WATER & SEWER PIPING AND FITTINGS**									
0015	Excludes excavation									
0020	See other utility items in Section 02 41 13.23									
0090	Concrete pipe 4″-10″ diameter	B-6	250	.096	L.F.		4.19	1.25	5.44	7.70
0100	42″-48″ diameter	B-13B	96	.583			25.50	10.35	35.85	50
0200	60″-84″ diameter	"	80	.700			30.50	12.45	42.95	60
0300	96″ diameter	B-13C	80	.700			30.50	23.50	54	72
0400	108″-144″ diameter	"	64	.875			38.50	29.50	68	90
0450	Concrete fittings 12″ diameter	B-6	24	1	Ea.		43.50	13	56.50	81
0480	Concrete end pieces 12″ diameter		200	.120	L.F.		5.25	1.56	6.81	9.65
0485	15″ diameter		150	.160			7	2.08	9.08	12.90
0490	18″ diameter		150	.160			7	2.08	9.08	12.90
0500	24″-36″ diameter		100	.240			10.50	3.12	13.62	19.35
0600	Concrete fittings 24″-36″ diameter		12	2	Ea.		87.50	26	113.50	162
0700	48″-84″ diameter	B-13B	12	4.667			204	83	287	400
0800	96″ diameter	"	8	7			305	124	429	600
0900	108″-144″ diameter	B-13C	4	14			610	470	1,080	1,450
1000	Ductile iron pipe 4″ diameter	B-21B	200	.200	L.F.		8.70	2.48	11.18	15.95
1100	6″-12″ diameter		175	.229			9.95	2.83	12.78	18.20
1200	14″-24″ diameter		120	.333			14.50	4.13	18.63	26.50
1300	Ductile iron fittings 4″-12″ diameter		24	1.667	Ea.		72.50	20.50	93	133
1400	14″-16″ diameter		18	2.222			96.50	27.50	124	178
1500	18″-24″ diameter		12	3.333			145	41.50	186.50	266
1600	Plastic pipe 3/4″-4″ diameter	B-6	700	.034	L.F.		1.50	.45	1.95	2.76
1700	6″-8″ diameter		500	.048			2.10	.63	2.73	3.87
1800	10″-18″ diameter		300	.080			3.49	1.04	4.53	6.45
1900	20″-36″ diameter		200	.120			5.25	1.56	6.81	9.65
1910	42″-48″ diameter		180	.133			5.80	1.74	7.54	10.75
1920	54″-60″ diameter		160	.150			6.55	1.95	8.50	12.10
2000	Plastic fittings 4″-8″ diameter		75	.320	Ea.		13.95	4.17	18.12	25.50
2100	10″-14″ diameter		50	.480			21	6.25	27.25	39
2200	16″-24″ diameter		20	1.200			52.50	15.60	68.10	96.50

02 41 Demolition

02 41 13 – Selective Site Demolition

	02 41 13.78 Selective Demolition, Radio Towers	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0800	120′	K-2	.80	30	Ea.		1,550	298	1,848	2,825
0900	190′		.40	60			3,125	595	3,720	5,625

	02 41 13.80 Selective Demo., Utility Poles and Cross Arms	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, UTILITY POLES & CROSS ARMS									
0100	Utility poles, wood, 20′-30′ high	R-3	6	3.333	Ea.		193	21.50	214.50	315
0200	35′-45′ high	"	5	4			232	26	258	375
0300	Cross arms, wood, 4′-6′ long	1 Elec	5	1.600			93		93	139

	02 41 13.82 Selective Removal, Pavement Lines and Markings	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE REMOVAL, PAVEMENT LINES & MARKINGS									
0015	Does not include traffic control costs									
0020	See other items in Section 32 17 23.13									
0100	Remove permanent painted traffic lines and markings	B-78A	500	.016	C.L.F.		.82	1.71	2.53	3.12
0200	Temporary traffic line tape	2 Clab	1500	.011	L.F.		.43		.43	.65
0300	Thermoplastic traffic lines and markings	B-79A	500	.024	C.L.F.		1.23	2.62	3.85	4.75
0400	Painted pavement markings	B-78B	500	.036	S.F.		1.48	.70	2.18	3.02

	02 41 13.84 Selective Demolition, Walks, Steps and Pavers	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, WALKS, STEPS AND PAVERS									
0100	Splash blocks	1 Clab	300	.027	S.F.		1.06		1.06	1.62
0200	Tree grates	"	50	.160	Ea.		6.40		6.40	9.70
0300	Walks, limestone pavers	2 Clab	150	.107	S.F.		4.25		4.25	6.45
0400	Redwood sections		600	.027			1.06		1.06	1.62
0500	Redwood planks		480	.033			1.33		1.33	2.02
0600	Shale paver		300	.053			2.13		2.13	3.24
0700	Tile thinset paver		675	.024			.94		.94	1.44
0800	Wood round	B-1	350	.069	Ea.		2.78		2.78	4.23
0900	Asphalt block	2 Clab	450	.036	S.F.		1.42		1.42	2.16
1000	Bluestone		450	.036			1.42		1.42	2.16
1100	Slate, 1″ or thinner		675	.024			.94		.94	1.44
1200	Granite blocks		300	.053			2.13		2.13	3.24
1300	Precast patio blocks		450	.036			1.42		1.42	2.16
1400	Planter blocks		600	.027			1.06		1.06	1.62
1500	Brick paving, dry set		300	.053			2.13		2.13	3.24
1600	Mortar set		180	.089			3.54		3.54	5.40
1700	Dry set on edge		240	.067			2.66		2.66	4.05
1800	Steps, brick		200	.080	L.F.		3.19		3.19	4.86
1900	Railroad tie		150	.107			4.25		4.25	6.45
2000	Bluestone		180	.089			3.54		3.54	5.40
2100	Wood/steel edging for steps		1000	.016			.64		.64	.97
2200	Timber or railroad tie edging for steps		400	.040			1.59		1.59	2.43

	02 41 13.86 Selective Demolition, Athletic Surfaces	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, ATHLETIC SURFACES									
0100	Synthetic grass	2 Clab	2000	.008	S.F.		.32		.32	.49
0200	Surface coat latex rubber	"	2000	.008	"		.32		.32	.49
0300	Tennis court posts	B-11C	16	1	Ea.		47	19.55	66.55	92.50

	02 41 13.88 Selective Demolition, Lawn Sprinkler Systems	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, LAWN SPRINKLER SYSTEMS									
0100	Golf course sprinkler system, 9 hole	4 Clab	.10	320	Ea.		12,800		12,800	19,400
0200	Sprinkler system, 24′ diam. @ 15′ OC, per head	B-20	110	.218	Head		9.75		9.75	14.90
0300	60′ diam. @ 24′ OC, per head	"	52	.462	"		20.50		20.50	31.50
0400	Sprinkler heads, plastic	2 Clab	150	.107	Ea.		4.25		4.25	6.45
0500	Impact circle pattern, 28′-76′ diam.		75	.213			8.50		8.50	12.95

02 81 20 – Hazardous Waste Handling

02 81 20.10 Hazardous Waste Cleanup/Pickup/Disposal		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0010	**HAZARDOUS WASTE CLEANUP/PICKUP/DISPOSAL**									
0100	For contractor rental equipment, i.e., dozer,									
0110	Front end loader, dump truck, etc., see 01 54 33 Reference Section									
1000	Solid pickup									
1100	55 gal. drums				Ea.				240	265
1120	Bulk material, minimum				Ton				190	210
1130	Maximum				"				595	655
1200	Transportation to disposal site									
1220	Truckload = 80 drums or 25 C.Y. or 18 tons									
1260	Minimum				Mile				3.95	4.45
1270	Maximum				"				7.25	7.35
3000	Liquid pickup, vacuum truck, stainless steel tank									
3100	Minimum charge, 4 hours									
3110	1 compartment, 2200 gallon				Hr.				140	155
3120	2 compartment, 5000 gallon				"				200	225
3400	Transportation in 6900 gallon bulk truck				Mile				7.95	8.75
3410	In teflon lined truck				"				10.20	11.25
5000	Heavy sludge or dry vacuumable material				Hr.				140	160
6000	Dumpsite disposal charge, minimum				Ton				140	155
6020	Maximum				"				415	455

02 41 13 – Selective Site Demolition

02 41 13.88 Selective Demolition, Lawn Sprinkler Systems

	02 41 13.88 Selective Demolition, Lawn Sprinkler Systems	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0600	Pop-up, 42'-76' diam.	2 Clab	50	.320	Ea.		12.75		12.75	19.40
0700	39'-99' diam.		50	.320			12.75		12.75	19.40
0800	Sprinkler valves		40	.400			15.95		15.95	24.50
0900	Valve boxes		40	.400			15.95		15.95	24.50
1000	Controls		2	8			320		320	485
1100	Backflow preventer		4	4			159		159	243
1200	Vacuum breaker		4	4			159		159	243

02 41 13.90 Selective Demolition, Retaining Walls

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SELECTIVE DEMOLITION, RETAINING WALLS**									
0020	See other retaining wall items in Section 32 32									
0100	Concrete retaining wall, 6' high, no reinforcing	B-13K	200	.080	L.F.		4.49	8.30	12.79	15.90
0200	8' high		150	.107			6	11.10	17.10	21
0300	10' high		150	.107			6	11.10	17.10	21
0400	With reinforcing, 6' high		200	.080			4.49	8.30	12.79	15.90
0500	8' high		150	.107			6	11.10	17.10	21
0600	10' high		120	.133			7.50	13.85	21.35	26.50
0700	20' high		60	.267			14.95	27.50	42.45	53
0800	Concrete cribbing, 12' high, open/closed face		150	.107	S.F.		6	11.10	17.10	21
0900	Interlocking segmental retaining wall	B-62	800	.030			1.31	.22	1.53	2.23
1000	Wall caps	"	600	.040			1.75	.29	2.04	2.97
1100	Metal bin retaining wall, 10' wide, 4'-12' high	B-13	1200	.047			2.04	.49	2.53	3.64
1200	10' wide, 16'-28' high		1000	.056			2.45	.59	3.04	4.37
1300	Stone filled gabions, 6' x 3' x 1'		170	.329	Ea.		14.40	3.48	17.88	26
1400	6' x 3' x 1'-6"		75	.747			32.50	7.90	40.40	58
1500	6' x 3' x 3'		25	2.240			98	23.50	121.50	175
1600	9' x 3' x 1'		75	.747			32.50	7.90	40.40	58
1700	9' x 3' x 1'-6"		33	1.697			74	17.90	91.90	133
1800	9' x 3' x 3'		12	4.667			204	49	253	365
1900	12' x 3' x 1'		42	1.333			58.50	14.05	72.55	104
2000	12' x 3' x 1'-6"		20	2.800			122	29.50	151.50	219
2100	12' x 3' x 3'		6	9.333			410	98.50	508.50	730

02 41 13.92 Selective Demolition, Parking Appurtenances

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SELECTIVE DEMOLITION, PARKING APPURTENANCES**									
0100	Bumper rails, garage, 6" wide	B-6	300	.080	L.F.		3.49	1.04	4.53	6.45
0200	12" channel rail		300	.080			3.49	1.04	4.53	6.45
0300	Parking bumper, timber		1000	.024			1.05	.31	1.36	1.93
0400	Folding, with locks	B-1	100	.240	Ea.		9.70		9.70	14.80
0500	Flexible fixed garage stanchion	B-6	150	.160			7	2.08	9.08	12.90
0600	Wheel stops, precast concrete		120	.200			8.75	2.60	11.35	16.10
0700	Thermoplastic		120	.200			8.75	2.60	11.35	16.10
0800	Pipe bollards, 6"-12" diam.		80	.300			13.10	3.91	17.01	24

02 41 16 – Structure Demolition

02 41 16.13 Building Demolition

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**BUILDING DEMOLITION** Large urban projects, incl. 20 mi. haul R024119-10									
0011	No foundation or dump fees, C.F. is vol. of building standing									
0020	Steel	B-8	21500	.003	C.F.		.14	.13	.27	.36
0050	Concrete		15300	.004			.19	.19	.38	.50
0080	Masonry		20100	.003			.15	.14	.29	.38
0100	Mixture of types		20100	.003			.15	.14	.29	.38
0500	Small bldgs, or single bldgs, no salvage included, steel	B-3	14800	.003			.14	.15	.29	.39
0600	Concrete		11300	.004			.19	.20	.39	.51
0650	Masonry		14800	.003			.14	.15	.29	.39

22 11 13.48 Pipe, Fittings and Valves, Steel, Grooved-Joint		Crew	Daily Output	Labor-Hours	Unit	2018 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.	6.05	7		13.05	17.2[illegible]
1050	1″ diameter		63	.127		5.85	7.90		13.75	18.3[illegible]
1060	1-1/4″ diameter		58	.138		6.95	8.55		15.50	20.5[illegible]
1070	1-1/2″ diameter		51	.157		7.55	9.75		17.30	23
1080	2″ diameter		40	.200		8.75	12.45		21.20	28.5[illegible]
1090	2-1/2″ diameter	Q-1	57	.281		11.45	15.70		27.15	36
1100	3″ diameter		50	.320		13.85	17.90		31.75	42.5[illegible]
1110	4″ diameter		45	.356		24	19.90		43.90	56.5[illegible]
1120	5″ diameter		37	.432		43.50	24		67.50	84
1130	6″ diameter	Q-2	42	.571		49	33		82	104
1140	8″ diameter		37	.649		81	37.50		118.50	146
1150	10″ diameter		31	.774		108	45		153	187
1160	12″ diameter		27	.889		121	51.50		172.50	211
1170	14″ diameter		20	1.200		128	69.50		197.50	246
1180	16″ diameter		17	1.412		189	82		271	330
1190	18″ diameter		14	1.714		194	99.50		293.50	365
1200	20″ diameter		12	2		230	116		346	430
1210	24″ diameter		10	2.400		258	139		397	495
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.	6.25	7		13.25	17.45
1850	1″ diameter		63	.127		6.50	7.90		14.40	19.05
1860	1-1/4″ diameter		58	.138		7.80	8.55		16.35	21.50
1870	1-1/2″ diameter		51	.157		8.65	9.75		18.40	24
1880	2″ diameter		40	.200		10	12.45		22.45	29.50
1890	2-1/2″ diameter	Q-1	57	.281		12.95	15.70		28.65	38
1900	3″ diameter		50	.320		15.75	17.90		33.65	44.50
1910	4″ diameter		45	.356		26.50	19.90		46.40	59.50
1920	5″ diameter		37	.432		31	24		55	71
1930	6″ diameter	Q-2	42	.571		33	33		66	86.50
1940	8″ diameter		37	.649		50.50	37.50		88	112
1950	10″ diameter		31	.774		103	45		148	181
1960	12″ diameter		27	.889		124	51.50		175.50	215
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.	77	13.10		90.10	104
4740	1″ diameter		33	.242		59.50	15.05		74.55	88
4750	1-1/4″ diameter		27	.296		59.50	18.40		77.90	93
4760	1-1/2″ diameter		22	.364		59.50	22.50		82	99.50
4770	2″ diameter		17	.471		59.50	29.50		89	110
4780	2-1/2″ diameter	Q-1	27	.593		59.50	33		92.50	116

31 05 Common Work Results for Earthwork

31 05 19 – Geosynthetics for Earthwork

31 05 19.53 Reservoir Liners HDPE		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0010	**RESERVOIR LINERS HDPE**									
0011	Membrane lining									
1100	30 mil thick	3 Skwk	1850	.013	S.F.	.41	.68		1.09	1.49
1200	60 mil thick		1600	.015		.58	.79		1.37	1.84
1300	120 mil thick		1440	.017		.67	.87		1.54	2.08

31 05 23 – Cement and Concrete for Earthwork

31 05 23.30 Plant Mixed Bituminous Concrete		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**PLANT MIXED BITUMINOUS CONCRETE**									
0020	Asphaltic concrete plant mix (145 lb./C.F.)				Ton	65			65	71.50
0040	Asphaltic concrete less than 300 tons add trucking costs									
0050	See Section 31 23 23.20 for hauling costs									
0200	All weather patching mix, hot				Ton	65.50			65.50	72
0250	Cold patch					73.50			73.50	80.50
0300	Berm mix					64			64	70
0400	Base mix					65			65	71.50
0500	Binder mix					65			65	71.50
0600	Sand or sheet mix					65			65	71.50

31 05 23.40 Recycled Plant Mixed Bituminous Concrete		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**RECYCLED PLANT MIXED BITUMINOUS CONCRETE**									
0200	Reclaimed pavement in stockpile G				Ton	22			22	24
0400	Recycled pavement, at plant, ratio old:new, 70:30 G					35			35	38.50
0600	Ratio old:new, 30:70 G					52.50			52.50	57.50

31 06 Schedules for Earthwork

31 06 60 – Schedules for Special Foundations and Load Bearing Elements

31 06 60.14 Piling Special Costs		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**PILING SPECIAL COSTS**									
0011	Piling special costs, pile caps, see Section 03 30 53.40									
0500	Cutoffs, concrete piles, plain	1 Pile	5.50	1.455	Ea.		74.50		74.50	118
0600	With steel thin shell, add		38	.211			10.80		10.80	17.05
0700	Steel pile or "H" piles		19	.421			21.50		21.50	34
0800	Wood piles		38	.211			10.80		10.80	17.05
0900	Pre-augering up to 30' deep, average soil, 24" diameter	B-43	180	.267	L.F.		11.85	13.60	25.45	33
0920	36" diameter		115	.417			18.50	21.50	40	51.50
0960	48" diameter		70	.686			30.50	35	65.50	84.50
0980	60" diameter		50	.960			42.50	49	91.50	119
1000	Testing, any type piles, test load is twice the design load									
1050	50 ton design load, 100 ton test				Ea.				14,000	15,500
1100	100 ton design load, 200 ton test								20,000	22,000
1150	150 ton design load, 300 ton test								26,000	28,500
1200	200 ton design load, 400 ton test								28,000	31,000
1250	400 ton design load, 800 ton test								32,000	35,000
1500	Wet conditions, soft damp ground									
1600	Requiring mats for crane, add								40%	40%
1700	Barge mounted driving rig, add								30%	30%

31 06 60.15 Mobilization		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**MOBILIZATION**									
0020	Set up & remove, air compressor, 600 CFM	A-5	3.30	5.455	Ea.		220	14.30	234.30	350
0100	1,200 CFM	"	2.20	8.182			330	21.50	351.50	525
0200	Crane, with pile leads and pile hammer, 75 ton	B-19	.60	107			5,600	3,225	8,825	12,200

32 11 23 – Aggregate Base Courses

32 11 23.23 Base Course Drainage Layers		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010	**BASE COURSE DRAINAGE LAYERS**									
0011	For roadways and large areas									
0050	Crushed 3/4" stone base, compacted, 3" deep	B-36C	5200	.008	S.Y.	2.71	.38	.74	3.83	4.38
0100	6" deep		5000	.008		5.40	.40	.77	6.57	7.40
0200	9" deep		4600	.009		8.15	.43	.84	9.42	10.50
0300	12" deep		4200	.010		10.85	.47	.92	12.24	13.65
0301	Crushed 1-1/2" stone base, compacted to 4" deep	B-36B	6000	.011		4.52	.51	.75	5.78	6.55
0302	6" deep		5400	.012		6.80	.57	.83	8.20	9.25
0303	8" deep		4500	.014		9.05	.68	1	10.73	12.10
0304	12" deep		3800	.017		13.55	.81	1.19	15.55	17.45
0350	Bank run gravel, spread and compacted									
0370	6" deep	B-32	6000	.005	S.Y.	3.60	.27	.36	4.23	4.75
0390	9" deep		4900	.007		5.40	.33	.44	6.17	6.95
0400	12" deep		4200	.008		7.20	.38	.51	8.09	9.10
0600	Cold laid asphalt pavement, see Section 32 12 16.19									
1500	Alternate method to figure base course									
1510	Crushed stone, 3/4", compacted, 3" deep	B-36C	435	.092	E.C.Y.	28	4.58	8.90	41.48	47
1511	6" deep	B-36B	835	.077		28	3.67	5.40	37.07	42
1512	9" deep		1150	.056		28	2.66	3.92	34.58	39
1513	12" deep		1400	.046		28	2.19	3.22	33.41	37.50
1520	Crushed stone, 1-1/2", compacted, 4" deep		665	.096		28	4.60	6.80	39.40	45
1521	6" deep		900	.071		28	3.40	5	36.40	41
1522	8" deep		1000	.064		28	3.06	4.51	35.57	40
1523	12" deep		1265	.051		28	2.42	3.56	33.98	38
1530	Gravel, bank run, compacted, 6" deep	B-36C	835	.048		18.50	2.39	4.63	25.52	29
1531	9" deep		1150	.035		18.50	1.73	3.36	23.59	27
1532	12" deep		1400	.029		18.50	1.42	2.76	22.68	25.50
2010	Crushed stone, 3/4" maximum size, 3" deep	B-36	540	.074	Ton	18.05	3.39	2.85	24.29	28
2011	6" deep		1625	.025		18.05	1.13	.95	20.13	22.50
2012	9" deep		1785	.022		18.05	1.03	.86	19.94	22.50
2013	12" deep		1950	.021		18.05	.94	.79	19.78	22
2020	Crushed stone, 1-1/2" maximum size, 4" deep		720	.056		18.05	2.55	2.14	22.74	26
2021	6" deep		815	.049		18.05	2.25	1.89	22.19	25.50
2022	8" deep		835	.048		18.05	2.19	1.85	22.09	25
2023	12" deep		975	.041		18.05	1.88	1.58	21.51	24.50
2030	Bank run gravel, 6" deep	B-32A	875	.027		12.45	1.35	1.49	15.29	17.40
2031	9" deep		970	.025		12.45	1.22	1.34	15.01	17
2032	12" deep		1060	.023		12.45	1.11	1.23	14.79	16.75
6000	Stabilization fabric, polypropylene, 6 oz./S.Y.	B-6	10000	.002	S.Y.	.73	.10	.03	.86	.99
6900	For small and irregular areas, add						50%	50%		
7000	Prepare and roll sub-base, small areas to 2,500 S.Y.	B-32A	1500	.016	S.Y.		.79	.87	1.66	2.15
8000	Large areas over 2,500 S.Y.	"	3500	.007			.34	.37	.71	.92
8050	For roadways	B-32	4000	.008			.40	.54	.94	1.20

32 11 26 – Asphaltic Base Courses

32 11 26.13 Plant Mix Asphaltic Base Courses		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**PLANT MIX ASPHALTIC BASE COURSES**									
0011	Roadways and large paved areas									
0500	Bituminous concrete, 4" thick	B-25	4545	.019	S.Y.	14.60	.85	.59	16.04	18
0550	6" thick		3700	.024		21.50	1.04	.73	23.27	26
0560	8" thick		3000	.029		28.50	1.29	.90	30.69	34.50
0570	10" thick		2545	.035		35.50	1.52	1.06	38.08	42.50
1600	Macadam base, crushed stone or slag, dry-bound	B-36D	1400	.023	E.C.Y.	47.50	1.16	2.24	50.90	56.50

32 18 Athletic and Recreational Surfacing

32 18 23 – Athletic Surfacing

32 18 23.33 Running Track Surfacing		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0010	**RUNNING TRACK SURFACING**									
0020	Running track, asphalt concrete pavement, 2-1/2"	B-37	300	.160	S.Y.	14.90	6.75	.50	22.15	27
0102	Surface, latex rubber system, 1/2" thick, black	B-20	115	.209		47.50	9.30		56.80	66.50
0152	Colors		115	.209		58	9.30		67.30	78
0302	Urethane rubber system, 1/2" thick, black		110	.218		35.50	9.75		45.25	54
0402	Color coating		110	.218		43.50	9.75		53.25	63

32 31 Fences and Gates

32 31 11 – Gate Operators

32 31 11.10 Gate Operators		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**GATE OPERATORS**									
7810	Motor operators for gates (no elec wiring), 3' wide swing	2 Skwk	.50	32	Ea.	1,175	1,675		2,850	3,850
7815	Up to 20' wide swing		.50	32		1,525	1,675		3,200	4,250
7820	Up to 45' sliding		.50	32		2,750	1,675		4,425	5,600
7825	Overhead gate, 6' to 18' wide, sliding/cantilever		45	.356	L.F.	320	18.60		338.60	380
7830	Gate operators, digital receiver		7	2.286	Ea.	74.50	120		194.50	265
7835	Two button transmitter		24	.667		23	35		58	79
7840	3 button station		14	1.143		39.50	60		99.50	135
7845	Master slave system		4	4		173	209		382	510

32 31 13 – Chain Link Fences and Gates

32 31 13.20 Fence, Chain Link Industrial		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**FENCE, CHAIN LINK INDUSTRIAL**									
0011	Schedule 40, including concrete									
0020	3 strands barb wire, 2" post @ 10' OC, set in concrete, 6' H									
0200	9 ga. wire, galv. steel, in concrete	B-80C	240	.100	L.F.	19.80	4.14	.82	24.76	29
0248	Fence, add for vinyl coated fabric				S.F.	.68			.68	.75
0300	Aluminized steel	B-80C	240	.100	L.F.	22	4.14	.82	26.96	31
0301	Fence, wrought iron		240	.100		30	4.14	.82	34.96	40
0500	6 ga. wire, galv. steel		240	.100		25	4.14	.82	29.96	34.50
0600	Aluminized steel		240	.100		30.50	4.14	.82	35.46	40.50
0800	6 ga. wire, 6' high but omit barbed wire, galv. steel		250	.096		20	3.97	.78	24.75	29
0900	Aluminized steel, in concrete		250	.096		24	3.97	.78	28.75	33.50
0920	8' H, 6 ga. wire, 2-1/2" line post, galv. steel, in concrete		180	.133		32	5.50	1.09	38.59	44.50
0940	Aluminized steel, in concrete		180	.133		39	5.50	1.09	45.59	52.50
1400	Gate for 6' high fence, 1-5/8" frame, 3' wide, galv. steel		10	2.400	Ea.	208	99.50	19.60	327.10	400
1500	Aluminized steel, in concrete		10	2.400	"	209	99.50	19.60	328.10	405
2000	5'-0" high fence, 9 ga., no barbed wire, 2" line post, in concrete									
2010	10' OC, 1-5/8" top rail, in concrete									
2100	Galvanized steel, in concrete	B-80C	300	.080	L.F.	21	3.31	.65	24.96	28.50
2200	Aluminized steel, in concrete		300	.080	"	19.05	3.31	.65	23.01	26.50
2400	Gate, 4' wide, 5' high, 2" frame, galv. steel, in concrete		10	2.400	Ea.	219	99.50	19.60	338.10	415
2500	Aluminized steel, in concrete		10	2.400	"	197	99.50	19.60	316.10	390
3100	Overhead slide gate, chain link, 6' high, to 18' wide, in concrete		38	.632	L.F.	97	26	5.15	128.15	152
3105	8' high, in concrete	B-80	30	1.067		100	47.50	20.50	168	204
3108	10' high, in concrete		24	1.333		169	59	25.50	253.50	305
3110	Cantilever type, in concrete		48	.667		142	29.50	12.75	184.25	215
3120	8' high, in concrete		24	1.333		168	59	25.50	252.50	300
3130	10' high, in concrete		18	1.778		206	79	34	319	385
5000	Double swing gates, incl. posts & hardware, in concrete									
5010	5' high, 12' opening, in concrete	B-80C	3.40	7.059	Opng.	540	292	57.50	889.50	1,100

32 31 Fences and Gates

32 31 29 – Wood Fences and Gates

32 31 29.10 Fence, Wood		Crew	Daily Output	Labor-Hours	Unit	Material	Labor (2018 Bare Costs)	Equipment	Total	Total Incl O&P
1300	No. 2 cedar, treated wood rails, 6′ high	B-80C	160	.150	L.F.	13.45	6.20	1.22	20.87	25.50
1320	Gate, 3′-6″ wide		8	3	Ea.	89.50	124	24.50	238	315
1360	Treated pine, treated rails, 6′ high		160	.150	L.F.	13.95	6.20	1.22	21.37	26
1400	8′ high		150	.160	″	19.80	6.60	1.31	27.71	33.50
1420	Gate, 3′-6″ wide		9	2.667	Ea.	100	110	22	232	300

32 31 29.20 Fence, Wood Rail		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**FENCE, WOOD RAIL**									
0012	Picket, No. 2 cedar, Gothic, 2 rail, 3′ high	B-1	160	.150	L.F.	8.10	6.10		14.20	18.15
0050	Gate, 3′-6″ wide	B-80C	9	2.667	Ea.	78	110	22	210	277
0400	3 rail, 4′ high		150	.160	L.F.	9.10	6.60	1.31	17.01	21.50
0500	Gate, 3′-6″ wide		9	2.667	Ea.	95	110	22	227	295
5000	Fence rail, redwood, 2″ x 4″, merch. grade, 8′	B-1	2400	.010	L.F.	2.53	.41		2.94	3.40
6000	Fence post, select redwood, earth packed & treated, 4″ x 4″ x 6′		96	.250	Ea.	14	10.15		24.15	31
6010	4″ x 4″ x 8′		96	.250		19.25	10.15		29.40	36.50
6020	Set in concrete, 4″ x 4″ x 6′		50	.480		22	19.45		41.45	53.50
6030	4″ x 4″ x 8′		50	.480		23	19.45		42.45	55
6040	Wood post, 4′ high, set in concrete, incl. concrete		50	.480		14.20	19.45		33.65	45
6050	Earth packed		96	.250		17.20	10.15		27.35	34.50
6060	6′ high, set in concrete, incl. concrete		50	.480		17.70	19.45		37.15	49
6070	Earth packed		96	.250		12.10	10.15		22.25	29

32 32 Retaining Walls

32 32 13 – Cast-in-Place Concrete Retaining Walls

32 32 13.10 Retaining Walls, Cast Concrete		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**RETAINING WALLS, CAST CONCRETE**									
1800	Concrete gravity wall with vertical face including excavation & backfill									
1850	No reinforcing									
1900	6′ high, level embankment	C-17C	36	2.306	L.F.	89	122	15.80	226.80	300
2000	33° slope embankment		32	2.594		103	137	17.80	257.80	345
2200	8′ high, no surcharge		27	3.074		110	163	21	294	395
2300	33° slope embankment		24	3.458		133	183	23.50	339.50	450
2500	10′ high, level embankment		19	4.368		157	231	30	418	560
2600	33° slope embankment		18	4.611		217	244	31.50	492.50	650
2800	Reinforced concrete cantilever, incl. excavation, backfill & reinf.									
2900	6′ high, 33° slope embankment	C-17C	35	2.371	L.F.	80.50	125	16.25	221.75	298
3000	8′ high, 33° slope embankment		29	2.862		93	151	19.65	263.65	355
3100	10′ high, 33° slope embankment		20	4.150		121	219	28.50	368.50	500
3200	20′ high, 500 lb./L.F. surcharge		7.50	11.067		360	585	76	1,021	1,375
3500	Concrete cribbing, incl. excavation and backfill									
3700	12′ high, open face	B-13	210	.267	S.F.	40.50	11.65	2.81	54.96	65.50
3900	Closed face	″	210	.267	″	38	11.65	2.81	52.46	62.50
4100	Concrete filled slurry trench, see Section 31 56 23.20									

32 32 23 – Segmental Retaining Walls

32 32 23.13 Segmental Conc. Unit Masonry Retaining Walls		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SEGMENTAL CONC. UNIT MASONRY RETAINING WALLS**									
7100	Segmental retaining wall system, incl. pins and void fill									
7120	base and backfill not included									
7140	Large unit, 8″ high x 18″ wide x 20″ deep, 3 plane split	B-62	300	.080	S.F.	12.75	3.49	.58	16.82	20
7150	Straight split		300	.080		12.85	3.49	.58	16.92	20
7160	Medium, lt. wt., 8″ high x 18″ wide x 12″ deep, 3 plane split		400	.060		6.30	2.62	.44	9.36	11.35

33 14 13 – Public Water Utility Distribution Piping

33 14 13.25 Water Supply, Polyvinyl Chloride Pipe		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
8785	20" diameter	B-20A	9.14	3.501	Ea.	465	169		634	770
8790	24" diameter	↓	7.53	4.250	↓	540	206		746	905

33 14 13.35 Water Supply, HDPE		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**WATER SUPPLY, HDPE**									
0011	Butt fusion joints, SDR 21 40' lengths not including excavation or backfill									
0100	4" diameter	B-22A	400	.100	L.F.	2.50	4.60	1.71	8.81	11.65
0200	6" diameter		380	.105		5.65	4.84	1.80	12.29	15.60
0300	8" diameter		320	.125		8.85	5.75	2.14	16.74	21
0400	10" diameter		300	.133		11.50	6.15	2.28	19.93	24.50
0500	12" diameter	↓	260	.154		13	7.10	2.63	22.73	28
0600	14" diameter	B-22B	220	.182		15.35	8.35	9.85	33.55	40.50
0700	16" diameter		180	.222		18.90	10.20	12.05	41.15	50
0800	18" diameter		140	.286		28	13.15	15.50	56.65	68
0900	24" diameter	↓	100	.400	↓	49.50	18.40	21.50	89.40	107
1000	Fittings									
1100	Elbows, 90 degrees									
1200	4" diameter	B-22A	32	1.250	Ea.	17.25	57.50	21.50	96.25	130
1300	6" diameter		28	1.429		44.50	65.50	24.50	134.50	176
1400	8" diameter		24	1.667		116	76.50	28.50	221	276
1500	10" diameter		18	2.222		252	102	38	392	475
1600	12" diameter	↓	12	3.333		297	153	57	507	620
1700	14" diameter	B-22B	9	4.444		570	204	241	1,015	1,200
1800	16" diameter		6	6.667		830	305	360	1,495	1,775
1900	18" diameter		4	10		955	460	540	1,955	2,350
2000	24" diameter	↓	3	13.333	↓	1,700	615	720	3,035	3,600
2100	Tees									
2200	4" diameter	B-22A	30	1.333	Ea.	21.50	61.50	23	106	142
2300	6" diameter		26	1.538		51.50	71	26.50	149	194
2400	8" diameter		22	1.818		130	83.50	31	244.50	305
2500	10" diameter		15	2.667		172	123	45.50	340.50	425
2600	12" diameter	↓	10	4		360	184	68.50	612.50	750
2700	14" diameter	B-22B	8	5		425	230	271	926	1,125
2800	16" diameter		6	6.667		500	305	360	1,165	1,400
2900	18" diameter		4	10		565	460	540	1,565	1,925
3000	24" diameter	↓	2	20	↓	920	920	1,075	2,915	3,600
4100	Caps									
4110	4" diameter	B-22A	34	1.176	Ea.	15	54	20	89	121
4120	6" diameter		30	1.333		30.50	61.50	23	115	153
4130	8" diameter		26	1.538		51	71	26.50	148.50	193
4150	10" diameter		20	2		161	92	34	287	355
4160	12" diameter	↓	14	2.857	↓	201	131	49	381	475

33 14 13.40 Water Supply, Black Steel Pipe		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**WATER SUPPLY, BLACK STEEL PIPE**									
0011	Not including excavation or backfill									
1000	Pipe, black steel, plain end, welded, 1/4" wall thk, 8" diam.	B-35A	208	.269	L.F.	31.50	13.10	8.70	53.30	64
1010	10" diameter		204	.275		40	13.35	8.85	62.20	74.50
1020	12" diameter		195	.287		47	14	9.25	70.25	83
1030	18" diameter		175	.320		73.50	15.60	10.30	99.40	116
1040	5/16" wall thickness, 12" diameter		195	.287		59.50	14	9.25	82.75	96.50
1050	18" diameter		175	.320		92	15.60	10.30	117.90	136
1060	36" diameter		28.96	1.934		173	94	62.50	329.50	400
1070	3/8" wall thickness, 18" diameter	↓	43.20	1.296	↓	108	63	42	213	261

33 16 Water Utility Storage Tanks

33 16 23 – Ground-Level Steel Water Storage Tanks

33 16 23.13 Steel Water Storage Tanks	Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0010 STEEL WATER STORAGE TANKS									
0910 Steel, ground level, ht./diam. less than 1, not incl. fdn., 100,000 gallons				Ea.				202,000	244,500
1000 250,000 gallons								295,500	324,000
1200 500,000 gallons								417,000	458,500
1250 750,000 gallons								538,000	591,500
1300 1,000,000 gallons								558,000	725,500
1500 2,000,000 gallons								1,043,000	1,148,000
1600 4,000,000 gallons								2,121,000	2,333,000
1800 6,000,000 gallons								3,095,000	3,405,000
1850 8,000,000 gallons								4,068,000	4,475,000
1910 10,000,000 gallons								5,050,000	5,554,500
2100 Steel standpipes, ht./diam. more than 1,100' to overflow, no fdn.									
2200 500,000 gallons				Ea.				546,500	600,500
2400 750,000 gallons								722,500	794,500
2500 1,000,000 gallons								1,060,500	1,167,000
2700 1,500,000 gallons								1,749,000	1,923,000
2800 2,000,000 gallons								2,327,000	2,559,000

33 16 36 – Ground-Level Reinforced Concrete Water Storage Tanks

33 16 36.16 Prestressed Conc. Water Storage Tanks	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 PRESTRESSED CONC. WATER STORAGE TANKS									
0020 Not including fdn., pipe or pumps, 250,000 gallons				Ea.				299,000	329,500
0100 500,000 gallons								487,000	536,000
0300 1,000,000 gallons								707,000	807,500
0400 2,000,000 gallons								1,072,000	1,179,000
0600 4,000,000 gallons								1,706,000	1,877,000
0700 6,000,000 gallons								2,266,000	2,493,000
0750 8,000,000 gallons								2,924,000	3,216,000
0800 10,000,000 gallons								3,533,000	3,886,000

33 16 56 – Ground-Level Plastic Water Storage Cisterns

33 16 56.23 Plastic-Coated Fabric Pillow Water Tanks	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 PLASTIC-COATED FABRIC PILLOW WATER TANKS									
7000 Water tanks, vinyl coated fabric pillow tanks, freestanding, 5,000 gallons	4 Clab	4	8	Ea.	3,650	320		3,970	4,475
7100 Supporting embankment not included, 25,000 gallons	6 Clab	2	24		14,100	955		15,055	17,000
7200 50,000 gallons	8 Clab	1.50	42.667		20,500	1,700		22,200	25,200
7300 100,000 gallons	9 Clab	.90	80		39,700	3,200		42,900	48,600
7400 150,000 gallons		.50	144		46,200	5,750		51,950	60,000
7500 200,000 gallons		.40	180		83,000	7,175		90,175	102,500
7600 250,000 gallons		.30	240		93,500	9,575		103,075	117,500

33 31 Sanitary Sewerage Piping

33 31 11 – Public Sanitary Sewerage Gravity Piping

33 31 11.13 Sewage Collection, Vent Cast Iron Pipe	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 SEWAGE COLLECTION, VENT CAST IRON PIPE									
0020 Not including excavation or backfill									
2022 Sewage vent cast iron, B&S, 4" diameter	Q-1	66	.242	L.F.	22.50	13.55		36.05	45
2024 5" diameter	Q-2	88	.273		32	15.80		47.80	59
2026 6" diameter	"	84	.286		38.50	16.55		55.05	67.50
2028 8" diameter	Q-3	70	.457		61.50	27		88.50	109
2030 10" diameter		66	.485		103	28.50		131.50	156

33 71 16 – Electrical Utility Poles

33 71 16.23 Steel Electrical Utility Poles		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0880	85′	R-13	1.40	30	Ea.	7,200	1,700	168	9,068	10,600
0900	90′		1.25	33.600		9,425	1,900	188	11,513	13,400
0920	95′		1.15	36.522		11,800	2,050	205	14,055	16,300
0940	100′		1	42		14,400	2,375	235	17,010	19,700
0960	105′		.90	46.667		15,900	2,625	261	18,786	21,600
0980	Ladder clips					253			253	279
1000	Galvanized steel, round, tapered, w/one 6′ arm, 20′	R-15A	9.20	5.217		1,050	266	30.50	1,346.50	1,575
1020	25′		7.65	6.275		1,125	320	37	1,482	1,775
1040	30′		6.55	7.328		1,250	375	43	1,668	1,975
1060	35′		5.75	8.348		1,350	425	49	1,824	2,175
1080	40′		5.15	9.320		1,425	475	55	1,955	2,350
1200	Two 6′ arms, 20′		6.55	7.328		1,350	375	43	1,768	2,075
1220	25′		5.75	8.348		1,375	425	49	1,849	2,200
1240	30′		5.15	9.320		1,425	475	55	1,955	2,350
1260	35′		4.60	10.435		1,625	530	61.50	2,216.50	2,650
1280	40′		4.20	11.429		1,875	585	67.50	2,527.50	3,000
1400	One 12′ truss arm, 25′		7.65	6.275		1,300	320	37	1,657	1,950
1420	30′		6.55	7.328		1,350	375	43	1,768	2,075
1440	35′		5.75	8.348		1,450	425	49	1,924	2,300
1460	40′		5.15	9.320		1,625	475	55	2,155	2,575
1480	45′		4.60	10.435		1,875	530	61.50	2,466.50	2,950
1600	Two 12′ truss arms, 25′		5.75	8.348		1,525	425	49	1,999	2,400
1620	30′		5.15	9.320		1,575	475	55	2,105	2,525
1640	35′		4.60	10.435		1,700	530	61.50	2,291.50	2,750
1660	40′		4.20	11.429		1,875	585	67.50	2,527.50	3,025
1680	45′		3.85	12.468		2,125	635	73.50	2,833.50	3,350
3400	Galvanized steel, tapered, 10′		15.50	3.097		425	158	18.25	601.25	725
3420	12′		11.50	4.174		500	213	24.50	737.50	895
3440	14′		9.20	5.217		370	266	30.50	666.50	840
3460	16′		8.45	5.680		385	290	33.50	708.50	895
3480	18′		7.65	6.275		395	320	37	752	955
3500	20′		7.10	6.761		380	345	40	765	985
6000	Digging holes in earth, average	R-5	25.14	3.500			178	48	226	320
6010	In rock, average	"	4.51	19.512			990	269	1,259	1,800
6020	Formed plate pole structure									
6030	Material handling and spotting	R-7	2.40	20	Ea.		825	69	894	1,350
6040	Erect steel plate pole	R-5	1.95	45.128		10,400	2,300	620	13,320	15,500
6050	Guys, anchors and hardware for pole, in earth		7.04	12.500		630	635	172	1,437	1,850
6060	In rock		17.96	4.900		750	249	67.50	1,066.50	1,275
6070	Foundations for line poles									
6080	Excavation, in earth	R-5	135.38	.650	C.Y.		33	8.95	41.95	60
6090	In rock		20	4.400			224	60.50	284.50	400
6110	Concrete foundations		11	8		153	405	110	668	905

33 71 16.33 Wood Electrical Utility Poles		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**WOOD ELECTRICAL UTILITY POLES**									
0011	Excludes excavation, backfill and cast-in-place concrete									
1020	12″ Ponderosa Pine Poles treated 0.40 ACQ, 16′	R-3	3.20	6.250	Ea.	875	360	40.50	1,275.50	1,550
5000	Wood, class 3 yellow pine, penta-treated, 25′	R-15A	8.60	5.581		278	285	33	596	770
5020	30′		7.70	6.234		320	320	36.50	676.50	870
5040	35′		5.80	8.276		400	420	48.50	868.50	1,125
5060	40′		5.30	9.057		475	460	53.50	988.50	1,275
5080	45′		4.70	10.213		515	520	60	1,095	1,425

33 71 16 – Electrical Utility Poles

33 71 16.33 Wood Electrical Utility Poles

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor (2018 Bare Costs)	Equipment (2018 Bare Costs)	Total (2018 Bare Costs)	Total Incl O&P
5100	50′	R-15A	4.20	11.429	Ea.	635	585	67.50	1,287.50	1,650
5120	55′		3.80	12.632		745	645	74.50	1,464.50	1,875
5140	60′		3.50	13.714		995	700	81	1,776	2,250
5160	65′		3.20	15		1,300	765	88.50	2,153.50	2,675
5180	70′		3	16		1,825	815	94	2,734	3,325
5200	75′		2.80	17.143		2,350	875	101	3,326	4,000
6000	Wood, class 1 type C, CCA/ACA-treated, 25′		8.60	5.581		278	285	33	596	770
6020	30′		7.70	6.234		340	320	36.50	696.50	895
6040	35′		5.80	8.276		475	420	48.50	943.50	1,225
6060	40′		5.30	9.057		555	460	53.50	1,068.50	1,375
6080	45′		4.70	10.213		675	520	60	1,255	1,600
6100	50′		4.20	11.429		740	585	67.50	1,392.50	1,775
6120	55′		3.80	12.632		835	645	74.50	1,554.50	1,975
6200	Electric & tel sitework, 20′ high, treated wd., see Section 26 56 13.10	R-3	3.10	6.452		189	375	42	606	815
6400	25′ high		2.90	6.897		238	400	44.50	682.50	910
6600	30′ high		2.60	7.692		340	445	50	835	1,100
6800	35′ high		2.40	8.333		480	485	54	1,019	1,325
7000	40′ high		2.30	8.696		640	505	56.50	1,201.50	1,525
7200	45′ high		1.70	11.765		870	680	76	1,626	2,075
7400	Cross arms with hardware & insulators									
7600	4′ long	1 Elec	2.50	3.200	Ea.	149	186		335	440
7800	5′ long		2.40	3.333		165	194		359	470
8000	6′ long		2.20	3.636		171	212		383	505
9000	Disposal of pole & hardware surplus material	R-7	20.87	2.300	Mile		95	7.95	102.95	154
9100	Disposal of crossarms & hardware surplus material	"	40	1.200	"		49.50	4.15	53.65	80.50

33 71 19 – Electrical Underground Ducts and Manholes

33 71 19.15 Underground Ducts and Manholes

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor (2018 Bare Costs)	Equipment (2018 Bare Costs)	Total (2018 Bare Costs)	Total Incl O&P
0010	**UNDERGROUND DUCTS AND MANHOLES**									
0011	Not incl. excavation, backfill and concrete, in slab or duct bank									
1000	Direct burial									
1010	PVC, schedule 40, w/coupling, 1/2″ diameter	1 Elec	340	.024	L.F.	.30	1.37		1.67	2.38
1020	3/4″ diameter		290	.028		.40	1.61		2.01	2.84
1030	1″ diameter		260	.031		.66	1.79		2.45	3.41
1040	1-1/2″ diameter		210	.038		.97	2.22		3.19	4.38
1050	2″ diameter		180	.044		1.26	2.59		3.85	5.25
1060	3″ diameter	2 Elec	240	.067		2.26	3.88		6.14	8.30
1070	4″ diameter		160	.100		3.09	5.80		8.89	12.10
1080	5″ diameter		120	.133		4.61	7.75		12.36	16.65
1090	6″ diameter		90	.178		6.05	10.35		16.40	22
1110	Elbows, 1/2″ diameter	1 Elec	48	.167	Ea.	.62	9.70		10.32	15.20
1120	3/4″ diameter		38	.211		.78	12.25		13.03	19.15
1130	1″ diameter		32	.250		1.30	14.55		15.85	23.50
1140	1-1/2″ diameter		21	.381		2.22	22		24.22	35.50
1150	2″ diameter		16	.500		2.91	29		31.91	46.50
1160	3″ diameter		12	.667		10.50	39		49.50	69.50
1170	4″ diameter		9	.889		17.05	51.50		68.55	96.50
1180	5″ diameter		8	1		26	58		84	116
1190	6″ diameter		5	1.600		36	93		129	179
1210	Adapters, 1/2″ diameter		52	.154		.21	8.95		9.16	13.65
1220	3/4″ diameter		43	.186		.34	10.85		11.19	16.55
1230	1″ diameter		39	.205		.48	11.95		12.43	18.40
1240	1-1/2″ diameter		35	.229		.79	13.30		14.09	21

33 71 23 – Insulators and Fittings

33 71 23.16 Post Insulators	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010 **POST INSULATORS**									
7400 Insulators, pedestal type	R-11	112	.500	Ea.		27.50	5.90	33.40	48
7490 See also line 33 71 39.13 1000									

33 71 26 – Transmission and Distribution Equipment

33 71 26.13 Capacitor Banks	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 **CAPACITOR BANKS**									
1300 Station capacitors									
1350 Synchronous, 13 to 26 kV	R-11	3.11	18.006	MVAR	7,375	995	213	8,583	9,850
1360 46 kV		3.33	16.817		9,425	930	199	10,554	12,000
1370 69 kV		3.81	14.698		9,275	815	174	10,264	11,600
1380 161 kV		6.51	8.602		8,650	475	102	9,227	10,400
1390 500 kV		10.37	5.400		7,525	299	64	7,888	8,800
1450 Static, 13 to 26 kV		3.11	18.006		6,250	995	213	7,458	8,600
1460 46 kV		3.01	18.605		7,900	1,025	220	9,145	10,500
1470 69 kV		3.81	14.698		7,675	815	174	8,664	9,875
1480 161 kV		6.51	8.602		7,125	475	102	7,702	8,675
1490 500 kV		10.37	5.400		6,500	299	64	6,863	7,675
1600 Voltage regulators, 13 to 26 kV		.75	74.667	Ea.	280,000	4,125	885	285,010	315,000

33 71 26.23 Current Transformers	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 **CURRENT TRANSFORMERS**									
4050 Current transformers, 13 to 26 kV	R-11	14	4	Ea.	3,450	221	47.50	3,718.50	4,175
4060 46 kV		9.33	6.002		10,000	330	71	10,401	11,600
4070 69 kV		7	8		10,400	445	94.50	10,939.50	12,300
4080 161 kV		1.87	29.947		33,800	1,650	355	35,805	40,100

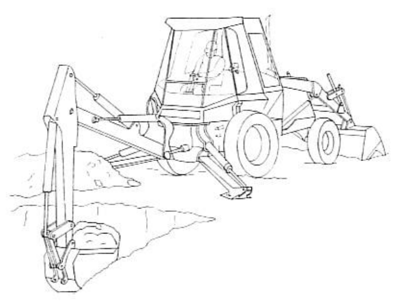
33 71 26.26 Potential Transformers	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 **POTENTIAL TRANSFORMERS**									
4100 Potential transformers, 13 to 26 kV	R-11	11.20	5	Ea.	4,925	277	59	5,261	5,875
4110 46 kV		8	7		10,100	385	82.50	10,567.50	11,800
4120 69 kV		6.22	9.003		10,700	500	106	11,306	12,700
4130 161 kV		2.24	25		23,200	1,375	296	24,871	27,900
4140 500 kV		1.40	40		69,000	2,225	475	71,700	80,000

33 71 39 – High-Voltage Wiring

33 71 39.13 Overhead High-Voltage Wiring	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010 **OVERHEAD HIGH-VOLTAGE WIRING**									
0100 Conductors, primary circuits									
0110 Material handling and spotting	R-5	9.78	8.998	W.Mile		455	124	579	825
0120 For river crossing, add		11	8			405	110	515	735
0150 Conductors, per wire, 210 to 636 kcmil		1.96	44.898		12,400	2,275	620	15,295	17,800
0160 795 to 954 kcmil		1.87	47.059		24,800	2,400	650	27,850	31,600
0170 1,000 to 1,600 kcmil		1.47	59.864		42,500	3,050	825	46,375	52,500
0180 Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
0200 For river crossing, add, 210 to 636 kcmil		1.24	70.968			3,600	980	4,580	6,525
0220 795 to 954 kcmil		1.09	80.734			4,100	1,125	5,225	7,425
0230 1,000 to 1,600 kcmil		.97	90.722			4,600	1,250	5,850	8,325
0240 Over 1,600 kcmil		.87	101			5,150	1,400	6,550	9,275
0300 Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
0400 Sagging	R-5	7.33	12.001	W.Mile		610	165	775	1,100
0500 Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
0510 161 kV		5.33	9.006			495	113	608	865
0520 345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800

33 71 39.13 Overhead High-Voltage Wiring		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0600	Make and install jumpers, per structure, 69 kV	R-8	3.20	15	Ea.	450	770	88	1,308	1,775
0620	161 kV		1.20	40		895	2,050	234	3,179	4,350
0640	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
0700	Spacers	R-10	68.57	.700		89.50	38.50	8.75	136.75	166
0720	For river crossings, add	"	60	.800			44	10	54	77
0800	Installing pulling line (500 kV only)	R-9	1.45	44.138	W.Mile	840	2,125	194	3,159	4,350
0810	Disposal of surplus material, high voltage conductors	R-7	6.96	6.897	Mile		285	24	309	460
0820	With trailer mounted reel stands	"	13.71	3.501	"		145	12.10	157.10	234
0900	Insulators and hardware, primary circuits									
0920	Material handling and spotting, 69 kV	R-7	480	.100	Ea.		4.13	.35	4.48	6.75
0930	161 kV		685.71	.070			2.89	.24	3.13	4.70
0950	345 to 500 kV		960	.050			2.06	.17	2.23	3.35
1000	Disk insulators, 69 kV	R-5	880	.100		91.50	5.10	1.38	97.98	109
1020	161 kV		977.78	.090		104	4.57	1.24	109.81	123
1040	345 to 500 kV		1100	.080		104	4.07	1.10	109.17	122
1060	See Section 33 71 23.16 for pin or pedestal insulator									
1100	Install disk insulator at river crossing, add									
1110	69 kV	R-5	586.67	.150	Ea.		7.60	2.07	9.67	13.75
1120	161 kV		880	.100			5.10	1.38	6.48	9.15
1140	345 to 500 kV		880	.100			5.10	1.38	6.48	9.15
1150	Disposal of surplus material, high voltage insulators	R-7	41.74	1.150	Mile		47.50	3.98	51.48	77
1300	Overhead ground wire installation									
1320	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1340	Overhead ground wire	R-5	1.76	50		3,300	2,550	690	6,540	8,200
1350	At river crossing, add		1.17	75.214			3,825	1,025	4,850	6,925
1360	Disposal of surplus material, grounding wire		41.74	2.108	Mile		107	29	136	194
1400	Installing conductors, underbuilt circuits									
1420	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1440	Conductors, per wire, 210 to 636 kcmil	R-5	1.96	44.898		12,400	2,275	620	15,295	17,800
1450	795 to 954 kcmil		1.87	47.059		24,800	2,400	650	27,850	31,600
1460	1,000 to 1,600 kcmil		1.47	59.864		42,500	3,050	825	46,375	52,500
1470	Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
1500	Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
1550	Sagging	R-5	8.80	10	W.Mile		510	138	648	915
1600	Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
1620	161 kV		5.33	9.006			495	113	608	865
1640	345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800
1700	Making and installing jumpers, per structure, 69 kV	R-8	5.87	8.177		450	420	48	918	1,175
1720	161 kV		.96	50		895	2,575	293	3,763	5,175
1740	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
1800	Spacers	R-10	96	.500		89.50	27.50	6.25	123.25	146
1810	Disposal of surplus material, conductors & hardware	R-7	6.96	6.897	Mile		285	24	309	460
2000	Insulators and hardware for underbuilt circuits									
2100	Material handling and spotting	R-7	1200	.040	Ea.		1.65	.14	1.79	2.68
2150	Disk insulators, 69 kV	R-8	600	.080		91.50	4.12	.47	96.09	107
2160	161 kV		686	.070		104	3.60	.41	108.01	121
2170	345 to 500 kV		800	.060		104	3.09	.35	107.44	120
2180	Disposal of surplus material, insulators & hardware	R-7	41.74	1.150	Mile		47.50	3.98	51.48	77
2300	Sectionalizing switches, 69 kV	R-5	1.26	69.841	Ea.	23,500	3,550	960	28,010	32,300
2310	161 kV		.80	110		26,600	5,600	1,525	33,725	39,400
2500	Protective devices		5.50	16		7,700	815	220	8,735	9,925
2600	Clearance poles, 8 poles per mile									
2650	In earth, 69 kV	R-5	1.16	75.862	Mile	6,325	3,850	1,050	11,225	13,900

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.	COST PER C.Y. LABOR	COST PER C.Y. 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.	.95	2.29	3.24
Hauling, 8 CY truck, cycle 0.5 mile, 20 MPH, 15 min. wait/Ld./Uld.	1.280	L.C.Y.	2.06	3.06	5.12
Spotter at earth fill dump or in cut	.020	Hr.		.97	.97
TOTAL			3.01	6.32	9.33

G1030 120	Excavate and Haul Common Earth	COST PER C.Y. EQUIP.	COST PER C.Y. LABOR	COST PER C.Y. TOTAL
1000	Excavate common earth, 1/2 C.Y. backhoe, two 8 C.Y. dump trucks, 1 MRT	3.01	6.30	9.31
1200	Three 8 C.Y. dump trucks, 3 mile round trip	5.95	10.80	16.75
1400	Two 12 C.Y. dump trucks, 4 mile round trip	6.30	8.25	14.55
1600	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mile round trip	3.03	5.25	8.28
1700	Five 8 C.Y. dump trucks, 3 mile round trip	5.90	10	15.90
1800	Two 12 C.Y. dump trucks, 2 mile round trip	5.35	6.40	11.75
1900	Two 16 C.Y. dump trailers, 3 mile round trip	5.15	5.45	10.60
2000	Two 20 C.Y. dump trailers, 4 mile round trip	4.95	5.35	10.30
2200	1-1/2 C.Y. backhoe, eight 8 C.Y. dump trucks, 3 mile round trip	5.70	8.95	14.65
2300	Four 12 C.Y. dump trucks, 2 mile round trip	4.94	5.50	10.44
2400	Six 12 C.Y. dump trucks, 4 mile round trip	5.95	6.35	12.30
2500	Three 16 C.Y. dump trailers, 2 mile round trip	4.17	4.07	8.24
2600	Two 20 C.Y. dump trailers, 1 mile round trip	3.33	3.32	6.65
2700	Three 20 C.Y. dump trailers, 3 mile round trip	4.38	4.18	8.56
2800	2-1/2 C.Y. excavator, six 12 C.Y. dump trucks, 1 mile round trip	3.57	3.72	7.29
2900	Eight 12 C.Y. dump trucks, 3 mile round trip	5.10	5.20	10.30
3000	Four 16 C.Y. dump trailers, 1 mile round trip	3.66	3.37	7.03
3100	Six 16 C.Y. dump trailers, 3 mile round trip	4.91	4.59	9.50
3200	Six 20 C.Y. dump trailers, 4 mile round trip	4.57	4.23	8.80
3400	3-1/2 C.Y. backhoe, six 16 C.Y. dump trailers, 1 mile round trip	3.89	3.23	7.12
3600	Ten 16 C.Y. dump trailers, 4 mile round trip	5.55	4.60	10.15
3800	Eight 20 C.Y. dump trailers, 3 mile round trip	4.46	3.65	8.11
4000	1/2 C.Y. pwr. shovel, four 8 C.Y. dump trucks, 2 mile round trip	5.30	8.10	13.40
4100	Two 12 C.Y. dump trucks, 1 mile round trip	4.32	4.96	9.28
4200	Four 12 C.Y. dump trucks, 4 mile round trip	6.40	6.70	13.10
4300	Two 16 C.Y. dump trailers, 2 mile round trip	4.68	4.85	9.53
4400	Two 20 C.Y. dump trailers, 4 mile round trip	5.40	5.55	10.95
4800	3/4 C.Y. pwr. shovel, six 8 C.Y. dump trucks, 2 mile round trip	5.20	7.85	13.05
4900	Three 12 C.Y. dump trucks, 1 mile round trip	4.21	4.28	8.49
5000	Five 12 C.Y. dump trucks, 4 mile round trip	6.50	6.45	12.95
5100	Three 16 C.Y. dump trailers, 3 mile round trip	5.60	5.20	10.80
5200	Three 20 C.Y. dump trailers, 4 mile round trip	5.25	4.84	10.09
5400	1-1/2 C.Y. pwr. shovel, six 12 C.Y. dump trucks, 1 mile round trip	3.75	3.71	7.46
5500	Ten 12 C.Y. dump trucks, 4 mile round trip	6.05	5.90	11.95

	DIVISION	NEW JERSEY																	
		NEW BRUNSWICK			NEWARK			PATERSON			POINT PLEASANT			SUMMIT			TRENTON		
		088 - 089			070 - 071			074 - 075			087			079			085 - 086		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
015433	CONTRACTOR EQUIPMENT		95.9	95.9		98.8	98.8		98.8	98.8		95.9	95.9		98.8	98.8		95.9	95.9
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	102.2	106.0	104.9	100.9	106.3	104.7	99.4	106.3	104.2	103.7	105.9	105.3	98.1	106.3	103.9	89.0	105.9	100.9
0310	Concrete Forming & Accessories	104.3	146.4	140.6	104.4	146.5	140.7	101.4	146.4	140.2	98.8	145.5	139.1	102.2	146.5	140.4	100.5	145.3	139.1
0320	Concrete Reinforcing	76.7	150.5	113.9	99.7	150.5	125.3	101.3	150.5	126.1	76.7	150.5	113.9	78.1	150.5	114.6	100.7	119.9	110.4
0330	Cast-in-Place Concrete	96.3	141.9	113.6	93.9	136.1	109.9	84.7	136.1	104.2	96.3	142.9	114.0	70.7	136.1	95.6	94.8	140.6	112.2
03	CONCRETE	97.5	143.8	118.7	91.6	142.1	114.7	87.1	142.1	112.2	97.2	143.8	118.5	78.2	142.1	107.4	91.9	137.6	112.8
04	MASONRY	109.7	143.0	130.4	96.6	143.0	125.4	94.0	143.0	124.4	98.0	141.1	124.7	96.6	143.0	125.4	101.9	141.1	126.2
05	METALS	96.6	120.5	103.9	102.0	123.7	108.7	95.5	123.7	104.2	96.6	120.3	103.9	94.3	123.7	103.4	102.0	109.1	104.2
06	WOOD, PLASTICS & COMPOSITES	111.5	146.1	130.8	100.0	146.2	125.7	105.0	146.2	127.9	104.1	146.1	127.5	106.1	146.2	128.4	93.5	146.1	122.8
07	THERMAL & MOISTURE PROTECTION	101.3	134.8	115.5	109.8	136.4	121.1	108.7	135.6	120.1	101.3	137.6	116.7	109.1	136.4	120.6	101.7	138.6	117.3
08	OPENINGS	92.0	144.2	104.0	100.6	144.2	110.6	107.3	144.2	115.8	93.8	144.2	105.3	108.3	144.2	116.5	98.5	136.7	107.3
0920	Plaster & Gypsum Board	113.3	147.0	136.0	102.5	147.0	132.4	110.2	147.0	134.9	108.4	147.0	134.3	109.1	147.0	134.6	103.4	147.0	132.7
0950, 0980	Ceilings & Acoustic Treatment	91.4	147.0	128.9	98.8	147.0	131.3	97.3	147.0	130.8	91.4	147.0	128.9	87.8	147.0	127.7	97.9	147.0	131.0
0960	Flooring	90.0	191.9	118.3	87.4	191.9	116.3	82.9	191.9	113.1	87.5	168.1	109.8	83.1	191.9	113.3	91.9	187.0	118.2
0970, 0990	Wall Finishes & Painting/Coating	83.0	145.9	119.6	85.4	145.9	120.6	84.0	145.9	120.1	83.0	145.9	119.6	84.0	145.9	120.1	86.6	145.9	121.2
09	FINISHES	89.6	155.3	125.4	90.7	155.4	125.9	88.0	155.4	124.6	88.2	150.9	122.3	86.4	155.4	123.9	92.4	154.2	126.0
COVERS	DIVS. 10 - 14, 25, 28, 41, 43, 44, 46	100.0	131.7	107.0	100.0	131.8	107.1	100.0	131.8	107.1	100.0	116.4	103.7	100.0	131.8	107.1	100.0	119.4	104.3
21, 22, 23	FIRE SUPPRESSION, PLUMBING & HVAC	99.8	137.5	115.9	100.0	137.5	116.1	100.1	137.5	116.1	99.8	136.5	115.5	99.9	137.5	116.0	100.2	136.2	115.6
26, 27, 3370	ELECTRICAL, COMMUNICATIONS & UTIL.	93.9	141.2	118.5	103.1	140.9	122.8	99.5	142.9	122.1	93.2	137.2	116.1	95.4	142.9	120.1	101.2	135.9	119.2
MF2016	WEIGHTED AVERAGE	97.4	137.8	115.1	99.1	137.9	116.1	97.4	138.2	115.3	96.8	135.8	113.9	95.8	138.2	114.3	98.5	133.9	114.0

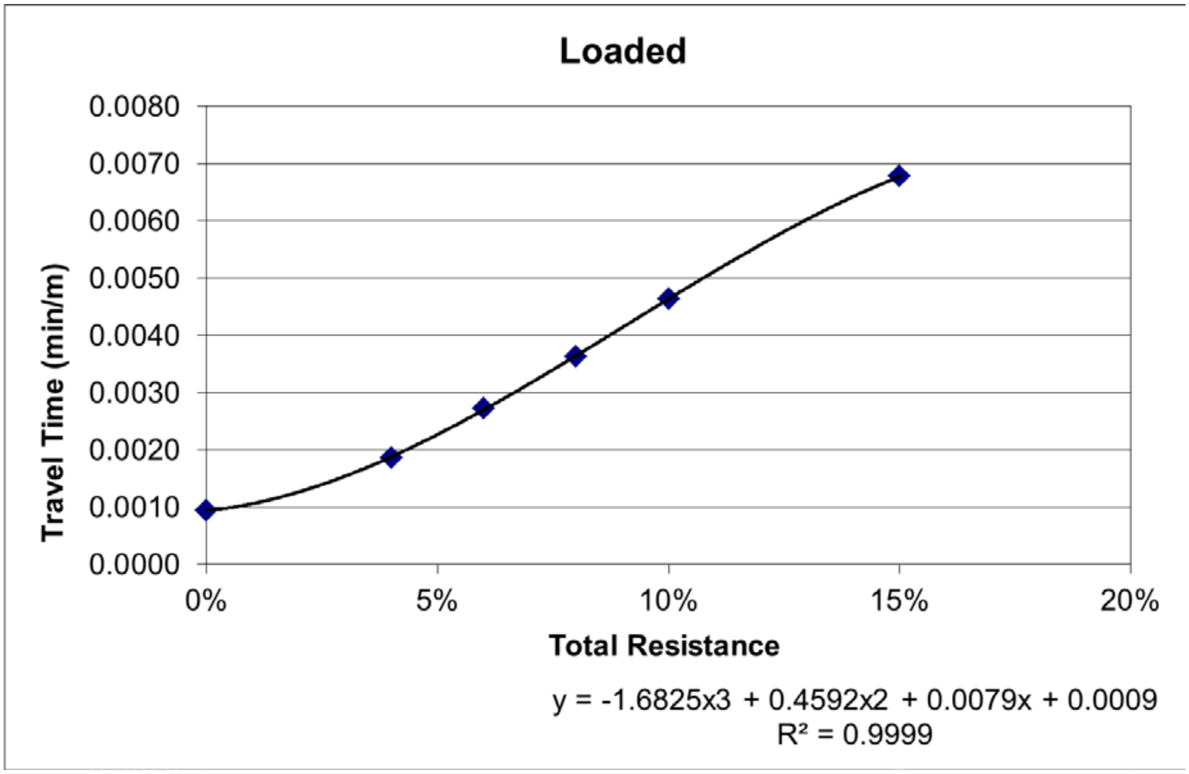
	DIVISION	NEW JERSEY			NEW MEXICO														
		VINELAND			ALBUQUERQUE			CARRIZOZO			CLOVIS			FARMINGTON			GALLUP		
		080, 083			870 - 872			883			881			874			873		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
015433	CONTRACTOR EQUIPMENT		96.3	96.3		111.0	111.0		111.0	111.0		111.0	111.0		111.0	111.0		111.0	111.0
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	93.9	104.7	101.4	92.3	102.4	99.4	112.0	102.4	105.3	98.8	102.4	101.3	98.8	102.4	101.3	108.5	102.4	104.2
0310	Concrete Forming & Accessories	96.0	144.0	137.4	99.0	64.1	68.9	97.1	64.1	68.6	97.1	64.0	68.5	99.1	64.1	68.9	99.1	64.1	68.9
0320	Concrete Reinforcing	75.8	135.4	105.9	97.0	71.0	83.9	109.7	71.0	90.2	110.9	71.0	90.8	106.1	71.0	88.4	101.5	71.0	86.1
0330	Cast-in-Place Concrete	84.0	140.9	105.6	93.6	70.1	84.7	94.7	70.1	85.3	94.6	70.0	85.3	94.5	70.1	85.2	88.9	70.1	81.8
03	CONCRETE	86.3	139.8	110.8	93.3	68.8	82.1	114.3	68.8	93.5	102.6	68.7	87.1	96.7	68.8	83.9	102.9	68.8	87.3
04	MASONRY	98.6	141.1	125.0	107.3	60.0	78.0	106.9	60.0	77.8	106.9	60.0	77.8	116.9	60.0	81.6	101.6	60.0	75.8
05	METALS	96.5	113.9	101.8	109.2	91.0	103.6	105.2	91.0	100.8	104.8	90.8	100.5	106.8	91.0	101.9	105.9	91.0	101.3
06	WOOD, PLASTICS & COMPOSITES	101.0	144.6	125.2	94.7	64.6	77.9	92.4	64.6	77.0	92.4	64.6	77.0	94.8	64.6	78.0	94.8	64.6	78.0
07	THERMAL & MOISTURE PROTECTION	100.8	137.6	116.4	96.9	70.8	85.8	99.5	70.8	87.3	98.2	70.8	86.6	97.1	70.8	86.0	98.2	70.8	86.6
08	OPENINGS	93.3	139.1	103.8	98.5	65.8	91.0	96.6	65.8	89.5	96.7	65.8	89.7	100.8	65.8	92.8	100.9	65.8	92.8
0920	Plaster & Gypsum Board	106.8	145.4	132.7	100.6	63.4	75.6	77.6	63.4	68.1	77.6	63.4	68.1	92.7	63.4	73.0	92.7	63.4	73.0
0950, 0980	Ceilings & Acoustic Treatment	91.4	145.4	127.8	99.3	63.4	75.1	102.3	63.4	76.1	102.3	63.4	76.1	97.1	63.4	74.4	97.1	63.4	74.4
0960	Flooring	86.6	168.1	109.2	87.7	69.5	82.7	98.5	69.5	90.4	98.5	69.5	90.4	89.3	69.5	83.8	89.3	69.5	83.8
0970, 0990	Wall Finishes & Painting/Coating	83.0	145.9	119.6	95.3	52.8	70.5	93.6	52.8	69.8	93.6	52.8	69.8	89.9	52.8	68.3	89.9	52.8	68.3
09	FINISHES	87.0	150.0	121.3	89.4	63.6	75.4	93.9	63.6	77.4	92.6	63.6	76.8	88.3	63.6	74.9	89.6	63.6	75.4
COVERS	DIVS. 10 - 14, 25, 28, 41, 43, 44, 46	100.0	119.4	104.3	100.0	84.0	96.5	100.0	84.0	96.5	100.0	84.0	96.5	100.0	84.0	96.5	100.0	84.0	96.5
21, 22, 23	FIRE SUPPRESSION, PLUMBING & HVAC	99.8	131.9	113.5	100.2	69.2	86.9	98.1	69.2	85.7	98.1	68.8	85.6	100.0	69.2	86.8	98.1	69.2	85.7
26, 27, 3370	ELECTRICAL, COMMUNICATIONS & UTIL.	93.2	144.6	119.9	88.1	88.5	88.3	91.7	88.5	90.0	89.4	88.5	88.9	86.2	88.5	87.4	85.6	88.5	87.1
MF2016	WEIGHTED AVERAGE	95.0	134.4	112.2	98.5	75.1	88.3	101.1	75.1	89.7	98.9	75.0	88.4	99.1	75.1	88.6	98.9	75.1	88.5

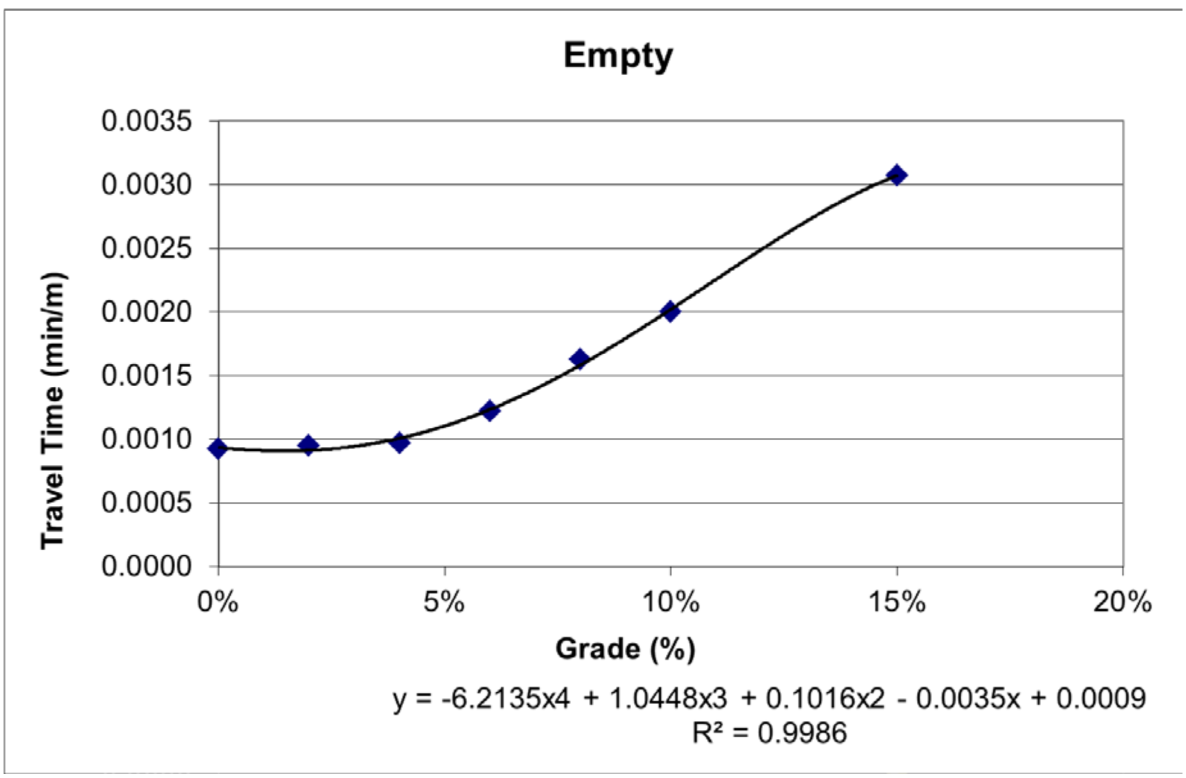
	DIVISION	NEW MEXICO																	
		LAS CRUCES			LAS VEGAS			ROSWELL			SANTA FE			SOCORRO			TRUTH/CONSEQUENCES		
		880			877			882			875			878			879		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
015433	CONTRACTOR EQUIPMENT		85.7	85.7		111.0	111.0		111.0	111.0		111.0	111.0		111.0	111.0		85.7	85.7
0241, 31 - 34	SITE & INFRASTRUCTURE, DEMOLITION	99.0	80.8	86.3	97.9	102.4	101.1	101.0	102.4	102.0	102.2	102.4	102.3	94.4	102.4	100.0	114.9	80.9	91.0
0310	Concrete Forming & Accessories	93.8	63.0	67.2	99.1	64.1	68.9	97.1	64.1	68.6	97.8	64.1	68.7	99.1	64.1	68.9	96.8	63.0	67.6
0320	Concrete Reinforcing	106.4	70.9	88.5	103.3	71.0	87.0	110.9	71.0	90.8	96.5	71.0	83.7	105.3	71.0	88.0	98.4	70.9	84.5
0330	Cast-in-Place Concrete	89.4	62.6	79.2	91.9	70.1	83.6	94.6	70.1	85.3	97.5	70.1	87.1	90.0	70.1	82.5	98.6	62.6	85.0
03	CONCRETE	81.3	65.3	74.0	94.3	68.8	82.6	103.4	68.8	87.6	93.5	68.8	82.2	93.1	68.8	82.0	87.1	65.3	77.1
04	MASONRY	102.2	59.6	75.8	101.9	60.0	75.9	118.3	60.0	82.1	94.9	60.0	73.2	101.8	60.0	75.9	99.0	59.6	74.6
05	METALS	103.6	83.0	97.2	105.6	91.0	101.1	106.1	91.0	101.4	102.7	91.0	99.1	105.9	91.0	101.3	105.5	83.0	98.6
06	WOOD, PLASTICS & COMPOSITES	81.4	63.5	71.4	94.8	64.6	78.0	92.4	64.6	77.0	93.9	64.6	77.6	94.8	64.6	78.0	85.9	63.5	73.5
07	THERMAL & MOISTURE PROTECTION	85.7	65.9	77.3	96.7	70.8	85.7	98.4	70.8	86.7	99.2	70.8	87.2	96.6	70.8	85.7	85.6	65.9	77.2
08	OPENINGS	92.3	65.2	86.1	97.3	65.8	90.1	96.6	65.8	89.5	100.0	65.8	92.2	97.1	65.8	89.9	90.7	65.2	84.9
0920	Plaster & Gypsum Board	75.9	63.4	67.5	92.7	63.4	73.0	77.6	63.4	68.1	107.8	63.4	78.0	92.7	63.4	73.0	94.1	63.4	73.5
0950, 0980	Ceilings & Acoustic Treatment	88.0	63.4	71.4	97.1	63.4	74.4	102.3	63.4	76.1	97.7	63.4	74.6	97.1	63.4	74.4	85.9	63.4	70.7
0960	Flooring	129.6	69.5	112.9	89.3	69.5	83.8	98.5	69.5	90.4	97.0	69.5	89.4	89.3	69.5	83.8	118.0	69.5	104.5
0970, 0990	Wall Finishes & Painting/Coating	82.8	52.8	65.3	89.9	52.8	68.3	93.6	52.8	69.8	95.9	52.8	70.8	89.9	52.8	68.3	82.3	52.8	65.1
09	FINISHES	102.6	62.7	80.9	88.2	63.6	74.8	92.7	63.6	76.9	96.6	63.6	78.6	88.1	63.6	74.8	100.0	62.8	79.8
COVERS	DIVS. 10 - 14, 25, 28, 41, 43, 44, 46	100.0	81.5	95.9	100.0	84.0	96.5	100.0	84.0	96.5	100.0	84.0	96.5	100.0	84.0	96.5	100.0	81.5	95.9
21, 22, 23	FIRE SUPPRESSION, PLUMBING & HVAC	100.4	68.9	86.9	98.1	69.2	85.7	99.9	69.2	86.8	100.1	69.2	86.9	98.1	69.2	85.7	98.1	68.9	85.6
26, 27, 3370	ELECTRICAL, COMMUNICATIONS & UTIL.	91.4	88.5	89.9	87.7	88.5	88.1	90.8	88.5	89.6	99.8	88.5	93.9	86.0	88.5	87.3	89.6	88.5	89.0
MF2016	WEIGHTED AVERAGE	96.4	71.7	85.6	97.2	75.1	87.5	100.3	75.1	89.3	99.1	75.1	88.6	96.8	75.1	87.3	96.6	71.8	85.7

Appendix B.2.5

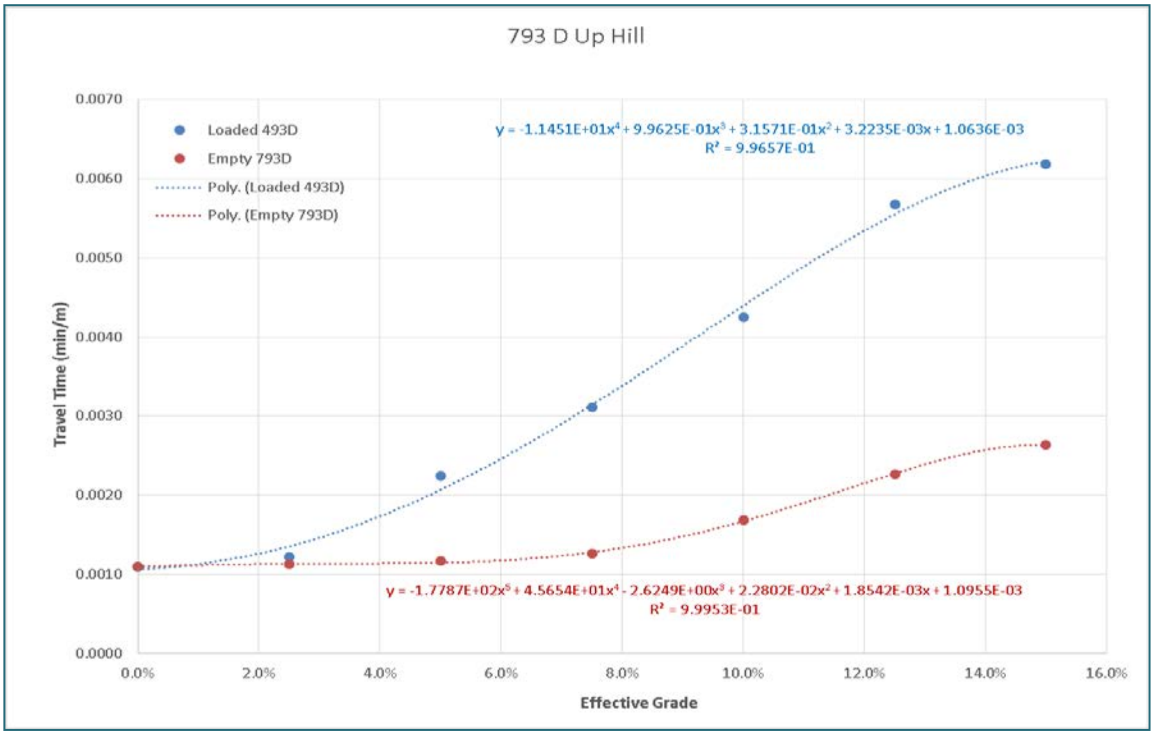
Equipment Curve Fits

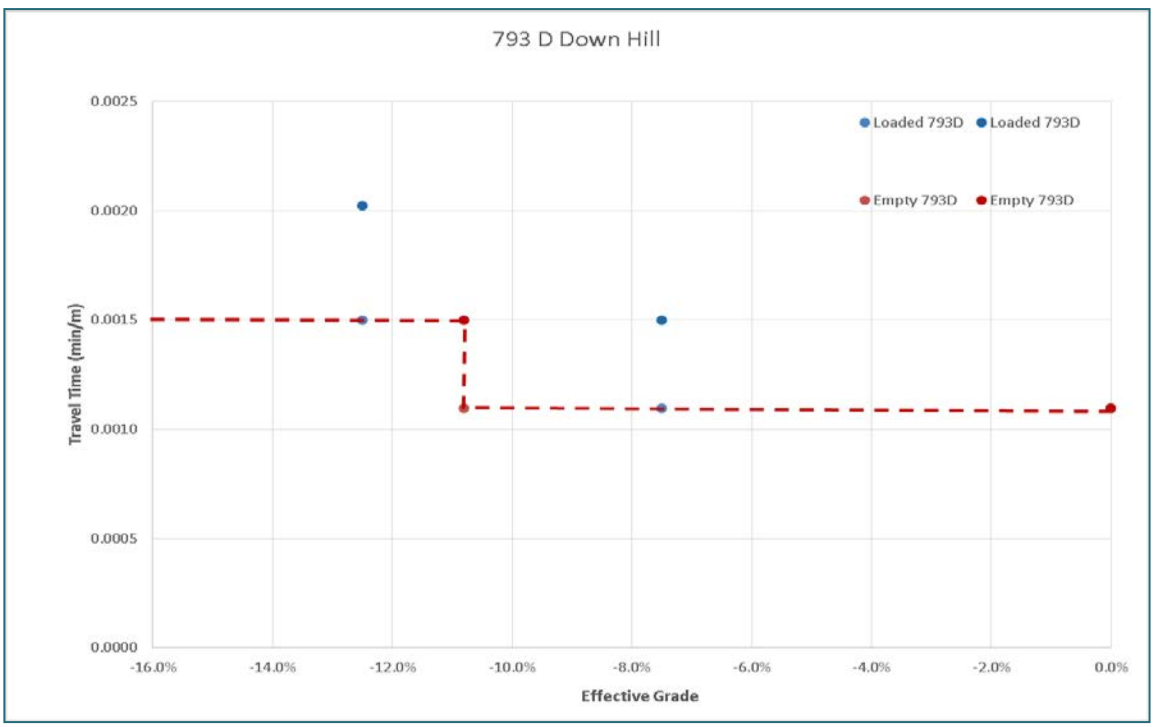
777F
Caterpillar Performance Handbook Edition 41 9-42





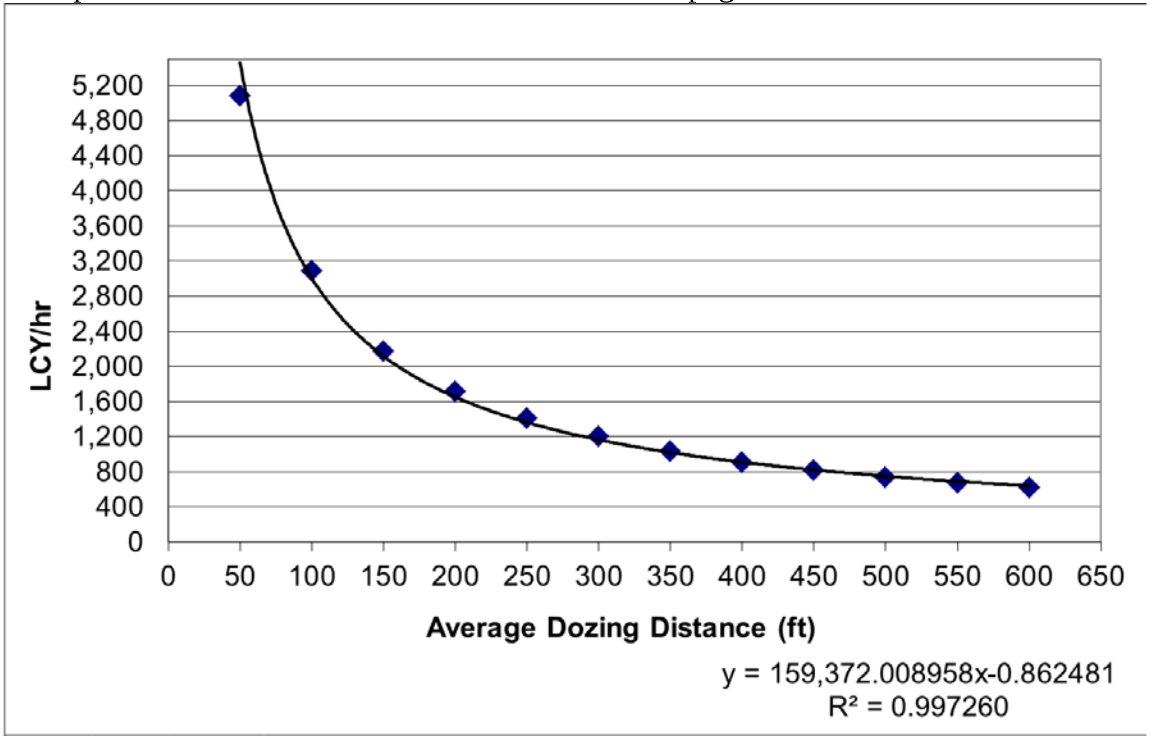
793D-Standard
Caterpillar Performance Handbook Edition 47





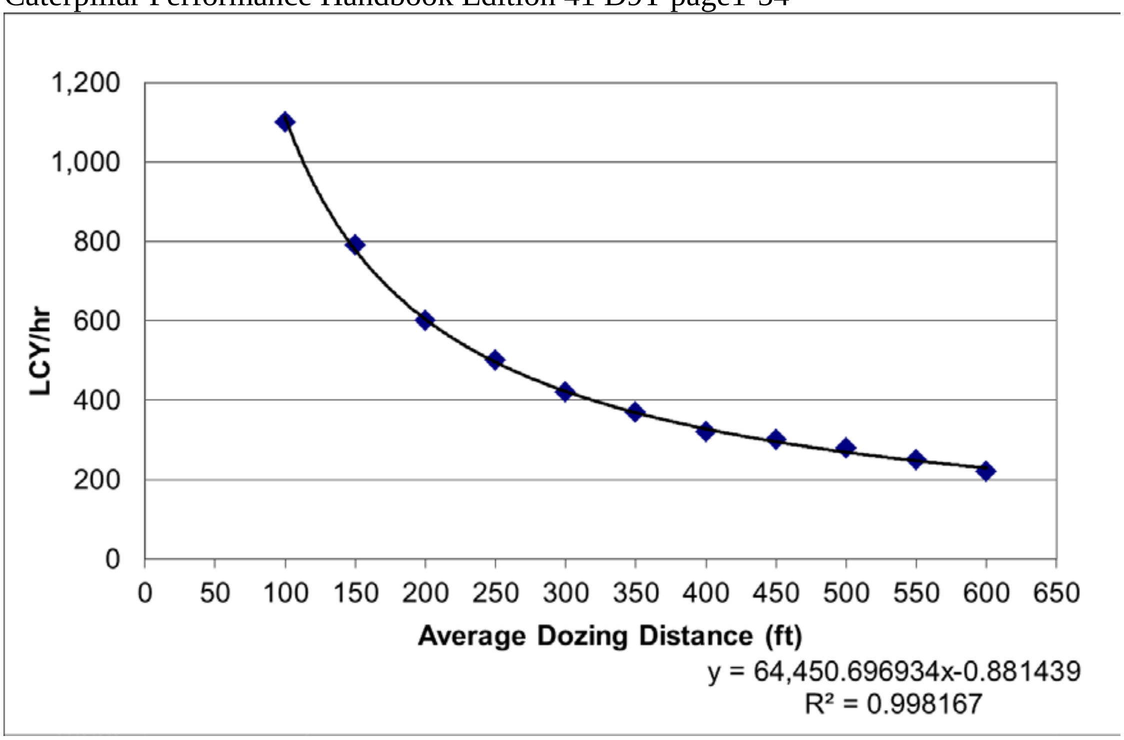
D11T CD

Caterpillar Performance Handbook Edition 42 D11R page1-53

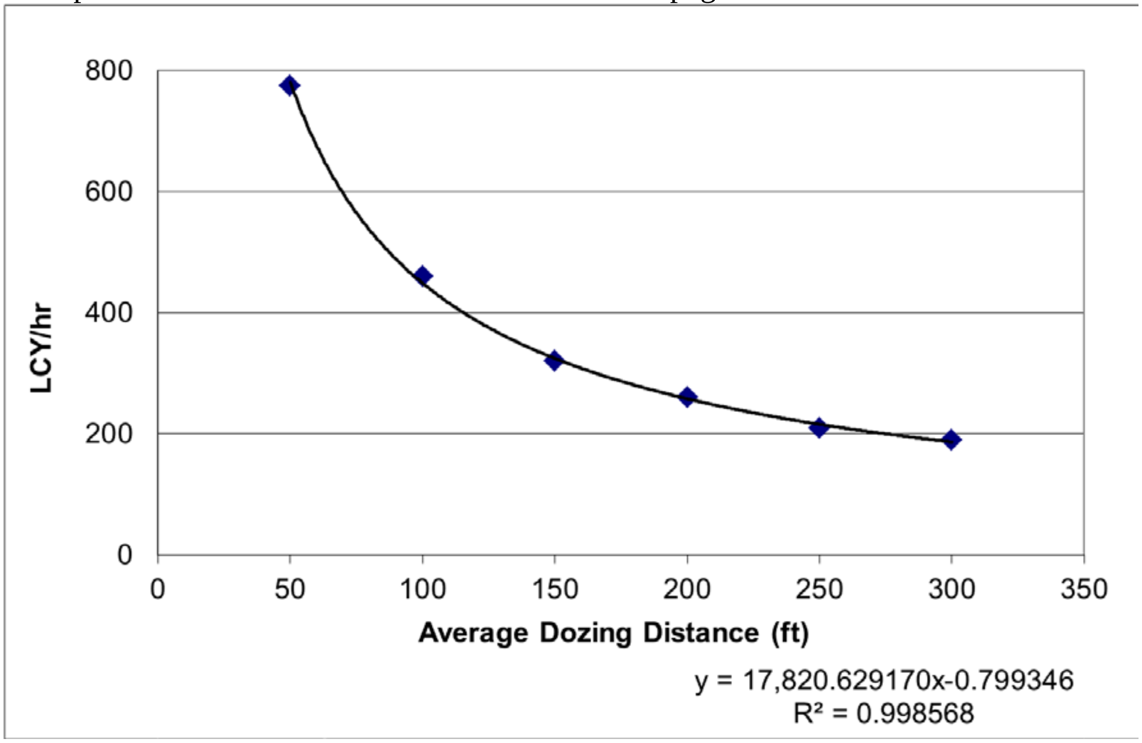


D9T

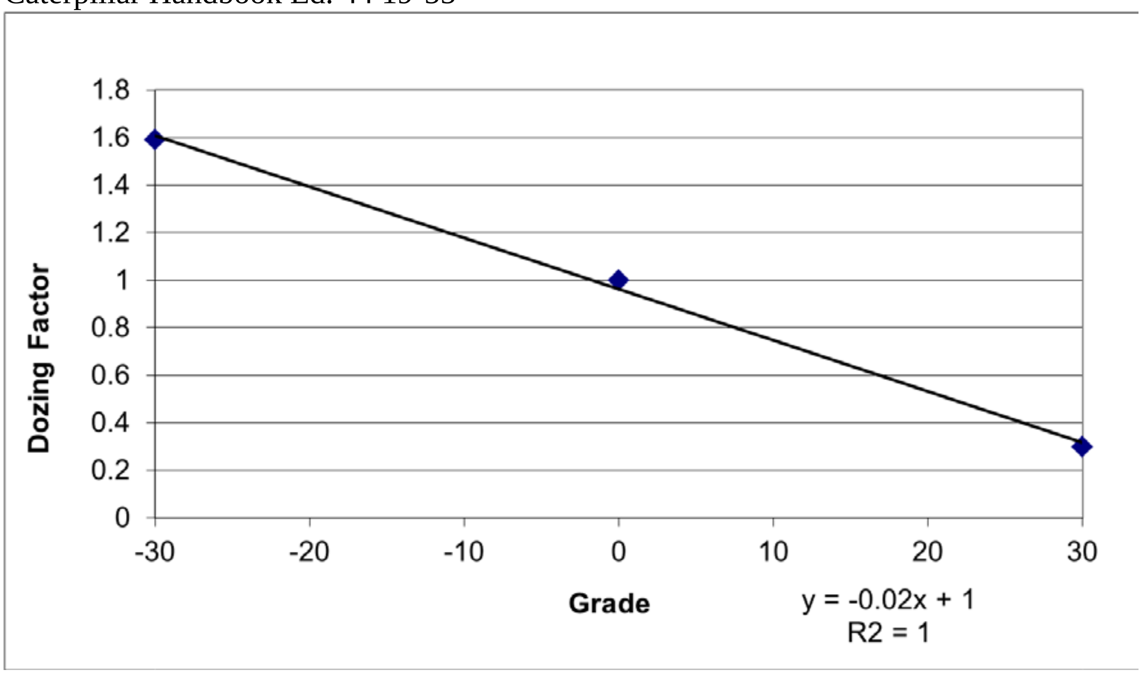
Caterpillar Performance Handbook Edition 41 D9T page1-54



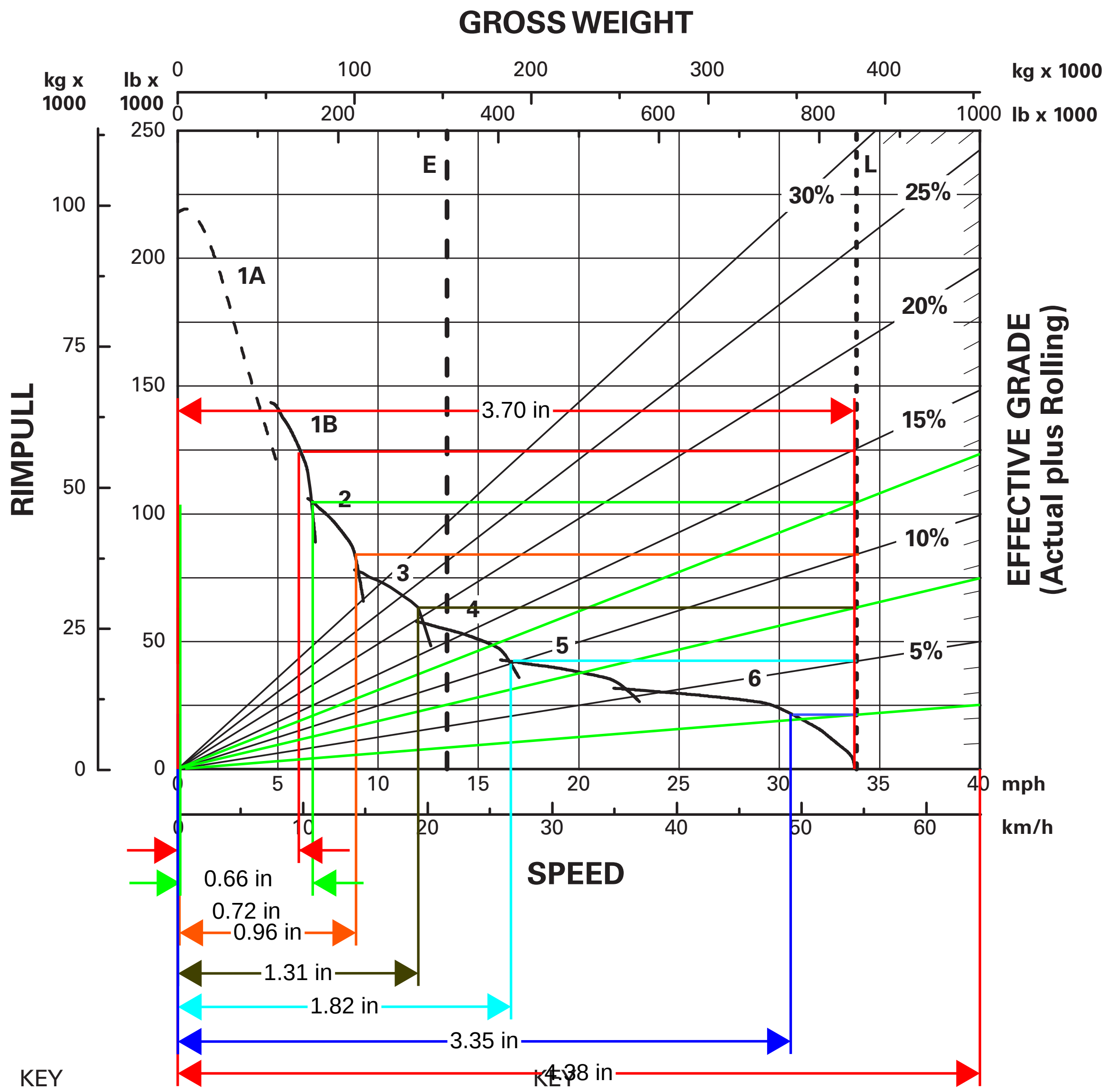
D6T
Caterpillar Performance Handbook Edition 41 D6T page1-55



Dozing Factor
Caterpillar Handbook Ed. 44 19-55



793D Rimpull-Speed-Gradeability
- Standard Arrangement*
- 40.00R57 Tires
- 1778 mm **(5'10")** Tire Radius

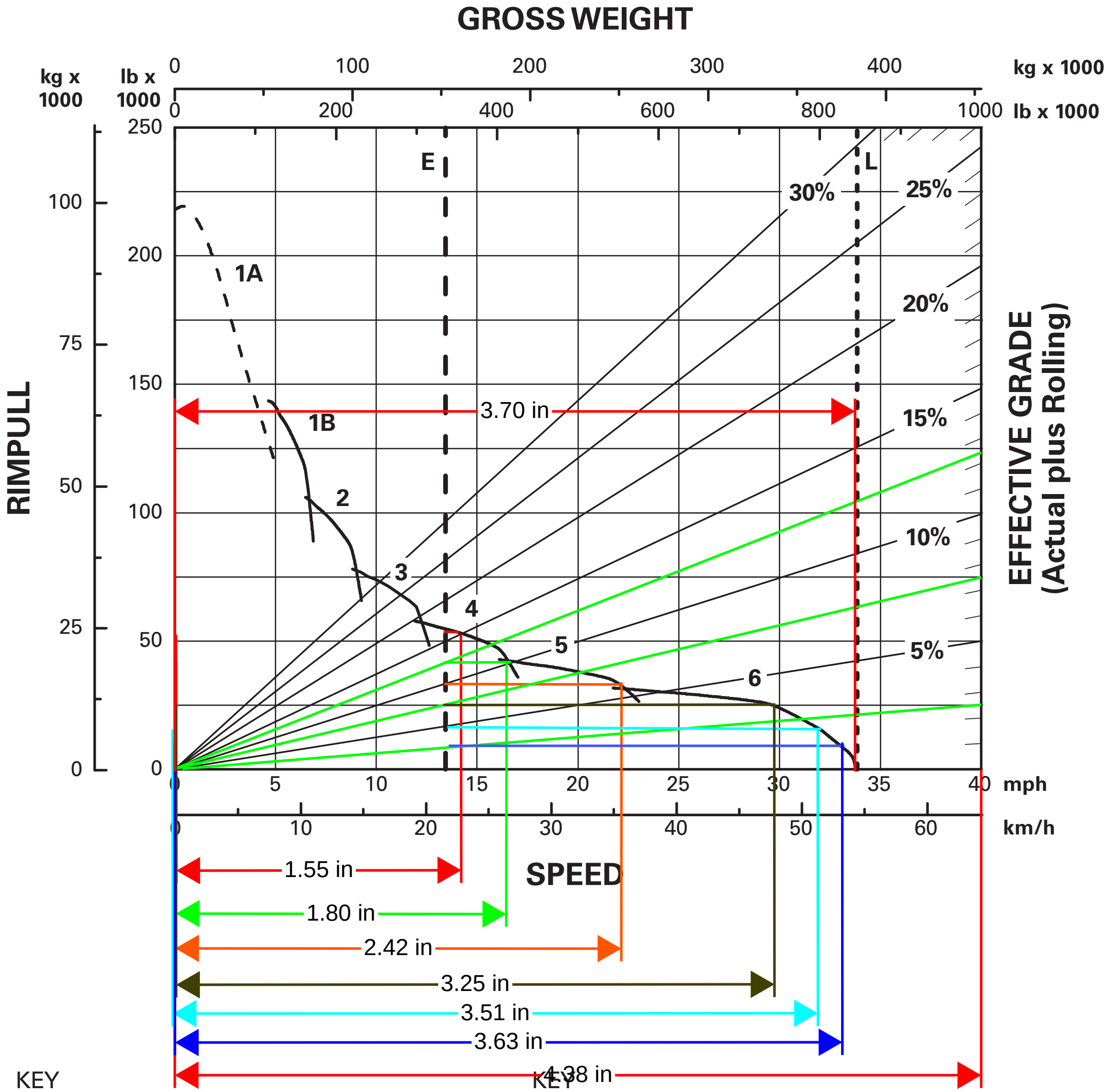


KEY
1A — 1st Gear (Torque Converter)
1B — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY
E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

*At Sea Level.

793D Rimpull-Speed-Gradeability
- Standard Arrangement*
- 40.00R57 Tires
- 1778 mm **(5'10")** Tire Radius



KEY

1A — 1st Gear (Torque Converter)
1B — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

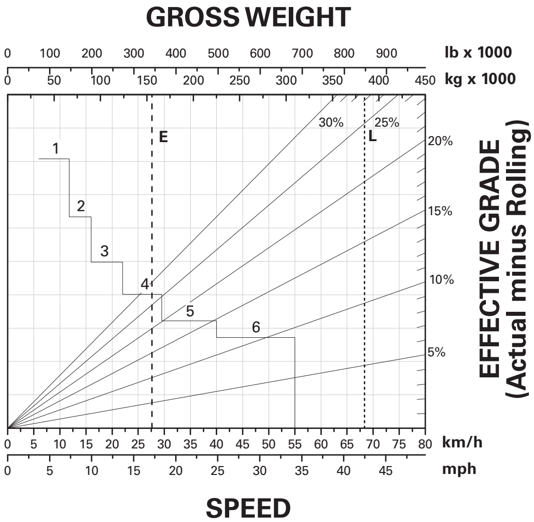
KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

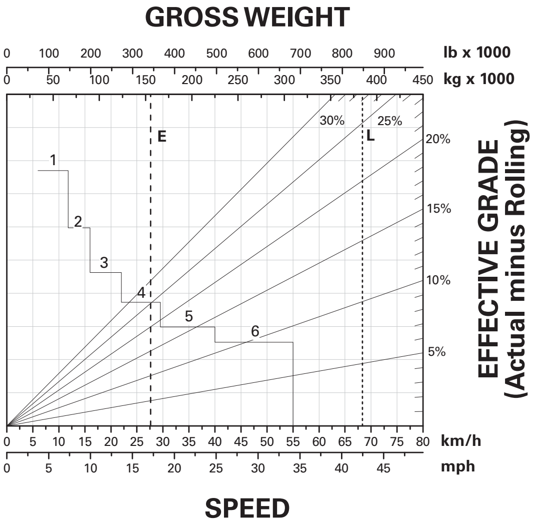
*At Sea Level.

793D Brake Performance

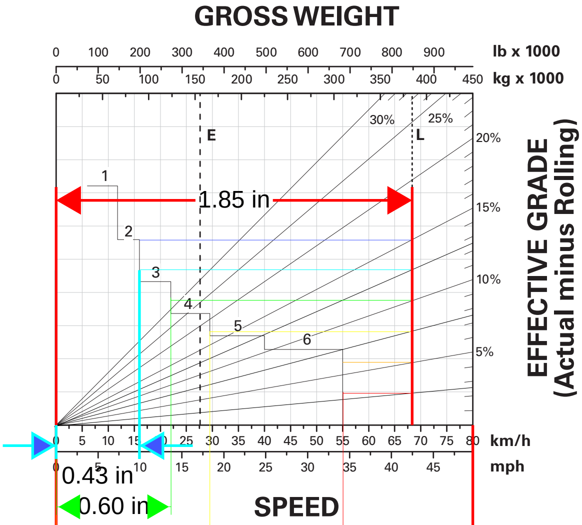
- Standard Arrangement*
- 450 m **(1500 ft)**
- 600 m **(2000 ft)**
- 900 m **(3000 ft)**
- 1500 m **(5000 ft)**



GRADE DISTANCE — 450 m (1500 ft)



GRADE DISTANCE — 600 m (2000 ft)

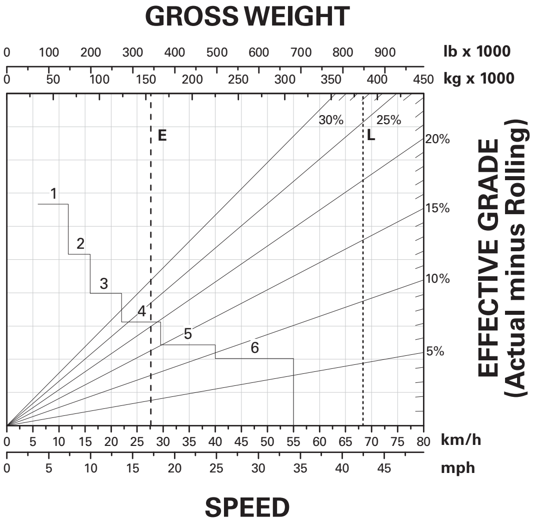


GRADE DISTANCE — 900 m (3000 ft)

0.80 in

1.49 in

2.17 in



GRADE DISTANCE — 1500 m (5000 ft)

KEY

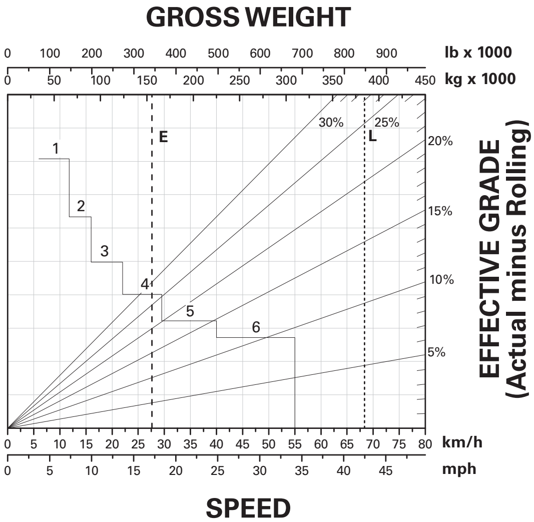
1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

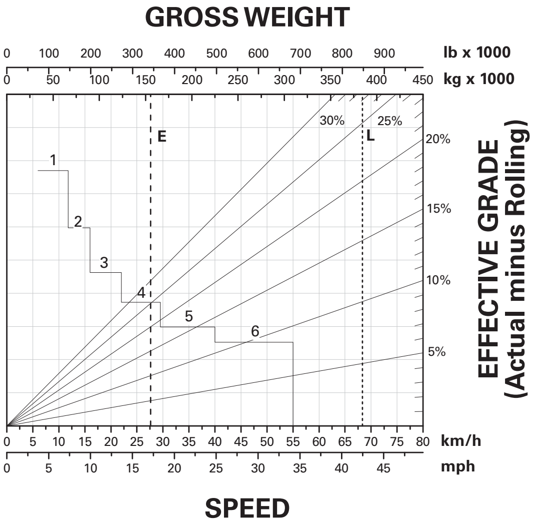
E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

*At Sea Level.

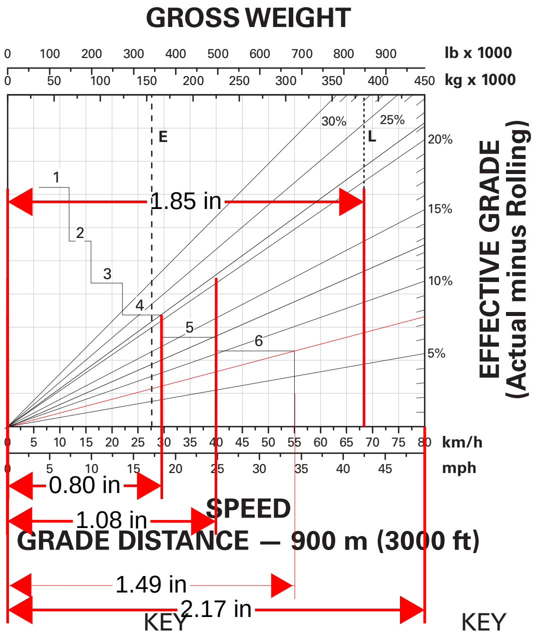
793D Brake Performance
- Standard Arrangement*
- 450 m **(1500 ft)** ● 600 m **(2000 ft)**
- 900 m **(3000 ft)** ● 1500 m **(5000 ft)**



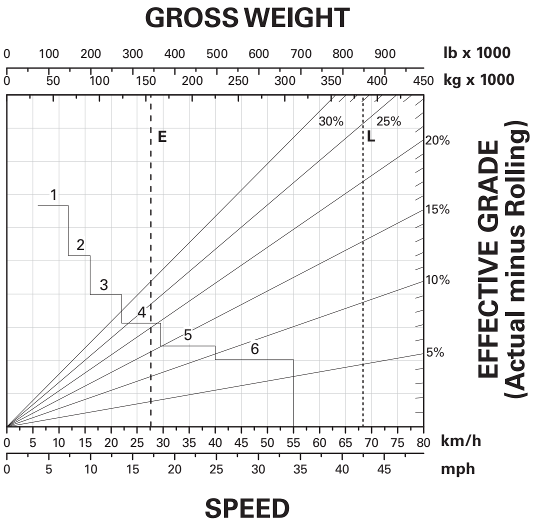
GRADE DISTANCE — 450 m (1500 ft)



GRADE DISTANCE — 600 m (2000 ft)



GRADE DISTANCE — 900 m (3000 ft)



GRADE DISTANCE — 1500 m (5000 ft)

KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

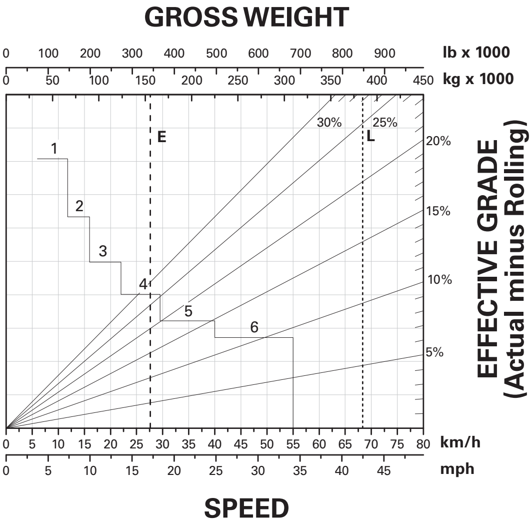
KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

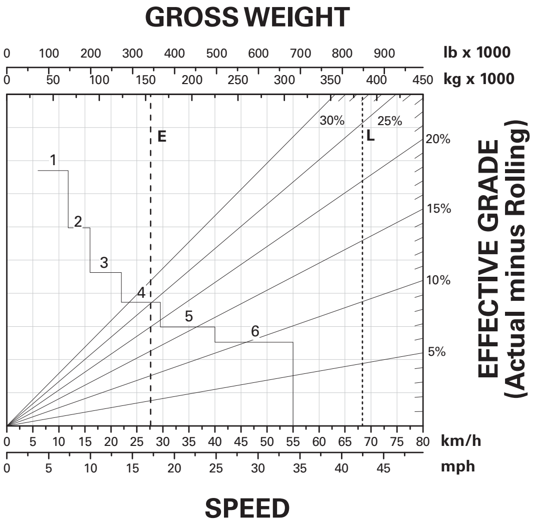
*At Sea Level.

793D Brake Performance

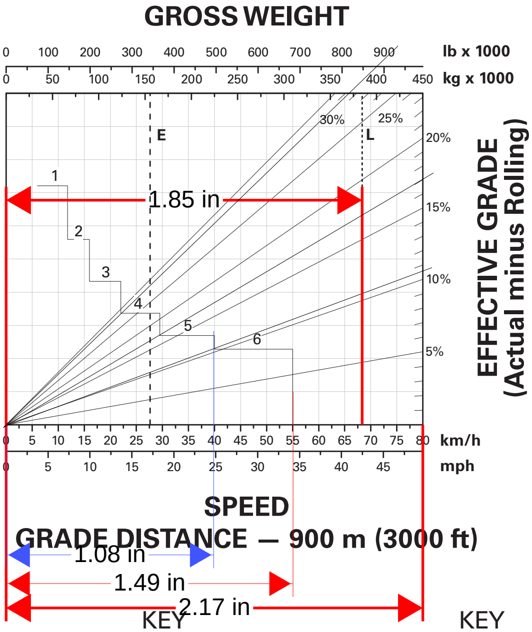
- Standard Arrangement*
- 450 m **(1500 ft)**
- 600 m **(2000 ft)**
- 900 m **(3000 ft)**
- 1500 m **(5000 ft)**



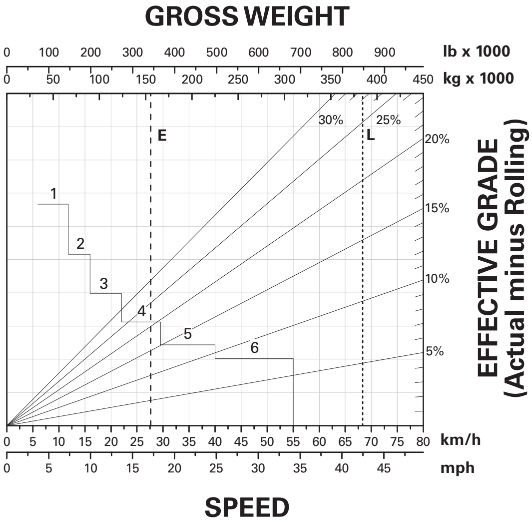
GRADE DISTANCE — 450 m (1500 ft)



GRADE DISTANCE — 600 m (2000 ft)



GRADE DISTANCE — 900 m (3000 ft)



GRADE DISTANCE — 1500 m (5000 ft)

KEY

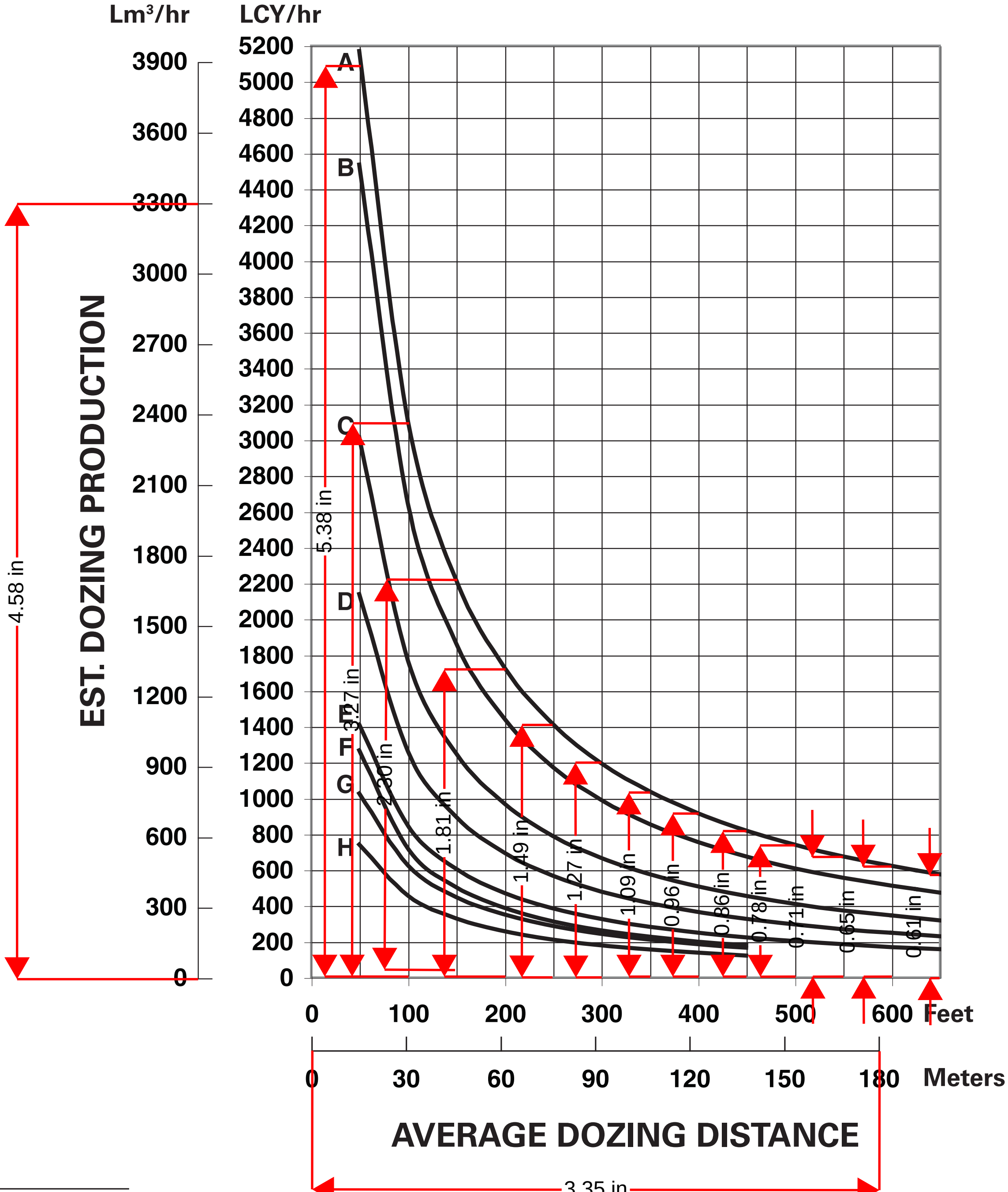
1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

*At Sea Level.

ESTIMATED DOZING PRODUCTION ● Universal Blades ● D7G through D11T CD



KEY

A — D11T CD
B — D11T
C — D10T
D — D9T
E — D8T
F — D7E
G — D7R Series 2
H — D7G

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

Appendix B.2.6

Misc. Caterpillar Handbook Sheets

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar, Peoria, Illinois, U.S.A.

JANUARY 2017

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.

SEBD0351-47

GENERAL

MINING AND EARTHMOVING

CONTENTS

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).

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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)

$$\text{Number of loads required} = \frac{12{,}500 \text{ BCY}}{16.2 \text{ BCY/Load}} = 772 \text{ Loads}$$

● ● ●

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. $\text{Load} = \frac{\text{Weight of load}}{\text{Bank density}} = \frac{42{,}000 \text{ lb}}{3125 \text{ lb/BCY}} = 13.4 \text{ BCY}$
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 (less delays) = Load/cycle × cycles/hr = 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. $$\text{Load} = \frac{\text{Weight of load}}{\text{Bank density}} = \frac{19\,050\text{ kg}}{1854\text{ kg/BCM}} = 10.3\text{ BCM}$$
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) = 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.

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):

Grade Resistance Factor = 10 kg/m ton × % grade
= 20 lb/U.S. ton × % grade

Grade resistance (assistance) is then obtained by multiplying the Grade Resistance Factor by the machine weight (GMW) in metric (U.S.) tons.

Grade Resistance = GR Factor × 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.

Grade Resistance = 1% of GMW × % 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.

Total Resistance = Rolling Resistance + 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.

Rolling Resistance (%) = 2% + 0.6% per cm tire penetration
= 2% + 1.5% per inch tire penetration
Grade Resistance (%) = % grade
Effective Grade (%) = RR (%) + GR (%)

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 wheels: 23 600 kg (52,000 lb)	Scraper unit 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.

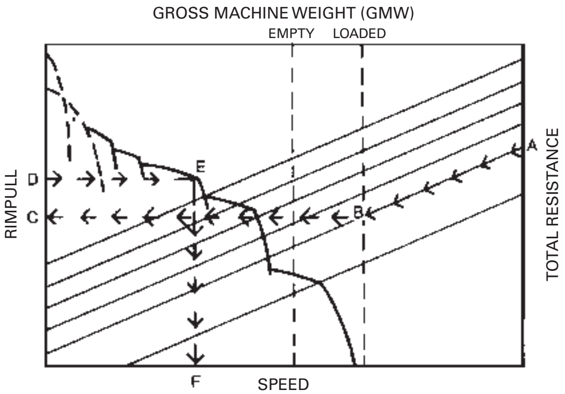
The Tables Section gives the altitude deration in percent of flywheel horsepower for current machines. It should be noted that some turbocharged engines can operate up to 4570 m (15,000 ft) before they require derating. Most machines are engineered to operate up to 1500-2290 m (5000-7500 ft) before they 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 rimpull 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.

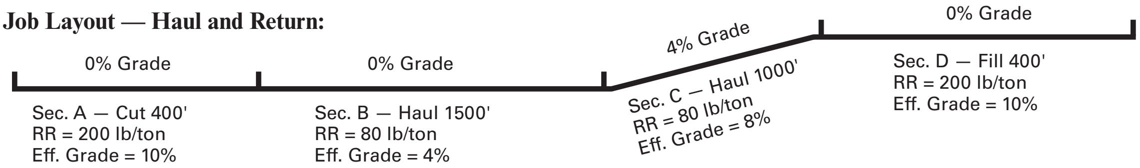
Example problem (English)

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 time*, 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

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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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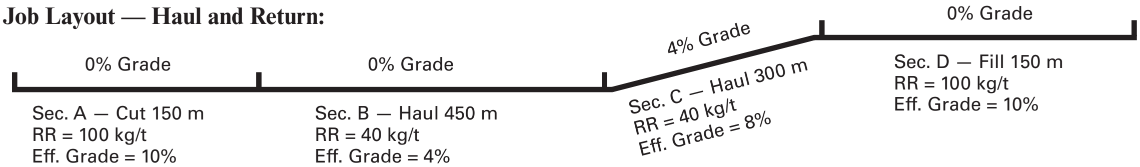
Example problem (Metric)

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

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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.

SYSTEMS

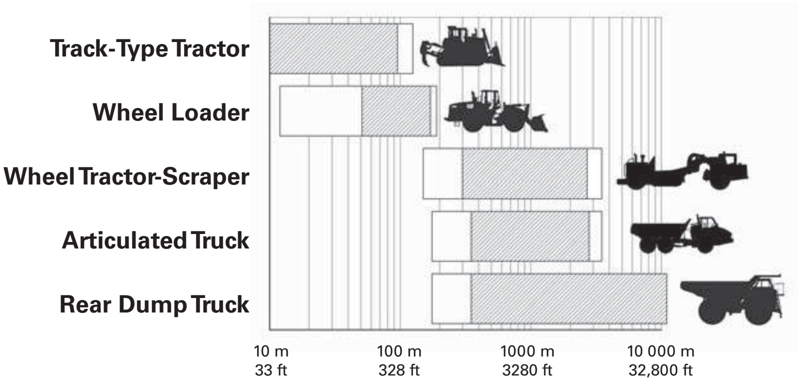
Caterpillar offers a variety of machines for different applications and jobs. Many of these separate machines function together in mining and earthmoving systems.

- Bulldozing with track-type tractors
- Load-and-Carry with wheel loaders
- Scrapers self-loading, elevator, auger, or push-pull configurations, or push-loaded by track-type tractors
- Articulated trucks loaded by excavators, track loaders or wheel loaders
- Off-highway trucks loaded by shovels, excavators or wheel loaders

Haul System Selection: In selecting a hauling system for a project, there may seem to be more than one "right" choice. Many systems may meet the distance, ground conditions, grade, material type, and production rate requirements. After considering all of the different factors, one hauling system usually provides better performance. This makes it critical for the dealer and customer to work together to get accurate information for their operation or project. Caterpillar is committed to providing the correct earthmoving system to match the customer's specific needs.

● ● ●

GENERAL LOADED HAUL DISTANCES FOR MOBILE SYSTEMS



LOADED HAUL DISTANCE

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

$$\%\text{ Grade} = \frac{\text{vertical change in elevation (rise)}}{\text{corresponding horizontal distance (run)}}$$

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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Notes —

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 Bias	Tires Radial	Track **	Track +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.

MOTO GRADERS

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.

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:

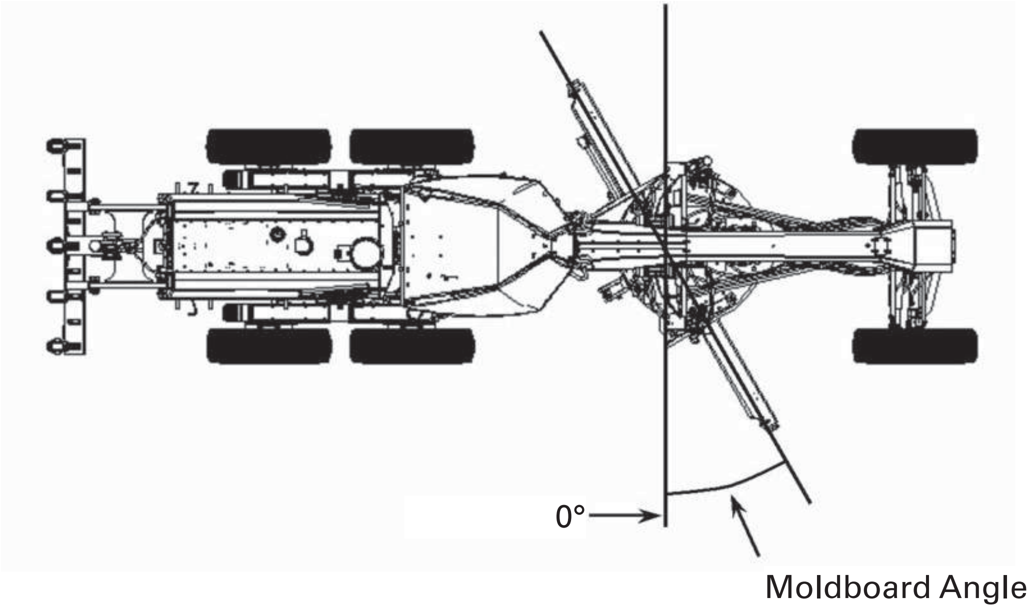
Typical operating speeds by application

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 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.

11

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.

WHEELED LOADERS

MODEL	980M		982M	
Emission Standards	**Tier 4 Final***		**Tier 4 Final***	
Maximum Engine: Net	288 kW	**386 hp**	292 kW	**392 hp**
Gross	317 kW	**425 hp**	325 kW	**436 hp**
Engine Model	**C13 ACERT**		**C13 ACERT**	
Maximum Net Power Engine RPM	**1700**		**1700**	
Bore	130 mm	**5.1"**	130 mm	**5.1"**
Stroke	157 mm	**6.2"**	157 mm	**6.2"**
No. Cylinders	**6**		**6**	
Displacement	12.5 L	**762.8 in³**	12.5 L	**762.8 in³**
Speeds Forward:	**km/h**	**mph**	**km/h**	**mph**
1st	6.9	**4.3**	6.2	**3.9**
2nd	13.3	**8.3**	11.9	**7.4**
3rd	23.5	**14.6**	21.1	**13.1**
4th	39.5	**24.5**	37.5	**23.3**
5th	—		—	
Speeds Reverse:	**km/h**	**mph**	**km/h**	**mph**
1st	7.8	**4.8**	7.0	**4.3**
2nd	15.2	**9.4**	13.6	**8.5**
3rd	26.9	**16.7**	24.1	**15.0**
4th	39.5	**24.5**	39.5	**24.5**
Hydraulic Cycle Time, Rated Load in Bucket:	**Seconds**		**Seconds**	
Raise (from Carry Position)	**5.3**		**5.3**	
Dump (at Maximum Raise)	**1.7**		**1.7**	
Lower (Empty, Float Down)	**3.1**		**3.1**	
Total	**10.1**		**10.1**	
Tread Width	2440 mm	**8'0"**	2540 mm	**8'4"**
Width Over Tires	3265 mm	**10'9"**	3452 mm	**11'4"**
Ground Clearance	453 mm	**1'6"**	426 mm	**1'5"**
Fuel Tank Capacity	426 L	**112.5 U.S. gal**	426 L	**112.5 U.S. gal**
DEF Tank Capacity	21 L	**5.5 U.S. gal**	21 L	**5.5 U.S. gal**
Hydraulic Tank Capacity	180 L	**48 U.S. gal**	180 L	**48 U.S. gal**

*Meets Tier 4 Final, Stage IV and Japan 2014 (Tier 4 Final) emission standards.

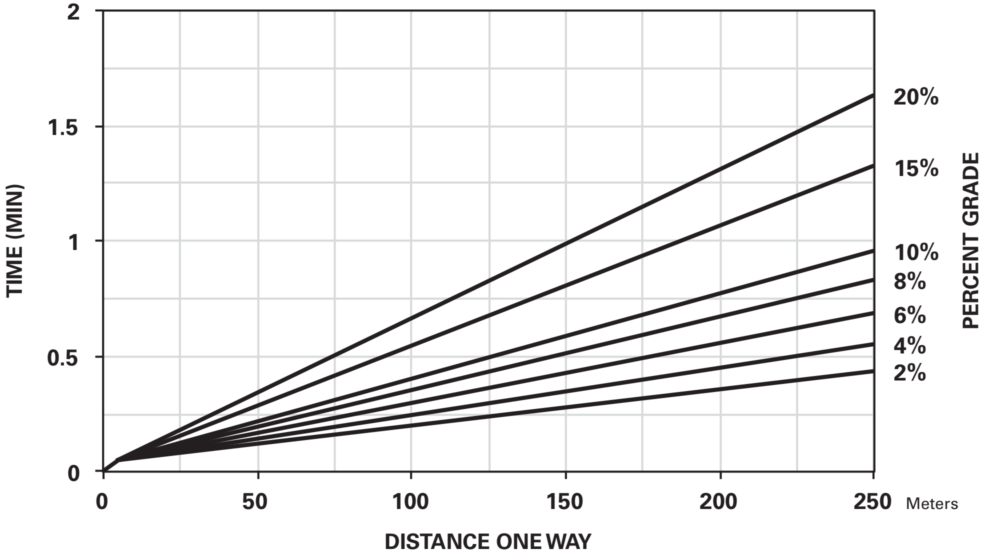
NOTE: Net Engine Power is provided according to SAE J1349 and ISO 9249. Gross Engine Power is provided according to SAE J1995. Machines may only be available in certain regions. Contact your local Cat dealer for product availability.

MODEL	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**

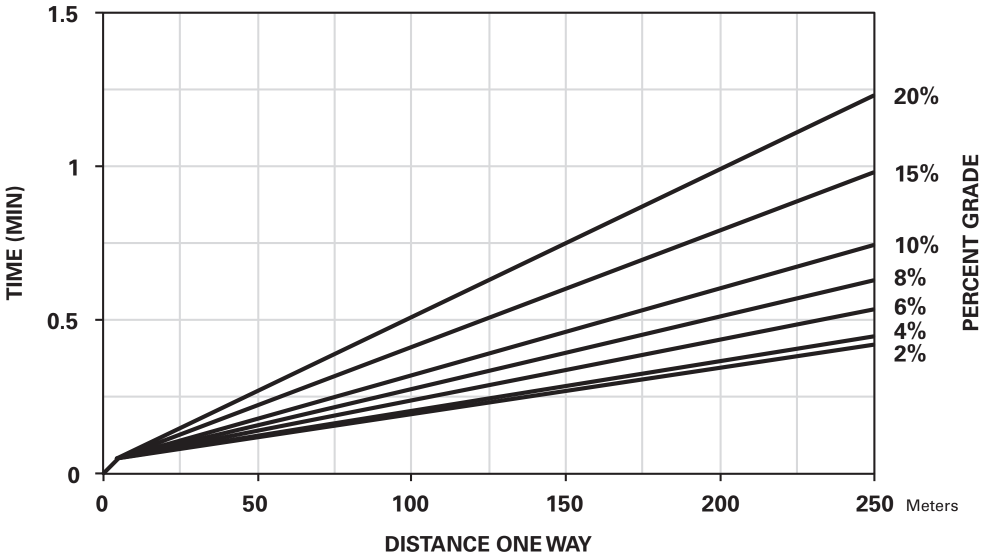
*Changes in bucket weight, including field installed wear iron, can impact rated payload. Consult your Cat dealer for assistance in selecting and configuring the proper bucket for the application. The Cat Large Wheel Loader Payload Policy is a guideline intended to maximize wheel loader structural and 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.

Travel Time — Loaded and Empty
- 980L/980M
- 29.5R25 L4 Tires

980L/980M TRAVEL TIME — LOADED



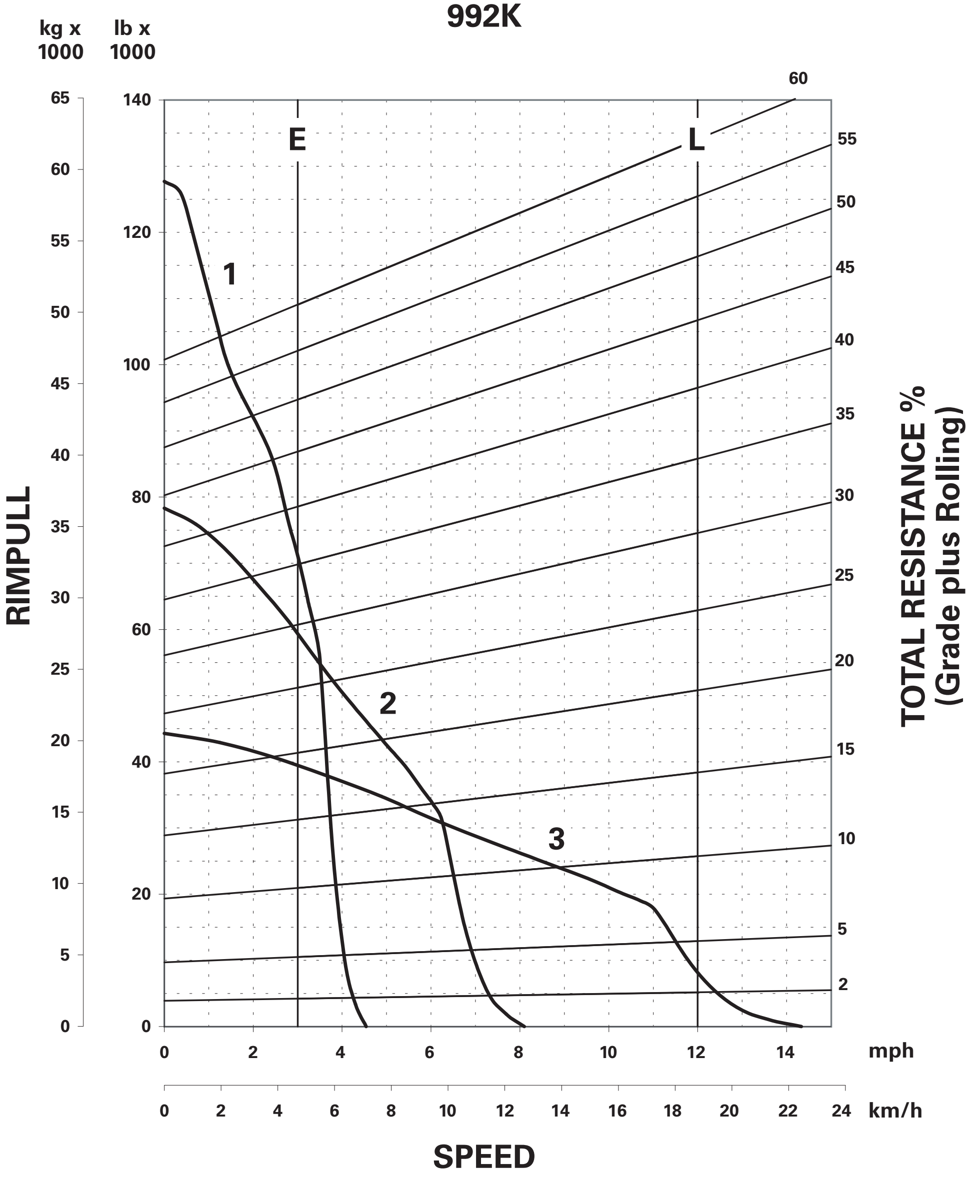
980L/980M TRAVEL TIME — EMPTY



Curves assume use of highest operating speed attainable.

In load-and-carry applications it is important to consult the tire manufacturer on load-speed ratings and pressure recommendations.

Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.



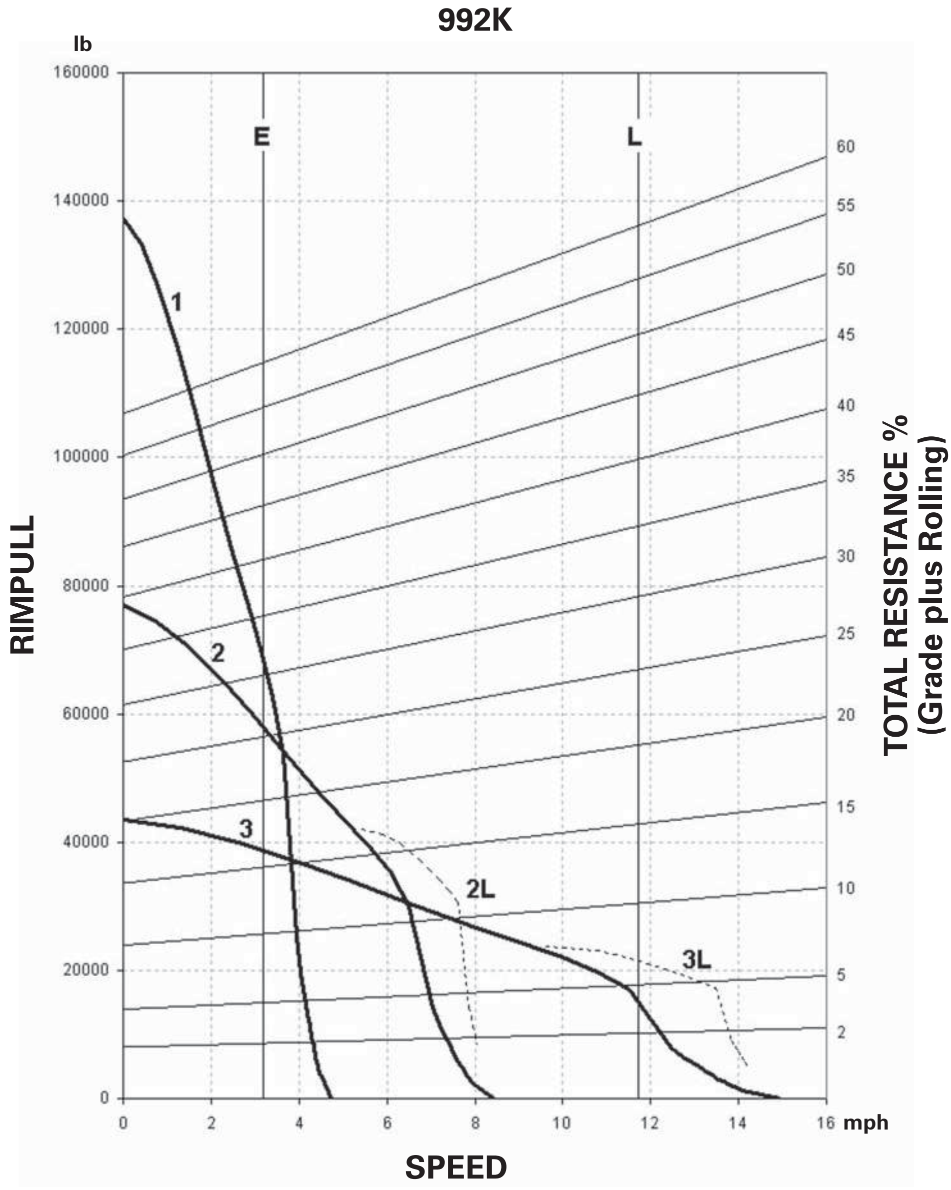
KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear

KEY

E — Empty 92 797 kg (204,580 lb)
L — Loaded 114 570 kg (252,580 lb)

Calculated Pull: Idle Hydraulics
Curves Assume NO SLIP Conditions



KEY

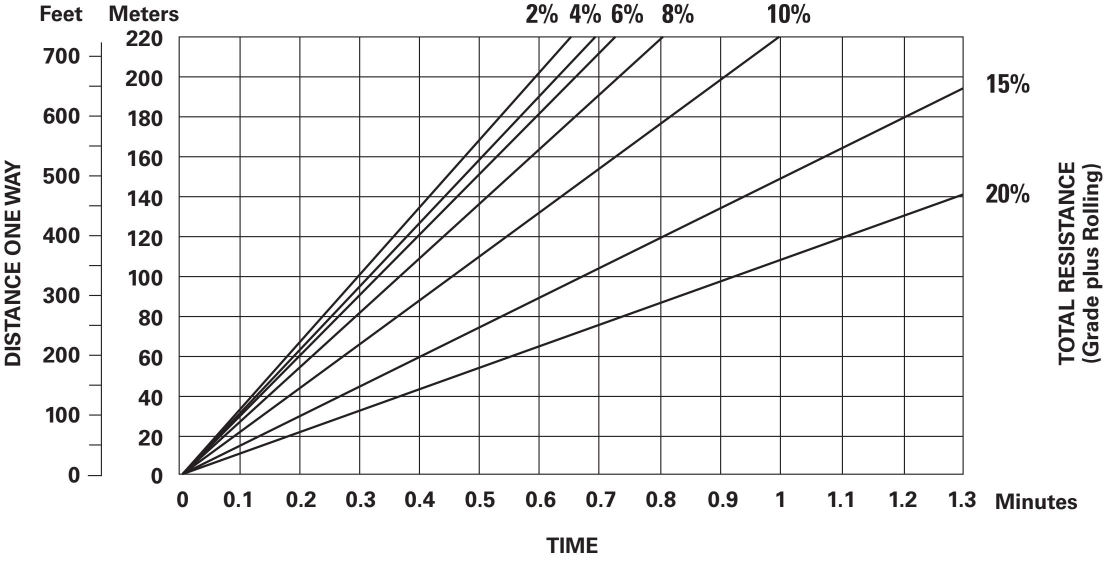
1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear

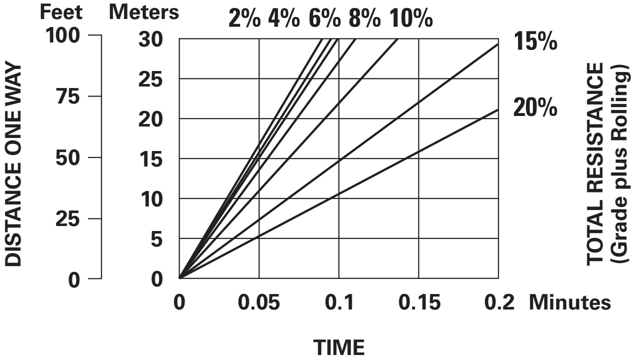
KEY

E — Empty 92 797 kg (204,580 lb)
L — Loaded 114 570 kg (252,580 lb)

Calculated Pull: Idle Hydraulics
Curves Assume NO SLIP Conditions

992K TRAVEL TIME — LOADED

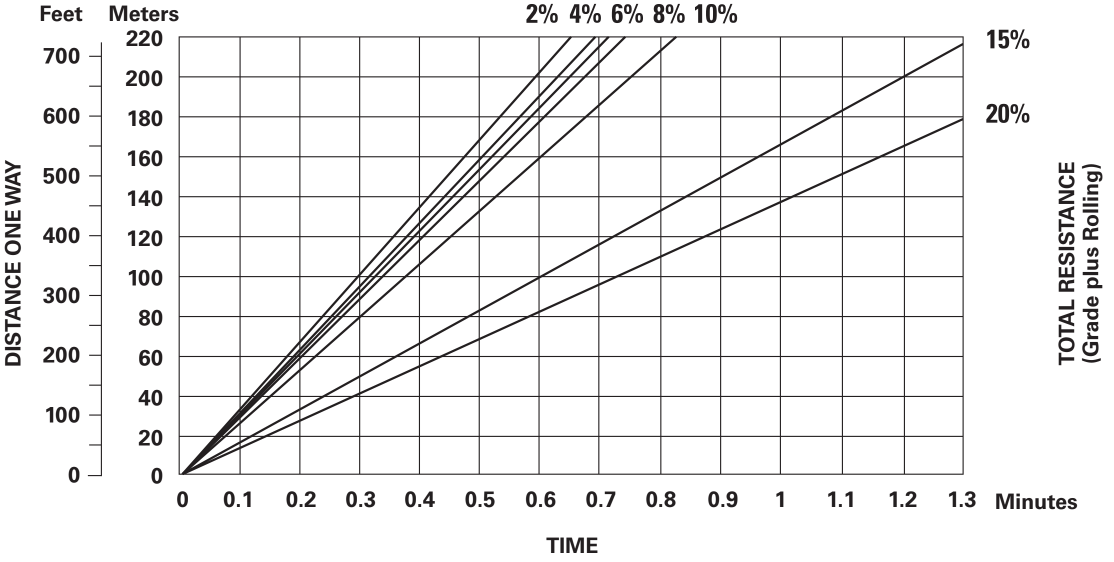


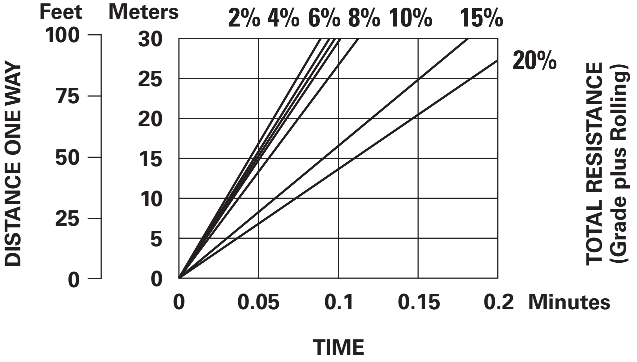


NOTE: Curves assume use of highest operating speed attainable: 3rd gear for 2%-10% TR, 2nd gear for 15% and 20% TR.

In load-and-carry applications it is important to consult the tire manufacturer on Ton-MPH ratings and pressure recommendations.

992K TRAVEL TIME — EMPTY





NOTE: Curves assume use of highest operating speed attainable: 3rd gear for 2%-10% TR, 2nd gear for 15% and 20% TR.

In load-and-carry applications it is important to consult the tire manufacturer on Ton-MPH ratings and pressure recommendations.

TRACKED DOZERS

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 in^3**	8.8 L	**537 in^3**
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 m^2	**4531 in^2**	3.15 m^2	**4878 in^2**
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.

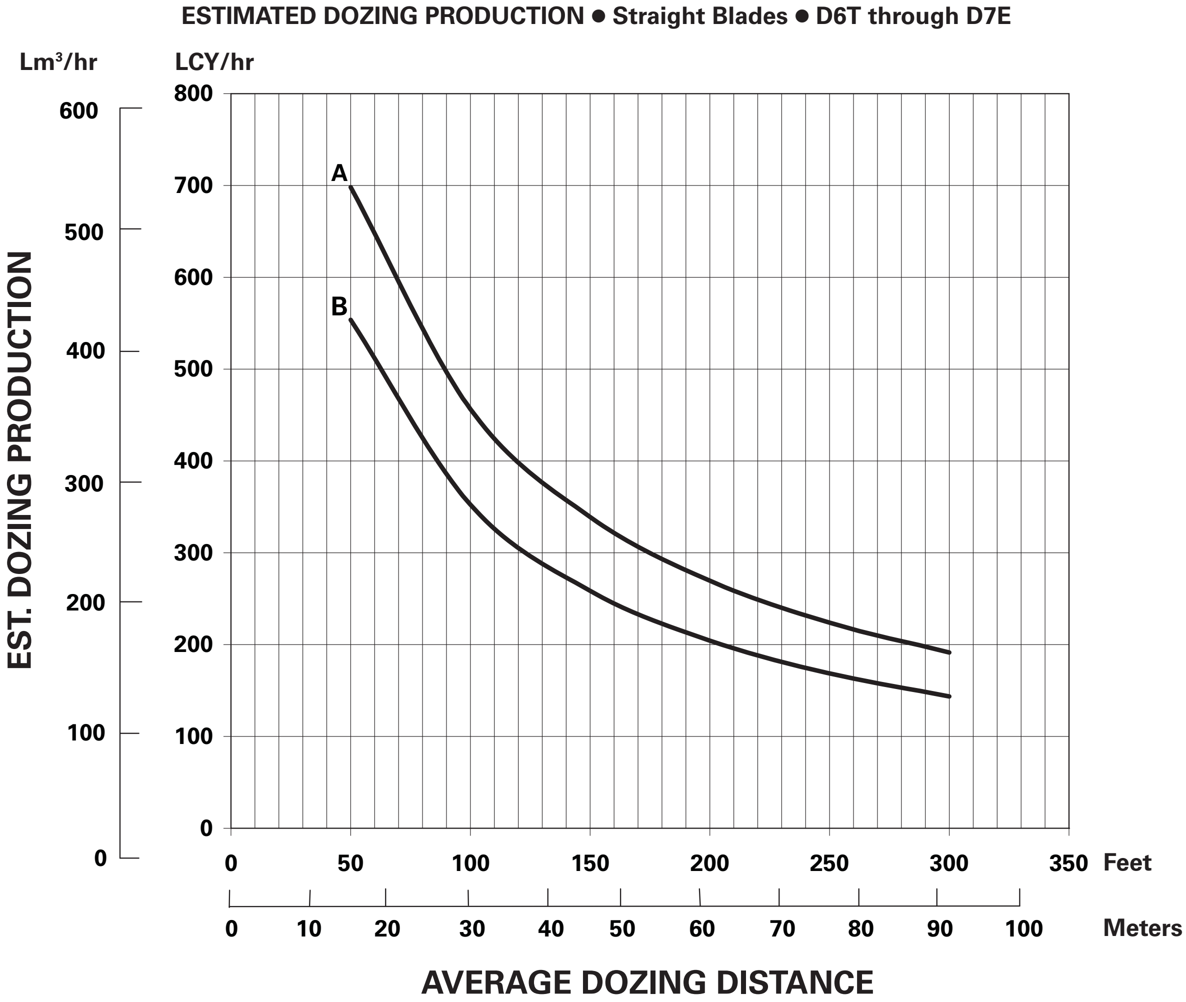
MODEL	D9R		D9T		D9T	
Emission Standards	—		**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent[1]**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**	
Flywheel Power	302 kW	**405 hp**	306 kW	**410 hp**	325 kW	**436 hp**
Operating Weight:[2]						
Power Shift Clutch Brake	48 784 kg	**107,548 lb**	—		—	
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 in³**	18.1 L	**1106 in³**	18.1 L	**1106 in³**
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 m²	**6569 in²**	4.24 m²	**6569 in²**	4.24 m²	**6569 in²**
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.

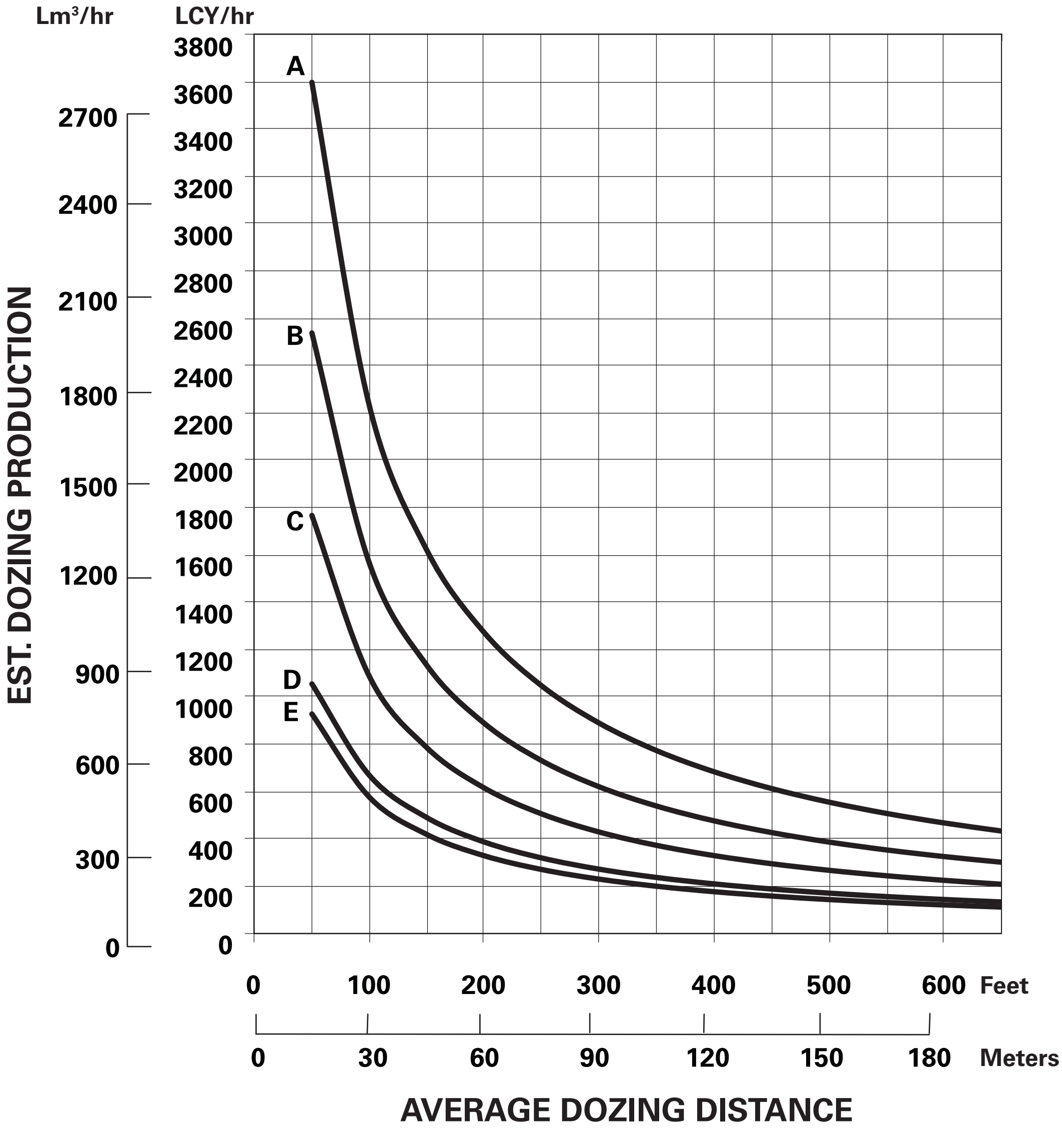


KEY

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 ● 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.

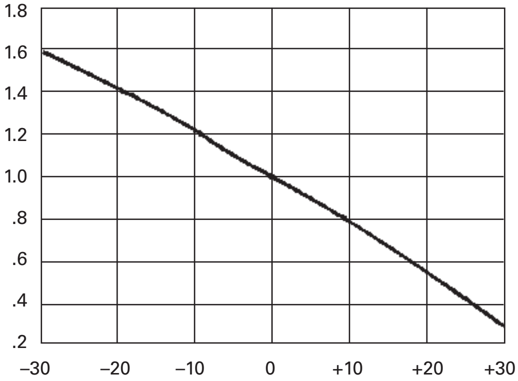
JOB CONDITION CORRECTION FACTORS

	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/Lm³ (2650 lb/LCY). Operator is average. Job efficiency is estimated at 50 min/hr.

Uncorrected Maximum Production — 458 Lm³/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 Lm³.

= 458 Lm³/h × Factors
= 309.6 Lm³/h

OFF-HIGHWAY TRUCKS

MODEL	793D Standard		793D XLWS	
Body Type	MSD II		MSD II	
Target Gross Machine Weight §	383 740 kg	**846,000 lb**	383 740 kg	**846,000 lb**
Basic Machine Weight*	51 135 kg	**112,734 lb**	51 310 kg	**113,119 lb**
Attachments**	65 898 kg	**145,281 lb**	67 514 kg	**148,844 lb**
Body Weight without Liners***	26 980 kg	**59,481 lb**	26 980 kg	**59,481 lb**
Full Liner	6209 kg	**13,688 lb**	6209 kg	**13,688 lb**
Operating Machine Weight	150 223 kg	**331,184 lb**	152 013 kg	**335,132 lb**
Debris (3% of Operating Machine Weight)	4507 kg	**9936 lb**	4560 kg	**10,054 lb**
Empty Operating Weight	154 729 kg	**341,119 lb**	156 574 kg	**345,186 lb**
Target Payload §	229.0 m tons	**252.4 tons**	227.2 m tons	**250.4 tons**
Capacity:				
Heaped (2:1) (SAE) Base Body	176 m^3	**230 yd^3**	176 m^3	**230 yd^3**
Distribution Empty:				
Front	**46.2%**		**46%**	
Rear	**53.8%**		**54%**	
Distribution Loaded:				
Front	**33.3%**		**33.3%**	
Rear	**66.7%**		**66.7%**	
Engine Model	**3516B HD EUI**		**3516B HD EUI**	
Number of Cylinders	**16**		**16**	
Bore	170 mm	**6.7"**	170 mm	**6.7"**
Stroke	215 mm	**8.5"**	215 mm	**8.5"**
Displacement	78 L	**4760 in^2**	78 L	**4760 in^2**
Net Power	1694 kW	**2273 hp**	1694 kW	**2273 hp**
Gross Power	1801 kW	**2415 hp**	1801 kW	**2415 hp**
Standard Tires	**40/00R57**		**40/00R57**	
Machine Clearance Turning Circle	33 m	**107'0"**	33 m	**107'0"**
Fuel Tank Refill Capacity	4353 L	**1150 U.S. gal**	4353 L	**1150 U.S. gal**
Top Speed (Loaded)	59.9 km/h	**37.2 mph**	59.9 km/h	**37.2 mph**
GENERAL DIMENSIONS (Empty):				
Height to Canopy Rock Guard Rail	6.6 m	**21'8"**	6.6 m	**21'8"**
Wheelbase	5.91 m	**19'5"**	5.91 m	**19'5"**
Overall Length (Base Body)	13.01 m	**42'9"**	13.01 m	**42'9"**
Loading Height (Base Body)	6.5 m	**21'5"**	6.5 m	**21'5"**
Height at Full Dump	13.25 m	**43'6"**	13.25 m	**43'6"**
Body Length (Target Length)	8.99 m	**29'6"**	8.99 m	**29'6"**
Width (Operating)	8.3 m	**27'3"**	8.3 m	**27'3"**
Width (Shipping)****	4.1 m	**13'5"**	4.1 m	**13'5"**
Front Tire Tread	5.63 m	**18'6"**	5.63 m	**18'6"**

*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 for the 793D Standard (MA1) 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.

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MODEL	794 AC		795F AC		797F	
Body Type	HE Body		MSD II		MSD II	
Target Gross Machine Weight §	521 631 kg	**1,150,000 lb**	570 166 kg	**1,257,000 lb**	623 690 kg	**1,375,000 lb**
Basic Machine Weight*	122 031 kg	**269,032 lb**	118 807 kg	**261,924 lb**	86 412 kg	**190,506 lb**
Attachments**	37 409 kg	**82,472 lb**	79 503 kg	**175,273 lb**	128 083 kg	**282,374 lb**
Body Weight without Liners***	28 186 kg	**62,140 lb**	38 663 kg	**85,237 lb**	44 275 kg	**97,610 lb**
Full Liner†	—		7623 kg	**16,806 lb**	7652 kg	**16,870 lb**
Operating Machine Weight	217 419 kg	**479,327 lb**	244 596 kg	**539,240 lb**	266 422 kg	**587,359 lb**
Debris (3% of Operating Machine Weight)	—		7338 kg	**16,177 lb**	7993 kg	**17,621 lb**
Empty Operating Weight	217 419 kg	**479,327 lb**	251 933 kg	**555,417 lb**	274 415 kg	**604,980 lb**
Target Payload §	291 m tons	**320 tons**	313-317 m tons	**345-350 tons**	335-363 m tons	**370-400 tons**
Capacity:						
Heaped (2:1) (SAE) Base Body	180-222 m^3	**236-290 yd^3**	213 m^3	**280 yd^3**	240-267 m^3	**315-350 yd^3**
Distribution Empty:						
Front	**49.0%**		**48%**		**45.7%**	
Rear	**51.0%**		**52%**		**54.3%**	
Distribution Loaded:						
Front	**33.0%**		**33%**		**33.3%**	
Rear	**67.0%**		**67%**		**66.7%**	
Engine Model	**C175-16**		**C175-16**		**C175-20**	
Number of Cylinders	**16**		**16**			
Bore	175 mm	**6.9"**	175 mm	**6.9"**	175 mm	**6.9"**
Stroke	220 mm	**8.7"**	220 mm	**8.7"**	220 mm	**8.7"**
Displacement	85 L	**5187 in^3**	85 L	**5187 in^3**	106 L	**6469 in^3**
Net Power	—		—		2830 kW	**3795 hp**
Gross Power	2051-2610 kW	**2750-3500 hp**	2535 kW	**3400 hp**	2983 kW	**4000 hp**
Standard Tires	**53/80R63**		**56/80R63**		**59/80R63**	
Machine Clearance Turning Circle	32.4 m	**106'0"**	38.7 m	**127'0"**	42.1 m	**138'1"**
Fuel Tank Refill Capacity	4922 L	**1300 U.S. gal**	7192 L	**1900 U.S. gal**	7571 L	**2000 U.S. gal**
Top Speed (Loaded)	60 km/h	**37 mph**	64 km/h	**40 mph**	67.9 km/h	**42.2 mph**
GENERAL DIMENSIONS (Empty):						
Height to Canopy Rock Guard Rail	7.59 m	**24'11"**	7.80 m	**25'8"**	7.71 m	**25'4"**
Wheelbase	6.65 m	**21'10"**	6.73 m	**22'1"**	7.20 m	**23'7"**
Overall Length (Base Body)	15.47 m	**50'9"**	15.15 m	**49'9"**	15.08 m	**48'9"**
Loading Height (Base Body)	6.71 m	**22'2"**	—		7.00 m	**23'0"**
Loading Height (Empty)	—		7.04 m	**23'2"**	—	
Height at Full Dump	14.75 m	**48'5"**	15.06 m	**49'6"**	15.70 m	**51'6"**
Body Length (Target Length)	10.21 m	**33'6"**	15.15 m	**49'9"**	9.98 m	**32'6"**
Width (Operating)	9.09 m	**29'10"**	8.97 m	**29'6"**	9.76 m	**32'0"**
Width (Shipping)	9.09 m	**29'10"**	8.97 m	**29'6"**	9.76 m	**32'0"**
Front Tire Tread	7.04 m	**23'1"**	6.24 m	**20'6"**	6.53 m	**20'5"**

*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).
§Reference Caterpillar's latest 10/10/20 Payload Policy for information on gross machine operating weight and target payload.
†Liner used for 797F is a 1/3 solid liner.
NOTE: Contact Mining Representative to use Caterpillar Weight Configurator for application specific weights.

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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.)

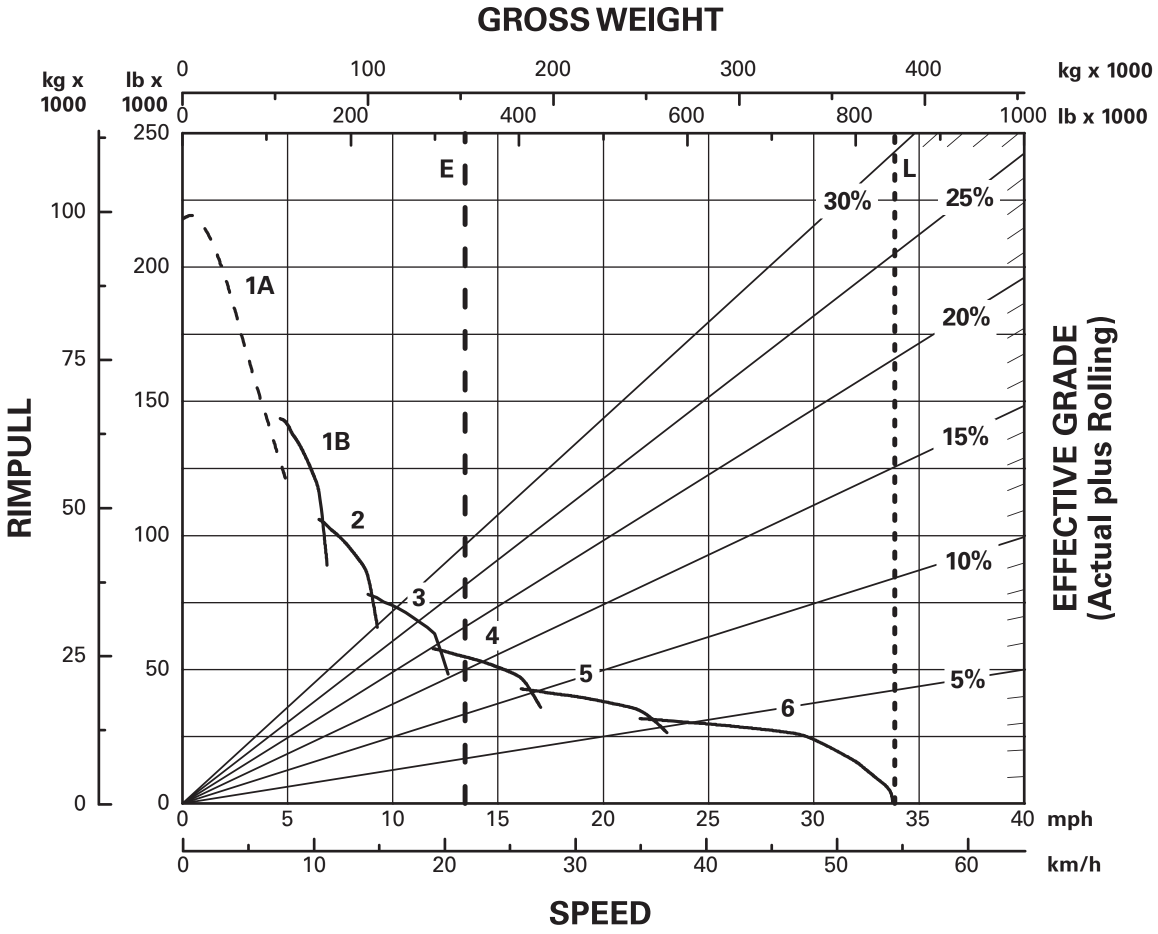
Total cycle time is the combination of:
1. The above fixed time
2. Hauling time (Loaded)
3. Return time (Empty)

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.

793D Rimpull-Speed-Gradeability
- Standard Arrangement*
- 40.00R57 Tires
- 1778 mm **(5'10")** Tire Radius



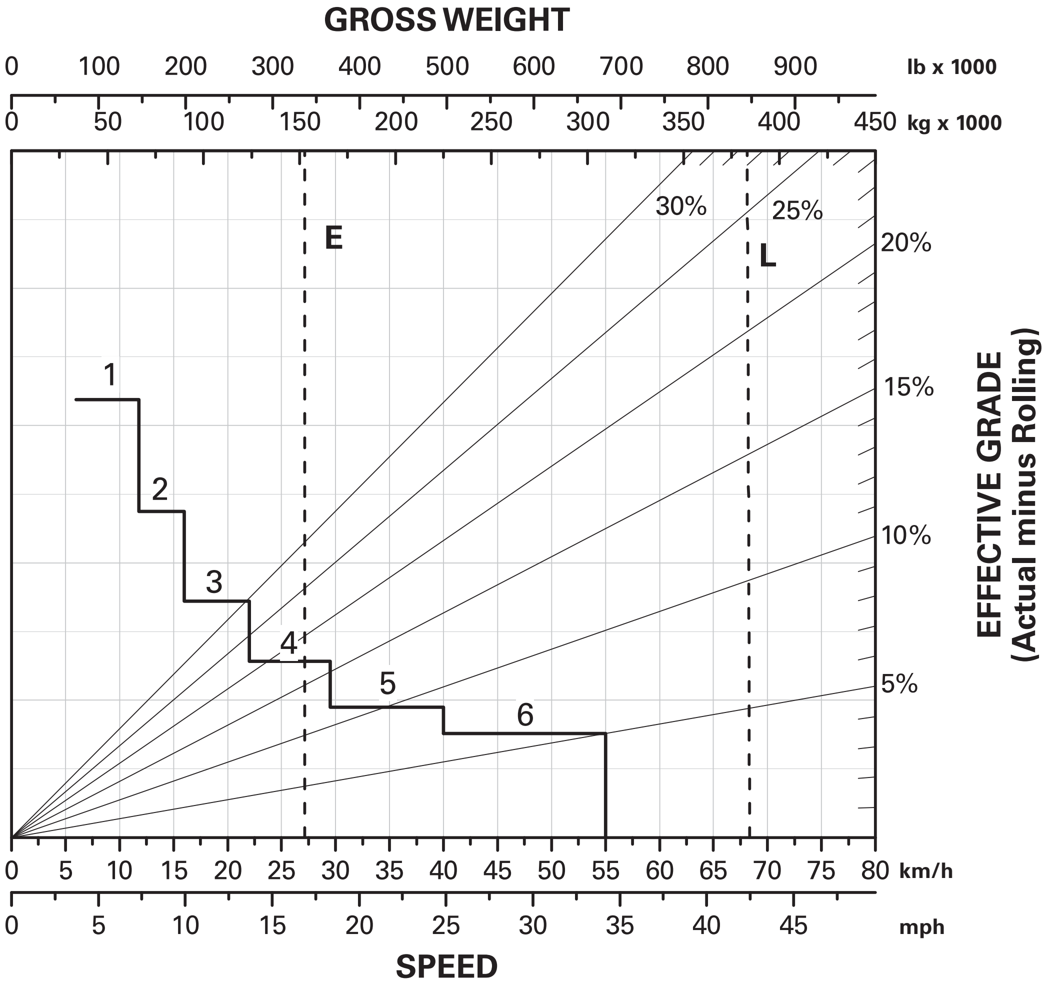
KEY

1A — 1st Gear (Torque Converter)
1B — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

*At Sea Level.



CONTINUOUS GRADE LENGTH

KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

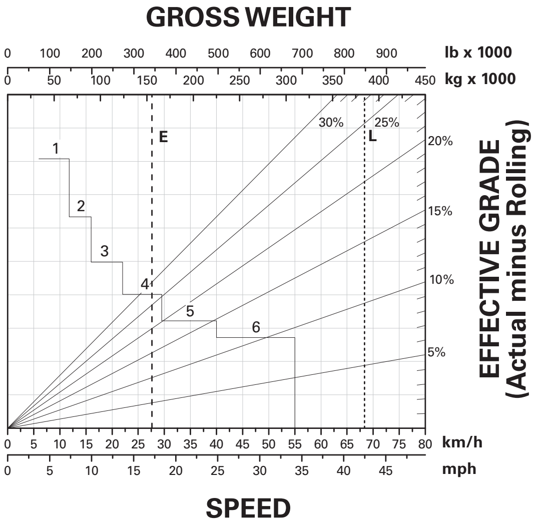
KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

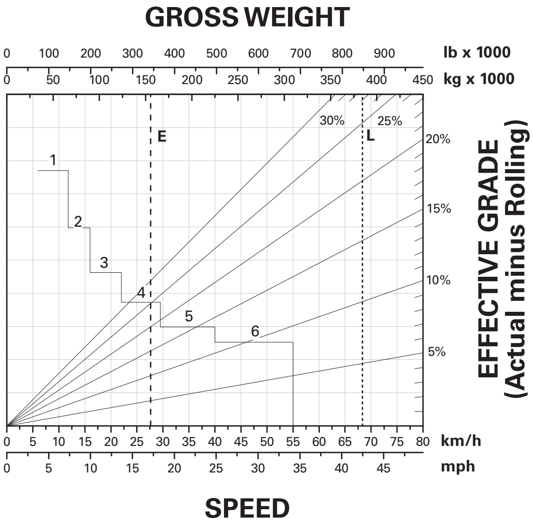
*At Sea Level.

793D Brake Performance

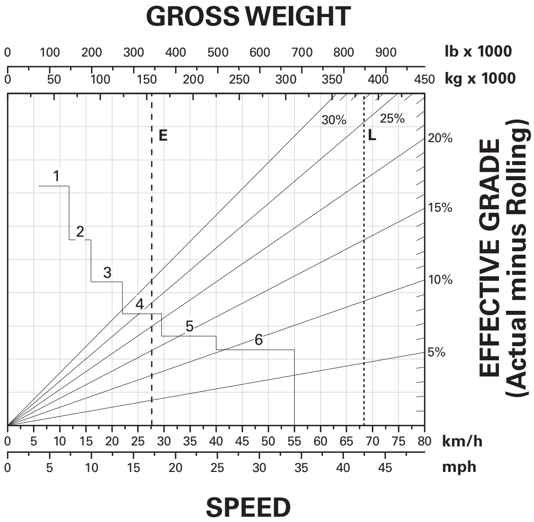
- Standard Arrangement*
- 450 m **(1500 ft)** • 600 m **(2000 ft)**
- 900 m **(3000 ft)** • 1500 m **(5000 ft)**



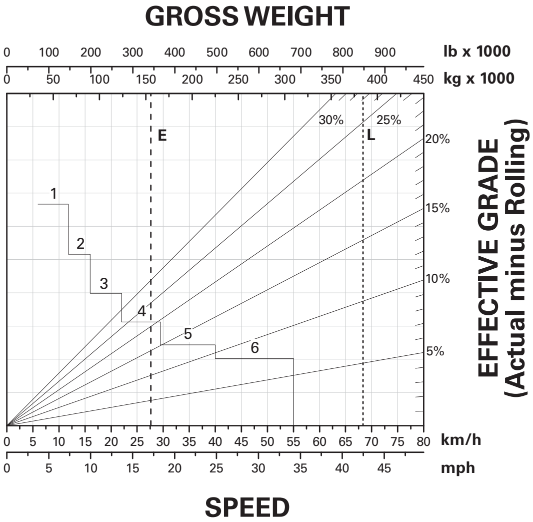
GRADE DISTANCE — 450 m (1500 ft)



GRADE DISTANCE — 600 m (2000 ft)



GRADE DISTANCE — 900 m (3000 ft)



GRADE DISTANCE — 1500 m (5000 ft)

KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty Operating Weight 154 729 kg (341,119 lb)
L — Target GMW 383 740 kg (846,000 lb)

*At Sea Level.

Appendix B.2.7

Misc. Unit Costs

Revegetation/Reclamation
Rangeland Rehabilitation
Landscaping / Fencing
Hydroseeding
Environmental Consulting

ROCKY MOUNTAIN RECLAMATION

Phone (307) 745-5235
(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.

T.G. McCauley, Inc.
P.O. Box 443
Cliff, NM 88028
575-535-2341
Fax 575-535-2343

Lic# 377614

tgmccauleyinc@gmail.com

March 13, 2018

To: Jean Humphrey
RE: rip rap to Cobre Mine

Here is the pricing for TG McCauley, Inc to deliver material to Cobre Mine. The conversion factor that was used for this size and type of material is 1.316. The price includes delivery but not any applicable sales tax. Please contact us with any questions. Thank you.

MATERIAL	QTY- CY	QYT-TONS	DEL PRICE
15" rip rap	50,000 yards	65,800 tons	$39.00/ ton
8" rip rap	20,000 yards	26,320 tons	$31.00/ ton

T.G. McCauley, Inc

Appendix B.2.8

Well Abandonment Costs

Wet Drill Hole Abandonment Unit Costs

		w/o		
MMD	**Indirects**	**Indirects**	**Inflation 2013 to 2018**	**Unit Cost**
($/ft)	**(%)**	**($/ft)**	**(%)**	**$/ft**
$ 14.00	28.30%	$ 10.04	5.607 %	10.60

Unit cost based on NM EMNRD MMD Guidance:

http://www.emnrd.state.nm.us/MMD/MARP/documents/MMD_Part3FAGuidelines_Sept2013.pdf

Inflation factor calculated from information at
https://edzarenski.com/2016/10/24/construction-inflation-index-tables-2017/

Appendix B.2.9

Down Drain
Channel Bench
Top Channel
Berm Unit Costs

Type 1 Top Channel Unit Cost Development

Task Description	Equipment	Productivity (cy/hr)	Productivity (hr/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	807	-	1.0	1.00	3,300	1.00	175	1853	0.75	50	1.00	1.00	1.00			
Waste	D11T	719	-	1.0	1.00	3,300	1.00	200	1651	0.75	50	1.00	1.00	1.00			
Finish Grade	D9T	-	0.0013	1.0	1.00	3,300	1.00	-	-	0.75	50	1.00	1.00	1.00	3	14.25	1

Task Description	Equipment	Volume[1] (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	DownDrain Cost ($/lf)
Excavate	D11T	2.4	0.003	$414.50	$26.29	$440.79	$1.34
Waste	D11T	2.4	0.003	$414.50	$26.29	$440.79	$1.50
Finish Grade	D9T	-	0.0013	$178.02	$26.29	$204.31	$0.27
Total							**$3.10**

Notes:
10' Bottom width, 3:1 side slopes, 2' deep, 1' thick riprap, 0.5' thick gravel
Volumes based on cross-section area for excavation and waste
Finish Grade assume 3 passes

Type 2 Top Channel Unit Cost Development

Task Description	Equipment	Productivity (cy/hr)	Productivity (hr/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	807	-	1.0	1.00	3,300	1.00	175	1853	0.75	50	1.00	1.00	1.00			
Waste	D11T	719	-	1.0	1.00	3,300	1.00	200	1651	0.75	50	1.00	1.00	1.00			
Finish Grade	D6T XL SU	-	0.0013	1.0	1.00	3,300	1.00	-	-	0.75	50	1.00	1.00	1.00	3	17.5	1

Task Description	Equipment	Volume[1] (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	DownDrain Cost ($/lf)	
Excavate	D11T	7.6	0.009	$414.50	$26.29	$440.79	$4.13	
Waste	D11T	7.6	0.011	$414.50	$26.29	$440.79	$4.63	
Finish Grade	D6T XL SU	-	0.0013	$88.86	$26.29	$115.15	$0.15	$4.78
Total							**$8.91**	

Notes:
20' Bottom width, 3:1 side slopes, 3' deep, 2.5' thick riprap, 0.5' thick gravel
Volumes based on cross-section area for excavation and waste
Finish Grade assume 2' overlap.

Downdrain (Type 2 Chanenel) Unit Cost Development

Task Description	Equipment	Productivity (cy/hr)	Productivity (hr/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	1,291	-	1.0	1.60	3,300	1.00	175	1853	0.75	50	1.00	1.00	1.00			
Waste	D11T	1,151	-	1.0	1.60	3,300	1.00	200	1651	0.75	50	1.00	1.00	1.00			
Finish Grade	D6T XL SU	-	0.0008	1.0	1.60	3,300	1.00	-	-	0.75	50	1.00	1.00	1.00	3	17.5	1

Task Description	Equipment	Volume[1] (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	DownDrain Cost ($/lf)
Excavate	D11T	7.6	0.006	$414.50	$26.29	$440.79	$2.58
Waste	D11T	7.6	0.007	$414.50	$26.29	$440.79	$2.89
Finish Grade	D6T XL SU	-	0.0008	$88.86	$26.29	$115.15	$0.09
Total							**$5.57**

Notes:
20' Bottom width, 3:1 side slopes, 3' deep, 2.5' thick riprap, 0.5' thick gravel
Volumes based on cross-section area for excavation and waste
Finish Grade assume 2' overlap.

Outslope Channel Unit Cost Development

Task Description	Equipment	Productivity (cy/hr)	Productivity (hr/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	807	-	1.0	1.00	3,300	1.00	175	1853	0.75	50	1.00	1.00	1.00			
Waste	D11T	1,151	-	1.0	1.60	3,300	1.00	200	1651	0.75	50	1.00	1.00	1.00			
Finish Grade	D6T XL SU	-	0.0004	1.0	1.00	3,300	1.00	-	-	0.75	50	1.00	1.00	1.00	1	17.5	1

Task Description	Equipment	Volume[1] (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	DownDrain Cost ($/lf)
Excavate	D11T	0.43	0.0005	$414.50	$26.29	$440.79	$0.23
Waste	D11T	0.43	0.0004	$414.50	$26.29	$440.79	$0.16
Finish Grade	D6T XL SU	-	0.0004	$88.86	$26.29	$115.15	$0.05
Total							**$0.45**

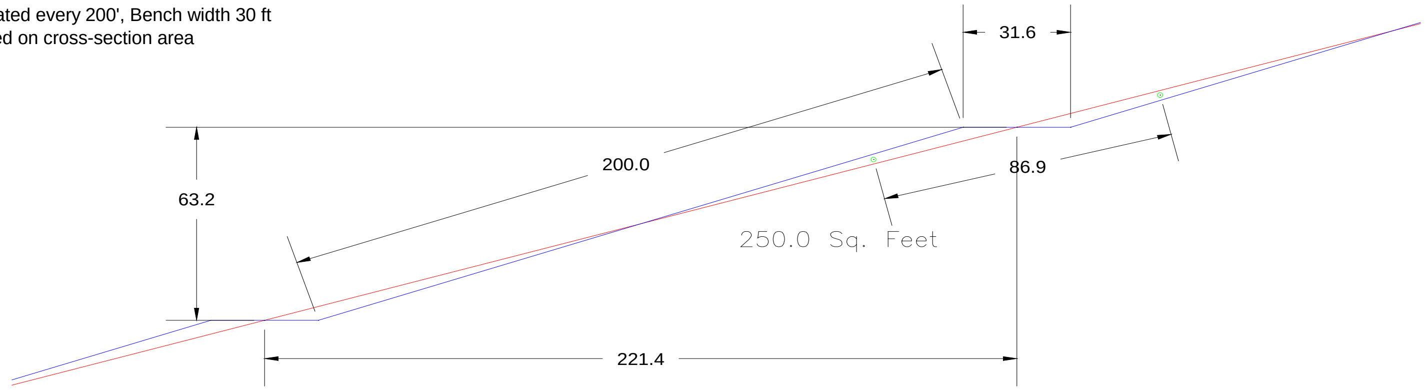
Notes:
Bench width 30 ft, 5% slope towards interior, 0.5' deep riprap by 20' wide riprap on 5% slope and 3' wide riprap on the 3:1 slope
Volumes based on cross-section area for excavation and waste
Finish Grade assume 2' overlap.

Bench Unit Cost Development for Stockpiles 3:1 slope

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# Passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	2362		1.0	1.6	3300	1.0	86.9	3389	0.75	50	1.0	1.0	1.0	-	-	-
Finish Grade	D9T		0.0013	1.0	1.0	3300	1.0	-	-	0.75	50	1.0	1.0	1.0	3	14.25	1.0

Task Description	Equipment	Volume (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Cost ($/lf)
Excavate	D11T	9.26	0.0039	$414.50	$26.29	$440.79	$1.73
Finish Grade	D9T	-	0.0013	$178.02	$26.29	$204.31	$0.27
Total							**$1.99**

Notes:
3:1 slope Located every 200', Bench width 30 ft
Volumes based on cross-section area

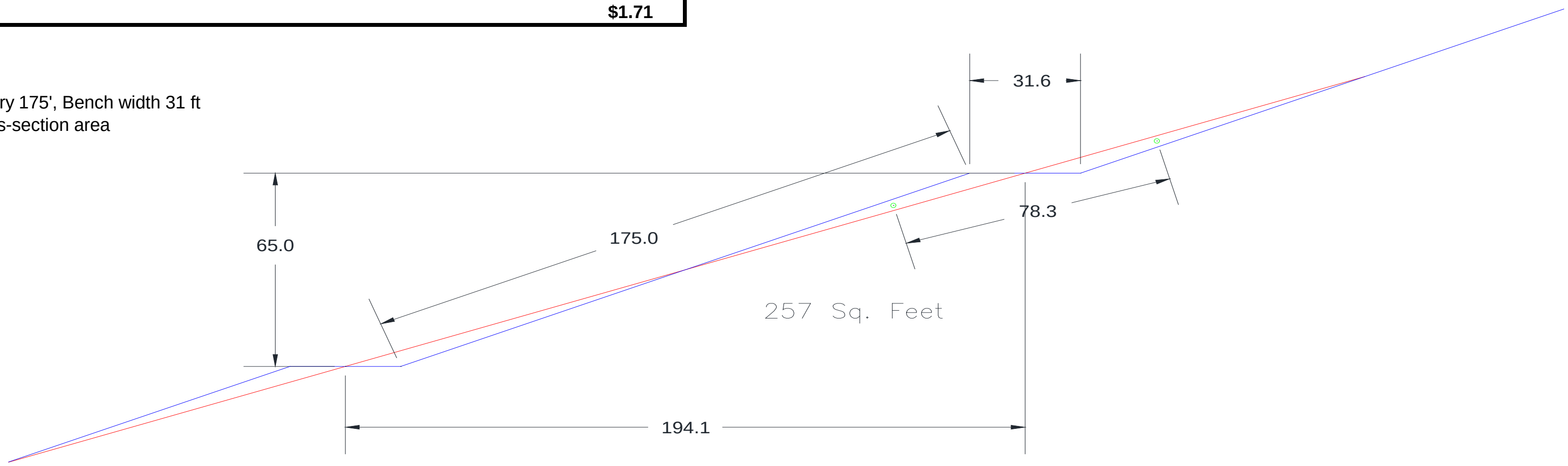


Bench Unit Cost Development for Stockpiles 2.5:1 slope

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# Passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	2917	-	1.0	1.8	3300	1.0	78.0	3720	0.75	50	1.0	1.0	1.0			
Finish Grade	D9T	-	0.0013	1.0	1.0	3300	1.0	-	-	0.75	50	1.0	1.0	1.0	3	14.25	1.0

Task Description	Equipment	Volume (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Cost ($/lf)
Excavate	D11T	9.52	0.0033	$414.50	$26.29	$440.79	$1.44
Finish Grade	D9T	-	0.0013	$178.02	$26.29	$204.31	$0.27
Total							**$1.71**

Notes:
2.5:1 slope Located every 175', Bench width 31 ft
Volumes based on cross-section area

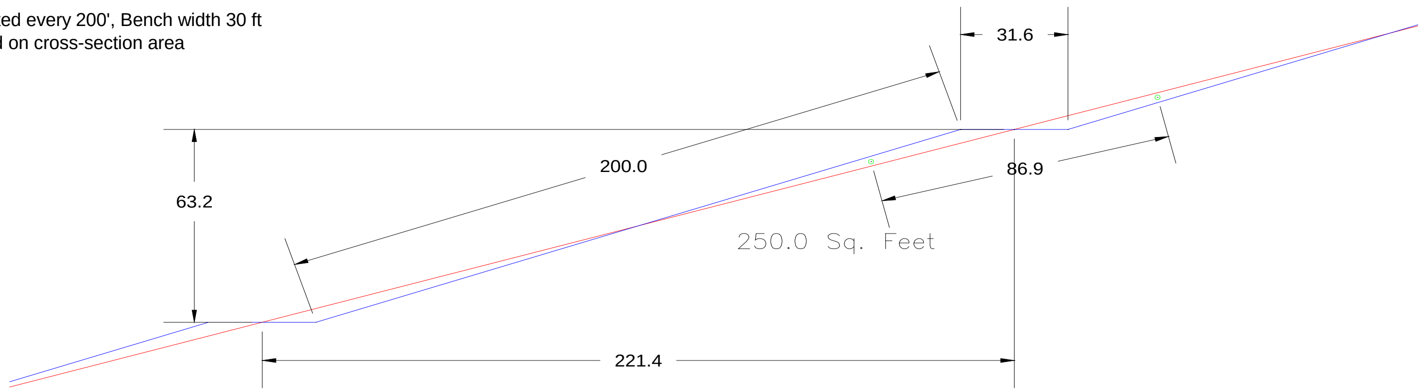


Bench Unit Cost Development for Tailings 3:1 slope

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/lf)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor	# Passes	Width (feet)	Speed (miles/hr)
Excavate	D11T	2688		1.0	1.6	2900	1.0	86.9	3389	0.75	50	1.0	1.0	1.0	-	-	-
Finish Grade	D9T		0.0011	1.0	1.0	2900	1.0	-	-	0.75	50	1.0	1.0	1.0	3	14.25	1.0

Task Description	Equipment	Volume (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Cost ($/lf)
Excavate	D11T	9.26	0.0034	$414.50	$26.29	$440.79	$1.52
Finish Grade	D9T	-	0.0011	$178.02	$26.29	$204.31	$0.23
Total							**$1.75**

Notes:
3:1 slope Located every 200', Bench width 30 ft
Volumes based on cross-section area



Berm Unit Cost Development

Task Description	Equipment	Productivity (cy/hr)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Maximum Push Distance (feet)	Normal Production (cy/hr)	Operator	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans. Factor
Excavate	D6T XL SU	196	1.0	1.00	3,300	1.00	100	449	0.75	50	1.00	1.00	1.00
Finish	D6T XL SU	340	1.0	1.00	3,300	1.00	50	781	0.75	50	1.00	1.00	1.00

Task Description	Equipment	Volume (cy/lf)	Productivity (hrs/lf)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Berm Cost ($/lf)
Excavate	D6T XL SU	3.7	0.0189	$88.86	$26.29	$115.15	$2.18
Finish Grade	D6T XL SU	1.2	0.0035	$88.86	$26.29	$115.15	$0.41
Total							**$2.59**

Berm 2:1 slope, 5' high, 10' top width

Excavate				
Berm Dimensions	10	5	50	ft3/lf
	10	5	50	ft3/lf
Total			100	ft3/lf
Volume			3.7	cy/lf

Finish Grade		
Slope length x1	11.2	ft
Slope length x1	11.2	ft
Top length	10	ft
Total Length	32.4	ft
Depth	1	ft
Width	1	ft
Volume	32.4	ft3/lf
Volume	1.2	cy/lf

Rip Rap Load and Haul Unit Cost

April 18, 2018

Rip Rap Haul		Cobre Riprap Haulage
Direct Costs		Current
	Earthmoving	$ 138,646
	Subtotal, Direct Costs	**$ 138,646**
Total Costs		**$ 138,646**

PERFORMANCE FACTORS

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Truck Cycle Time (min)	Optimum No. of Trucks	Productivity (cy/hr)	Task Time (hrs)	Truck Capacity (cy)	Heaped Capacity (cy)	Loader Cycles per Truck	Total Haul Distance (feet)	**Haul Distance Segment 1 (feet)	**Haul Distance Segment 2 (feet)	**Haul Grade Segment 1 (%)	**Haul Grade Segment 2 (%)
Haul riprap	Borrow Area	Destination st	793	74,470	13	2	1,302	69	126	169	12	7,920	7,920	0	0.0%	0.0%
							57.2									

Task Description	Rolling Resistance (%)	Haul Distance Segment 1 (meters)	Haul Distance Segment 2 (meters)	Haul Effective Grade Segment 1 (%)	Haul Effective Grade Segment 2 (%)	Return Effective Grade Segment 1 (%)	Return Effective Grade Segment 2 (%)	Haul Time (min)	Return Time (min)	Haul Loading Time (min)	Return Load/ Maneuver Time (min)	Dump/ Maneuver Time (min)	Work Hour (min/hr)	Travel Time Loaded Segment 1 (min/ft)	Travel Time Loaded Segment 2 (min/ft)	Travel Time Empty Segment 1 (min/ft)	Travel Time Empty Segment 2 (min/ft)
Haul riprap	2.5%	2,414	0	3%	0%	3%	3%	3.3	2.7	7.8	0.7	1.1	50	0.00135	0.00110	0.00113	0.00113

Loader

Task Description	Location 1	Location 2	Equipment	Volume (cy)	Net Bucket Capacity (cy)	Loader Cycle Time (min)	Productivity (cy/hr)	Task Time (hours)	Heaped Bucket Capacity (cy)	Bucket Fill Factor	Haul Distance (feet)	Haul Grade (%)	Rolling Resistance (%)	Load Bucket (min)	Swing Loaded (min)	Dump Bucket (min)	Swing Empty (min)	Work Hour (min/hr)
Load RipRap Material	Borrow Area	Destination st	992K	74,470	14.0	0.65	1,077	69	16	0.875	NA	NA	NA	NA	NA	NA	NA	50

Equipment Type		Task	Location 1	Location 2	Owning and Operating Cost ($/hr)	Fuel Consumption (gal/hr)	Fuel Consumption (gal)	Labor Cost ($/hr)	Number of Units (Equipment)	Time Req'd (hrs)	Total Cost ($)
Dozers-Earthmoving											
D11T CD		Dozer Assist	Borrow Area	-	$414.50	26	1,772	$ 26.29	1	69	$ 30,481
Water Truck			roads		$86.99	8	539	$ 26.29	1	69	$ 7,833
Motor Grader			roads		$99.13	14	992	$ 26.29	1	69	$ 8,673
Loaders											
	Cat 992K Loader	Load riprap	Borrow Area	9 Stockpile	$294.35	26	1,772	$ 26.56	1	69	$ 22,191
Trucks											
	Cat 793 truck	Haul riprap	Borrow Area	9 Stockpile	$478.45	26	3,545	$ 23.84	2	138	$ 69,467
										riprap haul total	$ 138,646
										$/yd^3	$ 1.86

Data Sources:

1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect cost is removed from the all-inclusive fuel quote and accounted for in the indirects.
3. https://www.electricitylocal.com/states/new-mexico/silver-city/
4. Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2018 labor rates.

https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2018.pdf Owning and Adjusted

Rip Rap Placment
Unit Cost

Gravel Placement

Assumptions:

300hp 980G Front Loader				
3.65 CY Bucket (heaped)				
85% bucket fill[1]				
Net 3.1 CY				
Load Time[1]				0.65 min
Delivery Travel Time[1]	150 ft at	4 mph =	5.87 ft/sec	0.43 min
Unload and Maneuver Time[1]	20 sec +	20 sec		0.67 min
Return Travel Time[1]				0.43 min
				2.17 min

300 hp 980G Front End Loader Operating, Ownership, Fuel, and Labor Cost (per hour)

	Fuel Use Gal per Hour[2]	Fuel Total $/hr[2,4]	Owner/Operate $/hr	Owner/Operate $/hr w/Fuel[2]	Owner/Operate $/hr w/Fuel & Labor
Cat 980G Loader	10.2	$ 20.16	$ 55.72	$ 75.88	$ 102.44

[3] Cost per cubic yard at 2.17 minutes per load, 50 minute work hour

	23	loads per hour
Loader costs $102.44 per hour,		$4.43 per load
Cost per CY	$1.43	
Fuel	$1.9718	per gallon

NOTES:

1. Equipment unit rates from EquipmentWatch Custom Cost Evaluator March 2018 (http://www.equipmentwatch.com). See attachments for rate development.
2. Griffin Propane March 12, 2018; Cobre receives an all-inclusive quote (direct and indirect costs) for the delivery of fuel to Cobre Mine (per MMD's requirements). The indirect
3. https://www.electricitylocal.com/states/new-mexico/silver-city/
4. Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2018 labor rates.
https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2018.pdf

Table 12: D11 Dozer 2015 Average Work Hour

D11T Dozer		
D11T Dozer Information	**Hours**	**Comments**
Hours/Day	8	Work Hours per Day
Downtime	15%	2018 EquipmentWatch,
Availability	6.8	Hours/Day
Availability	51	Minutes/Hour
% Availability	85%	

Table 10: Riprap Production Costs

Equipment	Equipment ($/hr)	# Equipment	Operator ($/hr)	# Operator	Total ($/hr)
Cat 992K Loader	$ 294.35	1	$ 26.56	1	$ 320.91
793 Haul Truck	$ 478.45	2	$ 23.84	2	$ 1,004.58
980G Loader	$ 75.88	0	$ 26.56	1	$ 102.44
14M Grader	$ 99.13	0	$ 26.29	1	$ 125.42
Water Truck	$ 86.99	1	$ 23.84	1	$ 110.83
Supervisor	$ -	-	$ 23.48	1	$ 23.48

APPENDIX B.3
ENGINEERING QUANTITIES

TELESTO SOLUTIONS INCORPORATED

2950 E. Harmony Road, Suite 200
Fort Collins, Colorado 80525
970-484-7704 / 970-484-7789 (FAX)

TECHNICAL MEMORANDUM

DATE:	**October 8, 2014**	**Telesto #**	**200189**
TO:	**Cobre Mining Company**		
FROM:	**April Tischer**		
SUBJECT:	**Earthwork Cost Estimate Takeoff Summary Quantity Definitions**		

This technical memorandum presents a summary discussion of the engineering quantities used in developing the reclamation earthwork cost estimate for the Continental Mine for the anticipated end of year 2019 topography. The reclamation quantities are summarized in Tables 1 through 3. Tables 1 and 2 list the quantities associated with the earthwork. Table 3 provides the riprap and gravel volume per foot for each channel type. The quantities for each facility were separated into sections of uniform slope, and matching reclamation criteria. A summary description of each item shown in Table 1 is presented below which includes the basis for determining each particular quantity.

Item 1.1 Outslope Cut - Pushdown

This item includes earthwork cut volume (cut) required for regrading tailings pond and stockpile outslopes. Quantities were calculated using Autodesk Civil 3D. The cut and fill volumes within each section were balanced to within 10%. The average of the cut and fill volumes were used in the cost estimate. The cut area is near the top of the slope and the fill area is near the base. It was assumed that the cut material will be pushed down the slope, where it will be placed as fill. Quantities required to excavate benches are included separately in Item 6.1.

Item 1.2 Outslope Fill - Pushdown

This item includes earthwork fill volumes (fill) required for regrading the tailings pond and stockpile outslopes. Quantities were calculated using Autodesk Civil 3D.

The cut and fill volumes within each section were balanced to within 10%. The average of the cut and fill volumes was used in the cost estimate. The cut area is near the top of the slope and the fill area is near the base. It was assumed that the cut material will be pushed down the slope, where it will be placed as fill. Quantities required to excavate benches are included separately in Item 6.1.

Item 1.3 Outslope Cut/Fill Pushdown Distance

This item is the average sloped distance between the approximate centroids of the cut and fill blocks for regrading the stockpile and tailings outslopes.

Item 1.4 Outslope Surface Grade

This item is the final overall grade of the regraded outslope, prior to cutting in any benches. For locations where benches are not required it is equal to the final slope.

Item 2.1 Top Cut

This item includes the earthwork cut volume required for regrading the tailings pond and stockpile top surfaces. Quantities were calculated using Autodesk Civil 3D. The cut and fill volumes within each section were balanced to within 10%. The average of the cut and fill volumes was used in the cost estimate. It was assumed that the cut material will be pushed to where it will be placed as fill.

Item 2.2 Top Fill

This item includes the earthwork fill volume required for regrading the tailings pond and stockpile top surfaces. Quantities were calculated using Autodesk Civil 3D. The cut and fill volumes within each section were balanced to within 10%. The average of the cut and fill volumes was used in the cost estimate. It was assumed that the cut material will be pushed to where it will be placed as fill.

Item 2.3 Top Cut/Fill Push Distance

This item is the average distance between the estimated centroid of the cut and fill blocks for regrading the stockpile and tailings top surfaces.

Item 2.4 Top Surface Grade %

This item is the final overall grade of the regraded top surface. Where no quantities are indicated in Items 2.2 and 2.3, the grading is done by area, Item 4.1, to obtain a smooth finish at the grade specified.

Item 3.1 Outslope Surface Approximate Sloped Area

This item includes the outslope area that will receive cover, and revegetation. Revegetation costs include chiseling or ripping, scarifying, discing, rangeland drill seeding, mulching, crimping, and mobilization. The planer (horizontal) area was multiplied by a slope correction factor to approximate the true sloped surface area.

Item 3.2 Outslope Surface Cover Push Distance

This item is the estimated average push distance to spread cover material over tailings or stockpile outslopes. It assumes the truck haul and dumping can be coordinated to minimize push distance.

Item 3.3 Outslope Surface Cover Depth

This item is the depth of cover, measured normal to the slope, to be placed over the tailings and stockpile outslopes. It does not include material that may already be approved as cover already in place for a particular facility.

Item 3.4 Outslope Surface Cover Fill

This item is the quantity of cover fill to cover the stockpile and tailings outslopes at the depth specified in Item 3.3, over the area specified in Item 3.1. Cover fill volumes were obtained by multiplying the area specified in Item 3.1 by Item 3.3 and converting to cubic yards.

Item 4.1 Top Surface Area

This item includes stockpile and tailings top surfaces as well as surface impoundments that will receive grading, cover, and revegetation where indicated. Grading involves making one pass with a blade over the surface to obtain a smooth finished grade. Revegetation costs include chiseling or ripping, scarifying, discing, rangeland drill seeding, mulching, crimping, and mobilization. This item includes borrow areas that require revegetation.

Item 4.2 Top Surface Cover Push Distance

This item is the estimated average push distance to spread cover material over stockpile and tailings top surfaces as well as surface impoundments. It assumes the truck haul and dumping can be coordinated to minimize push distance.

Item 4.3 Top Surface Cover Depth

This item is the depth of cover to be placed over stockpile and tailings top surfaces as well as surface impoundments. It does not include material that may already be approved as cover already in place for a particular facility.

Item 4.4 Top Surface Cover Fill

This item is the quantity of cover fill to cover the stockpile and tailings top surfaces as well as surface impoundments at the depth specified in Item 4.3 over the area specified in Item 4.1. Cover fill volumes were obtained by multiplying the area specified in Item 4.1 by Item 4.3 and converting to cubic yards.

Item 5.1 Cover Source

This item provides the location cover material is assumed to be obtained for each facility based on the 2014 mine expansion plan, the volume of available cover material, and proximity to the facility being covered. These haul routes are subject to change based on those factors. Borrow locations are used to determine haul distance and grades in Items 5.2 through 5.8.

Item 5.2 - 5.5 Cover Haul Distance

These items describe the two-dimensional haul distance between the approximate centroid of the borrow source and cover areas. Depending on the terrain, the haul route has been divided into as many as three segments. If the grades along the haul route are generally uniform, the haul route was described using one or two haul segments. The Drawings in the CCP show the main haul routes.

Item 5.6 - 5.8 Cover Haul Grades

These items represent the grades of the haul segments described in Items 5.2-5.5.

Item 6.1 Outslope Bench Length

This item represents the length of benches to be cut into the stockpile outslopes. The length of benches is equal to the length of the outslope channels. Bench cross sections are shown in the CCP Drawings.

Item 6.2 Outslope Channel Length

This item represents the length of surface water channels to be constructed on benches of the stockpile outslopes. It was assumed that channels will be located on each outslope bench. The conceptual channel locations and channel cross sections are shown on the CCP Drawings.

Item 6.3 Outslope Channel Riprap

This item includes the volume of riprap material required for the outslope channels described in Item 6.2. Because there is no known source of material that can supply these quantities in the vicinity of the stockpiles, it was assumed that all riprap is purchased. This assumption may change if a nearby source is identified. The riprap quantity calculations are summarized in Table 3.

Item 7.1 Channel Length

This item represents the length of surface water channels to be constructed on the stockpile and tailings top surfaces. The conceptual channel locations and channel cross-sections are shown on the CCP Drawings.

Item 7.2 Channel Riprap

This item includes the volume of riprap material required for the top channels described in Item 7.1. The riprap quantity calculations are summarized in Table 3.

Item 7.3 Gravel

This item includes the volume of gravel required for the top channels described in Item 7.1. The gravel quantity calculations are summarized in Table 3.

Item 8.1 Downdrain Length

This item represents the length of the downdrains to be constructed on the stockpiles and tailings. The conceptual downdrain locations, and channel cross-sections are shown on the Drawings in the CCP.

Item 8.2 Downdrain Riprap

This item includes the volume of riprap material required for the downdrains described in Item 8.1. The downdrain riprap calculations are summarized in Table 3.

Item 8.3 Downdrain Gravel

This item includes the volume of gravel required for the downdrains described in Item 8.1. The gravel quantity calculations are summarized in Table 3.

Item 9.1 Perimeter

This item describes the length of safety berm and fence.

TELESTO SOLUTIONS INCORPORATED	Continental Mine Closure/Closeout Plan Update	Made By: AAT	Date: 5-Dec-14
	Quantity Summary Sheet		

TABLE 1 - STOCKPILE QUANTITY SUMMARY

Facility Type	Item	Outslope Cut Pushdown (CY)	Outslope Fill Pushdown (CY)	Outslope Cut/Fill Pushdown Distance (ft)	Outslope Surface Grade %	Top Cut (CY)	Top Fill (CY)	Top Cut/Fill Push Distance (ft)	Top Surface Grade %	Outslope Surface Area[1] (Acres)	Outslope Surface Cover Push Distance (FT)	Outslope Surface Cover depth Depth (Inches)	Outslope Surface Cover Cover Fill (CY)
		Item 1.1	Item 1.2	Item 1.3	Item 1.4	Item 2.1	Item 2.2	Item 2.3	Item 2.4	Item 3.1	Item 3.2	Item 3.3	Item 3.4
Stockpiles	South Waste Rock Disposal Facility	-	-	-	-33% to -28%	666,680	666,680	540	-1%	256	100	36	1,237,104
	South Waste Rock Disposal Facility	-	-	-	-	-	-	-	-1%	-	-	-	-
	Disturbed Area Adjacent and North of South Waste Rock Disposal Facility	-	-	-	-	-	-	-	-	-	-	-	-
	Hanover Mountain Deposit	-	-	-	-	-	-	-	-	-	-	-	-
	Pearson-Barnes Mine Area	-	-	-	-	-	-	-	17%	-	-	-	-
	Pearson-Barnes Mine Area	-	-	-	-	-	-	-	17%	-	-	-	-
	Low Grade WRF	-	-	-	-33%	-	-	-	-	28	100	12	44,899
	Low Grade WRF	-	-	-	-33%	-	-	-	-	28	100	12	44,899
	Main Tailings Impoundment[1]	176,903	163,685	250	-33%	42,514	59,075	200	-0.8%	36.3	100	36	175,837
	Reclaim Pond Outlet Channel	-	-	-	-	62,226	-	-	-	-	-	-	-
	Tailing Pipeline Corridor[2]	-	-	-	-	-	-	-	-1%	-	-	-	-
Borrow Areas	Top Soil Stockpile	-	-	-	-	-	-	-	-	-	-	-	-
	NOBS (proposed)	-	-	-	-	-	-	-	-	-	-	-	-
	South OB Stockpile (proposed)	-	-	-	-	-	-	-	-	-	-	-	-
	Channel Cut used as Borrow Area Near Main Tailings Impoundment	-	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-1	-	-		-	-	-	-	-	-	-	-	-
	OB Stockpile-2	-	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-3	-	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-4	-	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-5	-	-	-	-	-	-	-	-	-	-	-	-
Roads	Haul Roads[3]	-	-	-	-	-	-	-	-1%	-	-	-	-
	Exploration Roads	-	-	-	-	-	-	-	-1%	-	-	-	-
Continental Pit	Continental Pit berm and fence disturbance					-	-	-	-	-	-	-	-
Surface Impoundments[4]	Grape Gulch Pond #3 (HDPE lined; reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Blackman's Seep (HDPE Lined; reclaimed year 5)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Upper Creek Containment Pond 1 (HDPE Lined; Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Magnetite Seepage Pond (HDPE Lined) (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 1 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 2 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 3 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 1 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 2 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	SWRF Dam 3 (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Decant Pond #4 (HDPE lined; reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	North Tailings Decant Pond (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	East WRF Containment (Proposed; Reclaimed Year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Decant Pond #4 (HDPE lined; reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	Decant Pond #4 (HDPE lined; reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	North Tailings Decant Pond (Reclaimed year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-
	East WRF Containment (Proposed; Reclaimed Year 12)	-	-	-	-	-	-	-	-1%	-	-	-	-

Facility Type	Item	Top Surface Surface Area (Acres)	Top Surface Cover Push Distance (FT)	Top Surface Cover depth Depth (Inches)	Top Surface Cover Fill (CY)	Cover Source	Cover Fill Haul Dist. Distance Total (ft)	Cover Fill Haul Dist. Distance Leg 1 (ft)	Cover Fill Haul Dist. Distance Leg 2 (ft)	Cover Fill Haul Dist. Distance Leg 3 (ft)	Cover Fill Haul Grade Grade Leg 1 (%)	Cover Fill Haul Grade Grade Leg 2 (%)	Cover Fill Haul Grade Grade Leg 3 (%)
		Item 4.1	Item 4.2	Item 4.3	Item 4.4	Item 5.1	Item 5.2	Item 5.3	Item 5.4	Item 5.5	Item 5.6	Item 5.7	Item 5.8
Stockpiles	South Waste Rock Disposal Facility	85	100	36	412,368	North OB Stockpile	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%
	South Waste Rock Disposal Facility	25	100	36	119,548	North OB Stockpile	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%
	Disturbed Area Adjacent and North of South Waste Rock Disposal Facility	21	-	-	-	-	-	-	-	-	-	-	-
	Hanover Mountain Deposit	93	100	36	451,572	North OB Stockpile	5,707	1,759	2,466	1482	-9.9%	-8.1%	6.7%
	Pearson-Barnes Mine Area	12	100	36	57,596	North OB Stockpile	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%
	Pearson-Barnes Mine Area	12	100	36	57,596	North OB Stockpile	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%
	Low Grade WRF	-	-	-	-	North OB Stockpile	5,310	2,310	3,000	0	-8.9%	-2.3%	-
	Low Grade WRF	-	-	-	-	North OB Stockpile	5,310	2,310	3,000	0	-8.9%	-2.3%	-
	Main Tailings Impoundment[1]	108	100	18	261,844	North OB Stockpile; Reclaim Pond Outlet Channel cut	7,193	2,310	1,940	2,943	-8.9%	1.5%	3.6%
	Reclaim Pond Outlet Channel	-	-	-	-	Reclaim Pond Outlet Channel cut used for cover material	1,172	1172	-	-	-0.9%	-	-
	Tailing Pipeline Corridor[2]	1.4	100	36	7,000	North OB Stockpile	7,193	2,310	1,940	2,943	-8.9%	1.5%	3.6%
Borrow Areas	Top Soil Stockpile	0.2	-	-	-	-	-	-	-	-	-	-	-
	NOBS (proposed)	17.4	-	-	-	-	-	-	-	-	-	-	-
	South OB Stockpile (proposed)	18.3	-	-	-	-	-	-	-	-	-	-	-
	Channel Cut used as Borrow Area Near Main Tailings Impoundment	1.7	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-1	4.6	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-2	0.9	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-3	5	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-4	4.3	-	-	-	-	-	-	-	-	-	-	-
	OB Stockpile-5	3.3	-	-	-	-	-	-	-	-	-	-	-
Roads	Haul Roads[3]	45	-	-	-	-	-	-	-	-	-	-	-
	Exploration Roads	37	-	-	-	-	-	-	-	-	-	-	-
Continental Pit	Continental Pit berm and fence disturbance	17.6	-	-	-	-	-	-	-	-	-	-	-
Surface Impoundments[4]	Grape Gulch Pond #3 (HDPE lined; reclaimed year 12)	0.4	100	36	1,839	North OB Stockpile	3,856	2310	1,546	-	-8.9%	-7.8%	-
	Blackman's Seep (HDPE Lined; reclaimed year 5)	0.01	100	36	48	North OB Stockpile	3,856	2310	1,546	-	-8.9%	-7.8%	-
	Upper Creek Containment Pond 1 (HDPE Lined; Reclaimed year 12)	1.1	100	36	5,469	North OB Stockpile	3,856	2310	1,546	-	-8.9%	-7.8%	-
	Magnetite Seepage Pond (HDPE Lined) (Reclaimed year 12)	0.2	100	36	968	North OB Stockpile	6,480	2,310	1,940	2,230	-8.9%	1.5%	-4.0%
	SWRF Dam 1 (Reclaimed year 12)	0.5	100	36	2,517	OB-1 Stockpile, OB-2 Stockpile, OB-3 Stockpile, Topsoil Stockpile, South OB Stockpile	3,630	3,630	-	-	-0.3%	-	-
	SWRF Dam 2 (Reclaimed year 12)	0.3	100	36	1,646	OB-1 Stockpile, OB-2 Stockpile, OB-3 Stockpile, Topsoil Stockpile, South OB Stockpile	3,630	3,630	-	-	-0.3%	-	-
	SWRF Dam 3 (Reclaimed year 12)	0.8	100	36	4,066	OB-1 Stockpile, OB-2 Stockpile, OB-3 Stockpile, Topsoil Stockpile, South OB Stockpile	3,630	3,630	-	-	-0.3%	-	-
	SWRF Dam 1 (Reclaimed year 12)	0.5	100	36	2,517	North OB Stockpile	14,159	2,310	7,312	4,537	-8.9%	-1.0%	2.6%
	SWRF Dam 2 (Reclaimed year 12)	0.3	100	36	1,646	North OB Stockpile	13,759	2,310	7,312	4,137	-8.9%	-1.0%	2.9%
	SWRF Dam 3 (Reclaimed year 12)	0.8	100	36	4,066	North OB Stockpile	12,759	2,310	7,312	3,137	-8.9%	-1.0%	3.8%
	Decant Pond #4 (HDPE lined; reclaimed year 12)	0.6	100	36	3,001	North OB Stockpile	4,110	2,310	1,800	-	-8.9%	-1.1%	-
	North Tailings Decant Pond (Reclaimed year 12)	0.5	100	36	2,226	North OB Stockpile	4,110	2,310	1,800	-	-8.9%	-1.1%	-
	East WRF Containment (Proposed; Reclaimed Year 12)	0.5	100	36	2,420	North OB Stockpile	4,110	2,310	1,800	-	-8.9%	-1.1%	-
	Decant Pond #4 (HDPE lined; reclaimed year 12)	0.6	100	36	3,001	North OB Stockpile	4,110	2,310	1,800	-	-8.9%	0.3%	-
	Decant Pond #4 (HDPE lined; reclaimed year 12)	0.6	100	36	3,001	OB-4 Stockpile	1,000	1000	-	-	2.5%	-	-
	North Tailings Decant Pond (Reclaimed year 12)	0.5	100	36	2,226	OB-4 Stockpile	1,000	1000	-	-	2.5%	-	-
	East WRF Containment (Proposed; Reclaimed Year 12)	0.5	100	36	2,420	OB-4 Stockpile	1,000	1000	-	-	2.5%	-	-

Facility Type	Item	Bench Length 3:1 slope (ft)	Bench Length 2.5:1 slope (ft)	Outslope Channel Length (ft)	Outslope Channel Riprap (CY)	Type 1 Channel Length (FT)	Type 1 Channel Riprap (CY)	Type 1 Channel Gravel (CY)	Type 2 Channel Length (ft)	Type 2 Channel Riprap (CY)	Type 2 Channel Gravel (CY)	Downdrain Length (ft)	Downdrain Riprap (CY)	Downdrain Gravel (CY)	Perimeter (ft)
		Item 6.1a	Item 6.1b	Item 6.2	Item 6.3	Item 7.1	Item 7.2	Item 7.3	Item 7.1	Item 7.2	Item 7.3	Item 8.1	Item 8.2	Item 8.3	Item 9.1
Stockpiles	South Waste Rock Disposal Facility	14,126	25,463	39,589	17,023	3,964	3,817	2,202	-	-	-	8,595	36,959	9,025	-
Tailings	Main Tailings Pond	3,894	-	3,894	1,674	-	-	-	2,141	9,206	2,248	1,353	5,818	1,421	-
	Magnetite Tailings	-	-	-	-	-	-	-	-	-	-	420	1,806	441	-
Continental Pit	Safety berm, Pits perimeter	-	-	-	-	-	-	-	-	-	-	-	-	-	6,635
	Chain link fence, Pits perimeter	-	-	-	-	-	-	-	-	-	-	-	-	-	2,453
Hanover Mountain Deposit	Safety berm, Pits perimeter	-	-	-	-	-	-	-	-	-	-	-	-	-	6,670
	Chain link fence, Pits perimeter	-	-	-	-	-	-	-	-	-	-	-	-	-	3,286

[1]Includes South Buttress area.
[2] Includes lengths of pipe from Mills 1 and 2 up to the top of the tailing impoundment, assumes pipelines on top of tailings are covered when the top is covered. Flushing the pipelines is covered under water management.
[3] CHR is included separately in Appendix B.4
[4]Surface Impoundment Areas are equal to the top surface area of the pond as described by surveyed stage-volume relationships.
NOBS - North Overburden Stockpile
OB - Overburden
WRF - Waste Rock Facility

Table 2 Miscellaneous Quantities

Item	Description	Quantity	Units
Monitoring wells*	Reclamation year 100	7	each
Reinforced Concrete Wall Demolition	SWRF Dam 1 (Reclaimed year 12)	270	ft
Reinforced Concrete Wall Demolition	SWRF Dam 2 (Reclaimed year 12)	153	ft
Reinforced Concrete Wall Demolition	SWRF Dam 3 (Reclaimed year 12)	235	ft
Reinforced Concrete Wall Demolition	East WRF Containment (Proposed; Reclaimed Year 12)	200	ft

*Assume each well 100-feet deep based on average depth to water.

Table 3 Channel Quantities

Item	Material	Units	Amount	Description[1]
Outslope Channel	Riprap	(cy/ft)	0.43	Bench width 30 ft, 5% slope towards interior, 0.5' deep riprap by 20' wide riprap on 5% slope and 3' wide riprap on the 3:1 slope
Top Surface Channels Type 1	Riprap	(cy/ft)	0.96	10' Bottom width, 3:1 side slopes, 2' deep, 1' thick riprap, 0.5' thick gravel
	Gravel	(cy/ft)	0.56	
Top Surface Channels Type 2	Riprap	(cy/ft)	4.30	20' Bottom width, 3:1 side slopes, 3' deep, 2.5' thick riprap, 0.5' thick gravel
	Gravel	(cy/ft)	1.05	
Downdrain (Type 2 Channel)	Riprap	(cy/ft)	4.30	20' Bottom width, 3:1 side slopes, 3' deep, 2.5' thick riprap, 0.5' thick gravel
	Gravel	(cy/ft)	1.05	

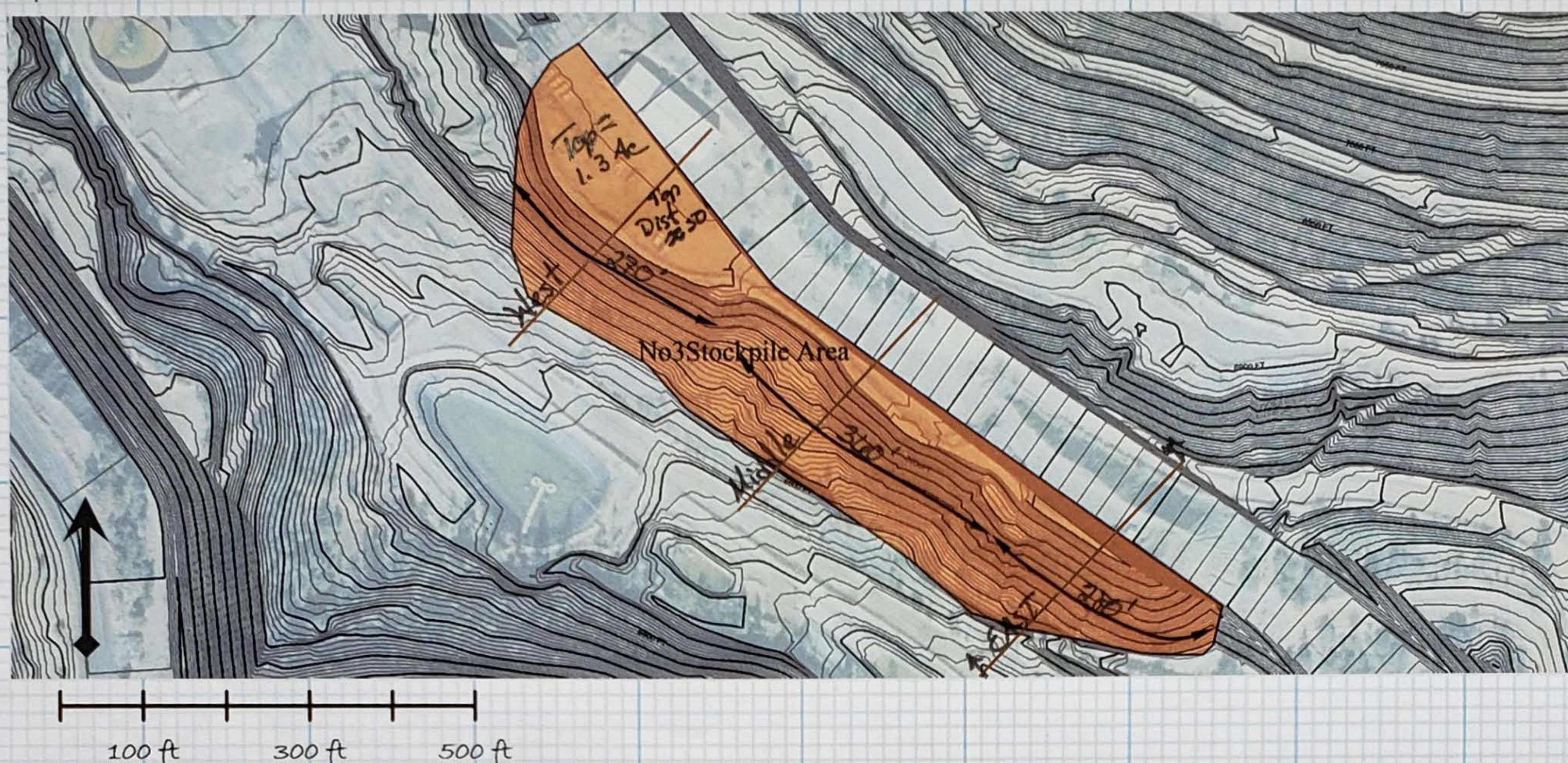
[1]Cross Sections are shown in the CCP Drawings.

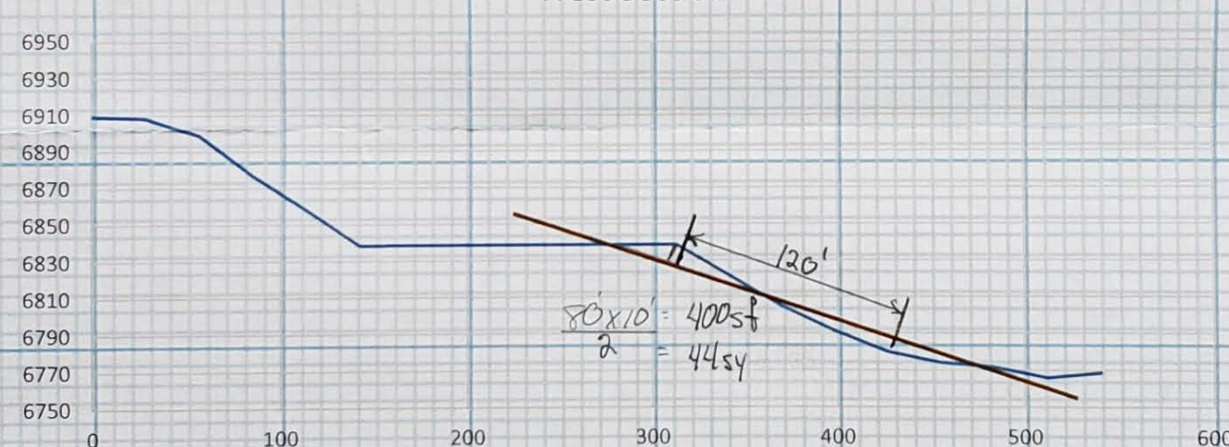
Job No: ~~Telesto Job Number~~ 200189	Client: ~~Client change~~ FMI Climax	1 of ~~4~~ 1	
Task No: ~~Task Name~~ No. 3 Stockpile	Computed by: ~~Jane Doe~~ Walt	~~4/20/10~~ 5/16/18	
~~DRAFT~~ WW	Checked by: ~~John Smith~~	~~4/20/10~~	

Calculation Documentation

Problem Statement:

A quick estimate on volumes of No. 3 Stockpile at the Continental Mine is needed for the CCP update





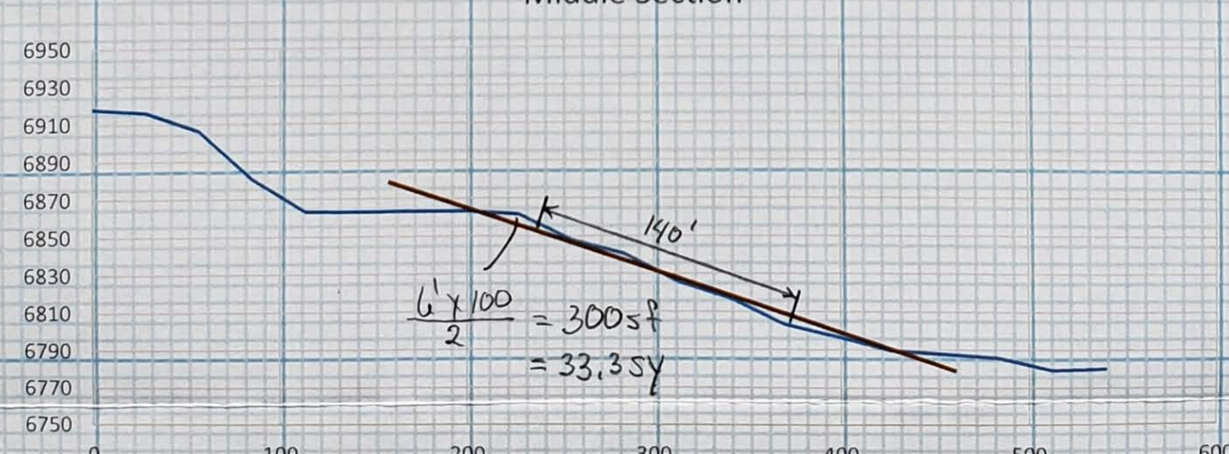
$V = 270' \times 44 sy \times {}^{yd}/_{3ft}$
$= 3{,}960$ cy

Weighted ave push distance

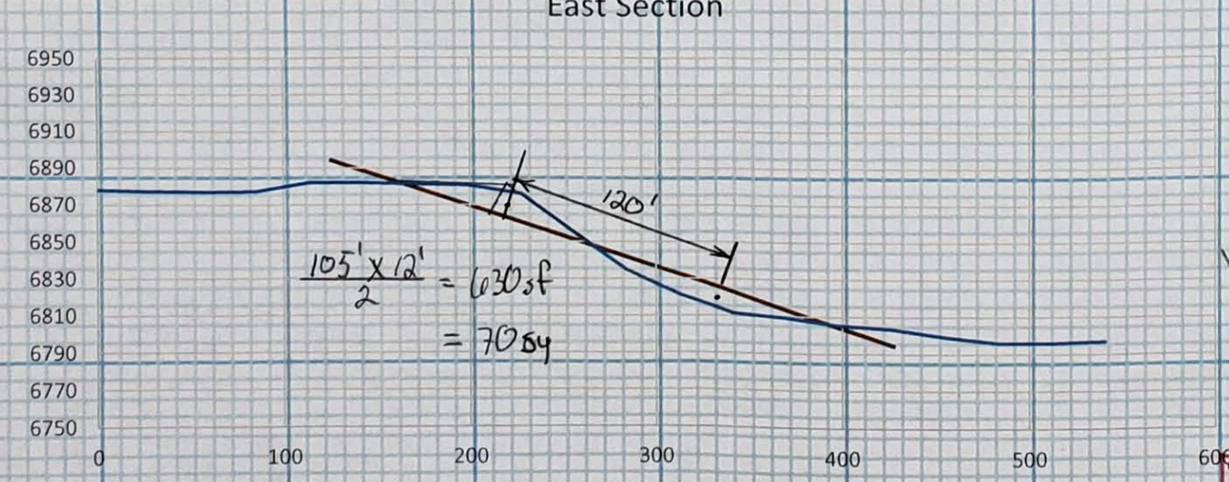
(120)(270)
(140)(360)
(120)(280)

116,400 / 910

Push Dist = 127.9 ft



$V = 360' \times 33.3 sy \times \frac{yd}{3ft}$
$= 3996$ cy



$V = 280' \times 70 sy \times \frac{yd}{3ft}$
$= 6{,}533$ cy

$\boxed{V_{Total} = 14{,}489 \text{ cy}}$

Appendix C
Water Management Cost Estimate
Summary Report

Prepared for

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

Prepared by

Telesto Solutions Inc.
2950 East Harmony Road Suite 200
Fort Collins, Colorado 80528

December 2014
Updated May 2018

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Signature Page

Appendix C
Water Management Cost Estimate
Summary Report

December 2014
Updated May 2018

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Walter Niccoli, PE – Report Review

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1.0 INTRODUCTION

As part of the update to the 2014 Continental Mine Closure Closeout Plan (CCP) update, Telesto Solutions Inc. (Telesto) prepared a water management reclamation cost estimate for financial assurance for Freeport-McMoRan Cobre Mining Company (Cobre). Freeport-McMoRan Chino Mines Company (Chino) has now taken over Cobre. This water management reclamation cost estimate update includes operations and maintenance, replacement, and removal costs related to post closure water management. 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 assumes reclamation would begin in 2024 (Reclamation Year 0). The original 2014 CCP 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 brought all costs and schedules into currency with a 2018 start of mining date.

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 (Appendix C.1), and the Main Tailings Impoundment (MTI) seeps are expected to decrease and eventually cease flowing (Appendix C.2). The reduction in the aforementioned sources will decrease the water requiring management. Facilities and post closure uses, based on 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 during and after reclamation is estimated to be **$2,990,000.** A summary of the estimate is provided in Table C-2. The costs presented in this estimate are current (2018) dollar costs, a net present value calculation will be presented separately. The remainder of this document describes the specifics used to develop the estimated cost.

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 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	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement		**28.3%**	
Ponds and Tanks	$520,594.94	$147,328	$667,923
Pumps	$659,426.27	$186,618	$846,044
Pipelines	$0.00	$0	$0
Electrical	$0.00	$0	$0
Subtotal	**$1,180,021.20**	**$333,946**	**$1,513,967**
Removal[1]		**28.3%**	
Pumps	$149,324.06	$42,259	$191,583
Pipelines	$114,136.15	$32,301	$146,437
Electrical	$52,380.78	$14,824	$67,205
Subtotal	**$315,840.98**	**$89,384**	**$405,225**
Operations and Maintenance		**17%**	
Ponds and Tanks	$225,298.15	$38,301	$263,599
Pumps	$113,383.30	$19,275	$132,658
Pipelines	$128,879.24	$21,909	$150,788
Electrical Infrastructure	$117,758.66	$20,019	$137,778
Materials		17%	
Electricity and Fuel	$30,408.18	$5,169	$35,578
Environmental Sampling	$297,192.00	$50,523	$347,715
Subtotal	**$912,919.54**	**$155,196**	**$1,068,116**
Total Estimated Cost	**$2,408,781.72**	**$579,000**	**$2,987,307**

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

Average annual stormwater runoff was determined using the SCS Curve Number Method (USDA, 2004a). A 100-year stochastic daily precipitation data set was developed using

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

the stochastic weather generator CLIGEN (USDA, 2004b), precipitation data from Ft. Bayard, New Mexico, and Continental Mine area precipitation records. Stormwater basins for the site were determined using the projected EOY 2023 topography. The EOY 2023 stormwater basins are roughly equivalent to post reclamation stormwater basins, and were used for both the pre and post reclamation stormwater runoff calculations. The runoff calculations are presented in Appendix C.1.

Appendix C.2 describes the calculation method used to estimate the seepage from the MTI seeps. A spreadsheet model was employed to execute a water balance of the zones above (unsaturated) and below (saturated) the phreatic surface within the MTI. The unsaturated zone inputs included infiltration, pre and post-reclamation, driven by precipitation, and the output was leakage into the saturated zone. The saturated zone had three main discharges: 1) east toe seeps, 2) southern toe seeps, and 3) vertical drainage. The future hydrologic behavior of current toe seeps was estimated using semi-empirical relationship to the total saturated volume of water stored at any time in the saturated zone of the MTI (currently estimated at over 1.5 billion gallons), and the premise that additional tailing deposition will not occur in the current plan. The spreadsheet model was calibrated to closely match current measured toe seepage rates, providing confidence that the model represents the existing seepage system.

Seeps from the WRFs flow seasonally. They are sourced from storage of monsoonal meteoric infiltration, which is subsequently released through seepage over the following months, and typically go dry before the following season's monsoon (Golder, 2009). These seeps occur near the WRFs outslopes due to the high permeability and large rocks present on the outslopes, which promotes meteoric infiltration. Because of the source and nature of the WRF seeps, they are expected to cease flowing after outslopes are covered with finer grained material or at facility reclamation. The Buckhorn Waste Rock Facility Seep and the WWRDF Inceptor Trenches (Grand Canyon Seeps) will be buried with finer grained waste rock by EOY 2019 and are expected to cease flowing before EOY 2023. The East WRF, Union Hill and Estrada seeps, due to their location, will remain active during the growth of the SWRDF and until after reclamation when meteoric infiltration is considerably reduced. The East WRF, Union Hill and Estrada seeps are assumed to cease flowing shortly after reclamation, assumed to be no later than 5-years after closure. The average 2013 WRF seepage flow rates from the East WRF, Union Hill, and Estrada Seeps (Golder, 2014) were used to approximate post reclamation flow rates in the SWRDF at EOY 2023. Thus, the cost estimate assumes these seeps cease flowing at reclamation Year 5.

Assumptions used in determining the quantity of water to be managed include:

- A Curve Number of 85 was used for pre reclamation stormwater runoff based on recent stormwater modeling efforts
- A Curve Number of 62 was used for post reclamation stormwater runoff (Telesto, 2008)
- Surface runoff capture from: the MTI, Magnetite Tailings Impoundment (MGTI), Waste Rock Facilities (WRFs), Ore Stockpiles and the areas contributing stormwater to Upper Creek Containment Pond 1 and Grape Gulch Pond #3 (including Hanover Mountain)
- Capture of surface seepage from the MTI, MGTI, and the South Waste Rock Disposal Facility (SWRDF)
- Table C.2 describes the expected seepage flow rates during pre and post reclamation. Seep flow rates for reclamation Year 0-5 use the 2013 seepage flow rate totals (Golder, 2014) for the WRFs and the MTI seepage rates predicted in Appendix C.2
- Future hydrologic behavior of current toe seeps was estimated using a semi-empirical relationship to the total saturated volume of water stored at any time in the saturated zone for the MTI
- The Bullfrog Pipeline has a maximum capacity of 1,230 gpm and has an Industrial PMLU

Yearly average seepage quantities are summarized in Table C- 3. Managed water volumes as a function of time are summarized in Table C-4.

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. Cost calculations are located in Appendix C.3 and are organized by Sheet number and/or name. Throughout this document, the items described are followed by a reference to the location of the corresponding calculation Sheet. An electronic copy of the cost estimate, Water

Management Sheets 1 through 4, Cobre_WM_2018_0517.xlsx spreadsheet, is provided in CCP Appendix D.

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[2]	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[3]	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

Assumptions and methods common throughout the cost estimate include the following:

- Miscellaneous unit costs were taken from several sources including R.S. Means Heavy Construction Cost Data Edition 26 (R.S. Means, 2014). All costs taken from R.S. Means were adjusted using the location factor for Las Cruces (84.7%). Miscellaneous unit costs are summarized in Table C.6 and used on Water Management Sheets 1 and 2. Supporting documentation is included in Appendix C.4
- Water management variables are provided in Table C.7 and used on Water Management Sheet 1
- Reclamation begins in 2024 (Reclamation Year 0)

[2] Measured 2013 seepage volumes (Golder 2014).
[3] The estimated yearly stormwater runoff for Upper Creek Containment 1 is based on EOY 2023 mine configuration and calculations in Appendix C.1

Table C-4 Water Management Volumes through Time

Closure Year	Average SWRDF Seeps (gpm)[4]	Average Main Tailings Impoundment (gpm)[5]	Average Storm Water Runoff (gpm)[6]	Average Magnetite Tailings Impoundment (gpm)[7]	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
Cobre_WM_2017.xlsx (Water Management Sheets)	
1 Reclamation and O&M Costs	Ponds/Tanks, Pumps, Pipelines, and Electrical Infrastructure capital and operation and maintenance direct cost calculations.
2 Sampling Cost	Post closure sampling cost development and sampling schedule.
3 WM Cash Flow	Capital cost over time
4 Summary	Cost summary including indirect cost percentages and direct costs calculated on Sheets 1and 2

- 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 (CCP Appendix B).
- 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, 2014) and 2) *Water Management System Analysis and Upgrade Recommendations Report* (Telesto, 2012).

[4] 1Average seep flow rate at EOY 2023 based on average East WRF, Union Hill, and Estrada Seeps flow rates 2013 (Golder 2014)
[5] Calculated drain down rates, see Appendix C.2
[6] Calculated stormwater runoff for reclaimed areas, See Appendix C.1
[7] 4Average seep flow rate at EOY 2023 based on average Magnetite Interceptor Trench Seeps flow rates 2013 (Golder 2014)

- Capital Indirect Costs of 28.3% were applied to the capital direct costs (water management facility replacement or removal) per MMD (1996) and OSM (2000) guidance. The indirect costs are comprised of:
  - Mobilization and Demobilization (3.8%)
  - Contingencies (4.0%)
  - Engineering Redesign Fee (2.5%)
  - Contractor Profit and Overhead (15.0%)
  - Project Management Fee (3.0%).

  Indirect cost percentages are identical to the percentages presented to MMD and the New Mexico Environment Department (NMED) in meetings with Tyrone on September 20, 2012, and on November 2, 2012. (Water Management Sheet 3 and 4)
- Operations and Maintenance Indirect Costs of 17% were applied for long term operations and maintenance per MMD (1996) and OSM (2000) guidance. The indirect costs are comprised of:
  - Contingencies (4.0%)
  - Contractor Profit and Overhead for long term operations and maintenance (10.0%, which accounts for the long term contract and repetitive annual work)
  - Project Management Fee (3.0%).
  - Mobilization and Demobilization as well as Engineering Redesign Fee are 0% for long term maintenance costs. Indirect cost percentages are identical to the percentages presented to MMD and the NMED in meetings with Tyrone on September 20, 2012, and on November 2, 2012. (Water Management Sheet 3 and 4)

4.1 Ponds and Tanks

Water management information and costs for ponds and tanks can be found in Appendix C.3 Water Management Sheets 1 and 3. Assumptions and methods for this portion of the cost estimate include:

- Replacement costs are based on replacement ages from Table C-6 and age at reclamation. The SWRF Dams 1-3 are currently 19 years old, all membrane lined ponds are 29 years old, the Surge Tank is 49 years old, and the East Waste Rock Facility Containment is new in 2023
- 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

Table C-6 Water Management Variables

Description	Variable
RSMeans NM Discount Rate	0.856
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

4.2 Pumps

Water management information and costs for pumps can be found in Appendix C.3, Water Management Sheets 1 and 3. Assumptions and methods for this portion of the cost estimate include:

- Replacement costs are based on replacement ages from Table C-6 and age at reclamation. Currently the SWRF Dam 1-3 pond and booster pumps are 115 years old, the Surge Tank and Reclaim Pond pumps are 11 years old, the Union Hill Adit Seep and Estrada Seep pumps are 9 years old, the East Waste Rock Facility Containment pumps will be new in 2023, and all other pumps are 24 years old.
- 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 can be found in Appendix C.3 Water Management Sheets 1 and 3. Replacement costs are based on replacement ages from Table C-6 and age at reclamation. Assumptions and methods for this portion of the cost estimate include:

- The Bullfrog Pipeline was assumed to be 7 years old,
- The SWRF Dams 1, 2 and 3 pipelines are 15 years old
- East WRF Containment pipelines are new at the start of reclamation.
- All other pipelines were assumed to be 24 years old at the start of reclamation.

4.4 Electrical Infrastructure

Water management information and costs for electrical infrastructure can be found in Appendix C.3, Water Management Sheets 1 and 3. Assumptions and methods for this portion of the cost estimate include:

- 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 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 is quarterly for reclamation years 0 through 5, decreasing to semi-annually for reclamation years 5 through 12 and then to annually for reclamation years 12 through 99. Sampling information and costs can be found in Appendix C.3, Water Management Sheets 2 and 3. Unit rate information can be found in Table C-7.

Table C-7 Water Treatment Unit Costs

Item	Base Unit Costs	Units	Scaled Unit Costs	RSMeans Line Item No.	RSMeans Page	Comment
Utility Pole Demo	$214.50	ea	$183.61	02 41 13.80 0100	36	Professional Judgment 15 to 30 gpm - includes pump control, control panel, installation, and flow meter.
Cross Arm Demo	$93.00	ea	$79.61	02 41 13.80 0300	36	Professional Judgment 50 gpm - includes pump control, control panel, installation, and flow meter.
Wood Electrical Utility Poles a.)	$696.5	ea	$596	33 71 16.33 6020	399	Professional Judgment 100 to 700 gpm - includes pump control, control panel, installation, and flow meter.
Utility Pole Installation b.)	$1,259	ea	$1,078	33 71 16.23 6010	398	Professional Judgment 800 to 2000 gpm - includes pump control, control panel, installation, and flow meter.
Utility Pole Installation c.)	$1.95	ea	$1.67	33 71 16.33 9000	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 3/4"-4" diameter
Utility Pole Installation d.)	$335.00	ea	$287	33 71 16.33 7600	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 6"-8" diameter
Electrical Wiring Installation	$579.00	wire mi	$496	33 71 39.13 0110	402	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 10"-18" diameter
Electrical Wiring Installation	$15,295.00	wire mi	$13,093	33 71 39.13 0150	402	Selective Demo, utility poles, wood, 20'-30' high
Electrical Wiring Installation	$309.00	wire mi	$265	33 71 39.13 0810	403	Selective Demo, cross arms, wood, 4'-6' long
Potential Transformers	$5,261.00	ea	$4,503	33 71 26.26 4100	402	Steel Pipe Schedule 40, black 24" diameter (221113.48 1210) without coupling and hanger
Pipe Removal	$1.95	lf	$1.67	02 41 13.38-1600	29	Membrane lining, 2X60 mil thick
Pipe Removal	$2.73	lf	$2.34	02 41 13.38-1700	29	Assume similar to 10' high 33 degree slope concrete retaining wall, cast concrete reinforced concrete cantilever, including excavation, backfill & reinforced.
Pipe Removal	$4.53	lf	$3.88	02 41 13.38-1800	29	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 4" diameter
Excavation of Soil	$8.28	cy	$7.088	G1030 120 1600	498	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 6" diameter
Reservoir Liners HDPE	$2.74	sf	$2.34544	31 05 19.53 1200	218	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 8" diameter
Small Concrete Dam	$92,125	ea	$78,859	32 32 13.10 3100	323	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 10" diameter
Water Treatment Tank	$295,500	ea	$252,948	33 16 23.13 1000	358	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 12" diameter
Pump	$10,000	ea	$10,298.21	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 14" diameter
Pump	$15,000	ea	$15,447.32	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 16" diameter
Pump	$25,000	ea	$25,745.53	-	-	250,000 gallon steel tank, not including foundation., height/diameter Less than 1
Pump	$30,000	ea	$30,894.63	-	-	Digging holes in rock
Water Supply Piping	$8.81	lf	$7.54	33 14 13.35 0100	352	Wood, class 1 type C, CCA/ACA-treated, 30' high, excludes excavation, backfill and cast-in-place concrete
Water Supply Piping	$12.29	lf	$10.52	33 14 13.35 0200	352	Cross arms 4' long, includes hardware and insulators
Water Supply Piping	$16.74	lf	$14.33	33 14 13.35 0300	352	Disposal of pole and hardware surplus material, assumes 100 feet of wire per pole
Water Supply Piping	$19.93	lf	$17.06	33 14 13.35 0400	352	13 to 26 kV
Water Supply Piping	$22.73	lf	$19.46	33 14 13.35 0500	352	Material handling and spotting-conductors, primary circuits
Water Supply Piping	$33.55	lf	$28.72	33 14 13.35 0600	352	Conductors, per wire, 210-636 kcmil
Water Supply Piping	$41.15	lf	$35.22	33 14 13.35 0700	352	Disposal of surplus material, high voltage conductors
Water Distribution Piping	$218.35	lf	$187	22 11 13.48 1780 and 1210	168	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mi round trip. Removes the overhead and profit (34% based on RS Means Crews O&P markup)
Electric Rate	$0.0502	kWh	0.0502	-	-	Industrial rate date looked up 3/01/2018 (http://www.electricitylocal.com/states/new-mexico/silver-city/) Subtracting indirect costs
Pump Removal Cost	$5,000	ea	$5,149.11	-	-	Engineering Judgment
Electric Panel Cost	$10,000	ea	$10,298.21	-	-	Engineering Judgment
Diesel Fuel Cost ($/gal)	$2.350	gal	$2.350	-	-	Griffin Propane verbal Quote, Silver City, NM (March, 2018) less indirect cost of 17% .
Environmental Sampler	$60	hr	$61.79	-	-	Engineering Judgment
Environmental Samle Rev	$70	hr	$72.09	-	-	Engineering Judgment
Environmental Sampling	$239	sample	$239.32	-	-	23 Constituents. Energy Laboratories, Inc., Quote March 2018 (www.energylab.com).
Shipping Env. Samples	$59.83	cooler	$59.83	-	-	Overnight FedEx $70 for a 10 lb. package 30"x18"x18" Silver City, NM to Casper, WY Energy Labs

5.0 REFERENCES

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Telesto Solutions, Inc. (Telesto). 2008. Condition 87 Continental Mine Surface Impoundment Study, Revision II. Prepared for Cobre Mining Company, Hurley, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. June 2008.

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APPENDIX C.1
RUNOFF CALCULATIONS

2950 E. Harmony Rd., Suite 200
Fort Collins, Colorado 80528
970-484-7704 / 970-484-7789 (FAX)

TECHNICAL MEMORANDUM

DATE:	**September 30, 2014**	**Telesto #**	**200189**
TO:	**Cobre Mining Company**		
FROM:	**April Tischer and Jon Cullor**		
SUBJECT:	**Sample Runoff Calculation: SCS Curve Number Method**		

Problem Statement

As part of the 2014 Closure/Closeout Plan Update, Cobre Mining Company must complete a water management cost estimate. As part of the cost estimate, the amount of surface water runoff to be pumped must be estimated so that related costs can be assigned.

Objectives

1. Estimate average annual stormwater runoff pumping rates for disturbed areas and reclaimed areas.

Approach

1. Estimate daily runoff depth using SCS Curve Number Method (USDA, 1986).
2. Use Surface Impoundment Study (Telesto, 2008) curve number for disturbed areas (CN=85) and covered and revegetated areas (CN=62).
3. A stochastic weather generator CLIGEN (USDA, 2004) was used to create a synthetic 100-year daily precipitation record for Ft. Bayard, New Mexico and then the data was scaled for the Continental Mine, such that the mean annual precipitation for the data set is equal to the 18.29 inches (Multiply by 18.26 in/yr / 15.10 in/yr).
4. Use the two CN's with the stochastic precipitation data for years 1-100 to estimate the average yearly runoff for disturbed and reclaimed areas. Divide total depth by 100 yrs to get average annual runoff depth.
5. Developed stormwater basins based on end of year 2019 areas contributing stormwater runoff to surface impoundments used for closure.
6. Use the average annual runoff depth and basin areas to estimate average annual

runoff volume in the water management cost estimate.

Data and Assumptions

1. Disturbed areas have minimal vegetation to limit runoff. Consequently, an average curve number (CN) of 85 was selected for disturbed areas based on recent stormwater modeling efforts. This represents a soil type with high runoff potential and high percentage of impervious area.

2. During post-closure, cover material has been placed and vegetation established. A curve number of 62 has been selected for this condition and represents a soil type in good hydrologic condition with moderate infiltration rates an cover including grass, weeds, and low growing brush (USDA, 1986; Table 2-2d cover type “herbaceous”, hydrologic soil group “B”), (Telesto, 2008).

3. CLIGEN command line:

   cligen522564.exe -b1 -y100 -iNm293265.par -oFtBa100y

   Runs a 100-year simulation (-y100) beginning in Year 1 (-b1) for Ft Bayard, New Mexico, Indiana, using "Nm293265.par" as the station parameter file, and puts the output into "FtBa100y".

   Notes:

   1. FtBa100y.txt renamed to FtBayard100y.txt
   2. FtBayard100y.txt reformatted to FtBayard100y_LineFormat.txt
   3. FtBayard100y_LineFormat.txt > FtBayarad100yr.xls

4. Ft. Bayard average annual rainfall = 15.10 in/yr.

5. Cobre average annual rainfall = 18.29 in/yr (SMI, 1999).

6. CobreAdjusted100yr.xls adjusted daily data [Ft. Bayard * (18.29/15.100)].

Calculations and Results

Disturbed Areas (CN = 85), the average yearly runoff is 48,155 gal/year/acre

Reclaimed Areas (CN = 62), the average yearly runoff is 2,530 gal/year/acre

See spreadsheet excerpt below.

$$S(in) = \frac{1000}{CN} - 10$$

$$I_a(in) = 0.2\,S$$

$$Q(in/day) = \frac{(P - I_a)^2}{(P - I_a) + S} \quad P > I_a$$

$$Q(in/day) = 0 \quad P \le I_a$$

$$Q(gpm) = Q\left(\frac{in}{day}\right) * \frac{1}{12}\left(\frac{ft}{in}\right) * \frac{1}{1440}\left(\frac{day}{\min}\right) * 43560\left(\frac{ft^2}{ac}\right) * 1(ac) * 7.48\left(\frac{gal}{ft^3}\right)$$

Yr	t time (day)	P precipitation (in)	CN curve number	S storativity (in)	Ia initial abstraction (in)	Q runoff depth (in/day)	Q runoff volume (gallons/day)	Q runoff volume (gpm/ac)	Annual Precip
1	44	0.00	85	1.76	0.35	0.000	0	0.0	
1	45	0.00	85	1.76	0.35	0.000	0	0.0	
1	46	0.07	85	1.76	0.35	0.000	0	0.0	
1	47	0.00	85	1.76	0.35	0.000	0	0.0	
1	48	0.00	85	1.76	0.35	0.000	0	0.0	
1	49	0.00	85	1.76	0.35	0.000	0	0.0	
1	50	0.64	85	1.76	0.35	0.041	1,106	0.8	
1	51	0.13	85	1.76	0.35	0.000	0	0.0	
1	52	0.00	85	1.76	0.35	0.000	0	0.0	
1	53	0.00	85	1.76	0.35	0.000	0	0.0	
1	54	0.08	85	1.76	0.35	0.000	0	0.0	
1	55	0.56	85	1.76	0.35	0.021	576	0.4	
1	56	0.00	85	1.76	0.35	0.000	0	0.0	
1	57	0.00	85	1.76	0.35	0.000	0	0.0	
1	58	0.00	85	1.76	0.35	0.000	0	0.0	

References:

Shepherd Miller, Inc. (SMI). 1999. Baseline Characterization of the Hydrology, Geology, and Geochemistry of the Proposed Continental Mine Expansion Project, Cobre Mining Company, Inc. Prepared for Cobre Mining Company, Inc. (Hurley, NM) by Shepherd Miller, Inc. (Fort Collins, CO).

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USDA. 2004. Cligen Weather Generator v522564, October, 26, 2004.

APPENDIX C.2

MTI DRAINDOWN CALCULATIONS

Problem Statement:

As part of the 2014 Closure/Closeout Plan (CCP) Update, Cobre Mining Company must complete a water management cost estimate. In order to estimate closure costs associated with the CCP, an estimate of the amount of drainage from the MTI is needed.

Objectives:

1. Provide a reasonable estimate of the drain down rates from the MTI
2. Support the CCP cost estimate

Approach:

1. Review previous drain down estimates
2. Evaluate the change in storage since tailings deposition ceased in 1999
   a. Use final topography and estimate water table elevation in 1999
   b. Use piezometric contour maps provided by URS as the basis for estimating water in tailings storage
   c. Use a few different estimating methods (surfaces, cross-sections) to estimate the change
3. Update the drain down conceptual model
4. Update the water balance and drain down estimates based on the conceptual model update and data gathered since 2008.

Data and Assumptions:

1. Golder Associates measurements of MTI seepage since 2006
2. Piezometric maps/data from URS since 2004
3. Current, 2013, flyover topography (Cobre, 2013)
4. 1948 topography (USGS, topo map)
5. See calculation sections for various assumptions

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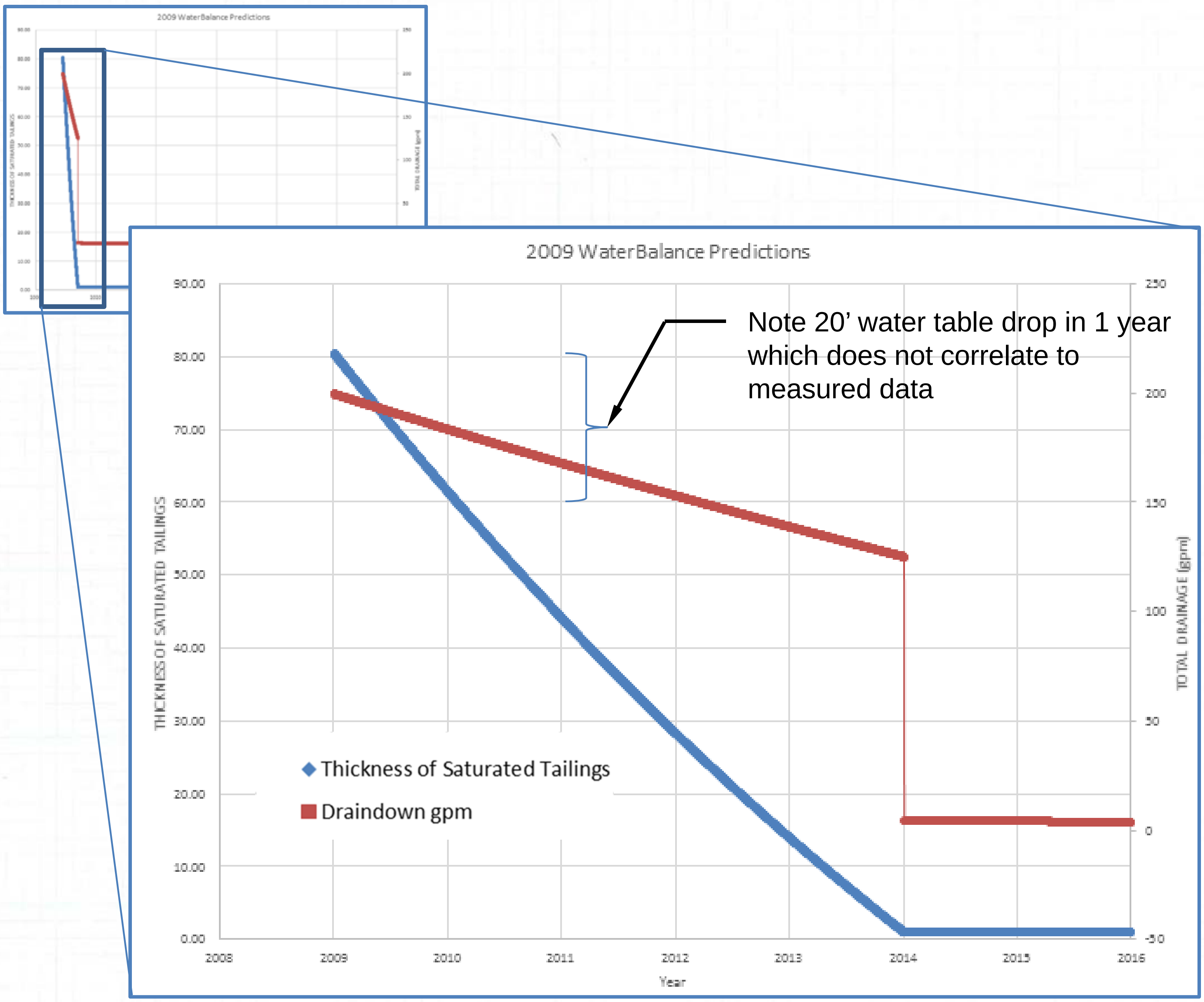
Job No.: 200189-002-02	Client: FCX-Cobre Mining Co.	Page 2 of 15
Task: MTI Drain Down	Computed By: W. Niccoli	Date: 10/07/14
	Checked By: D. Bauer	Date: 10/10/14

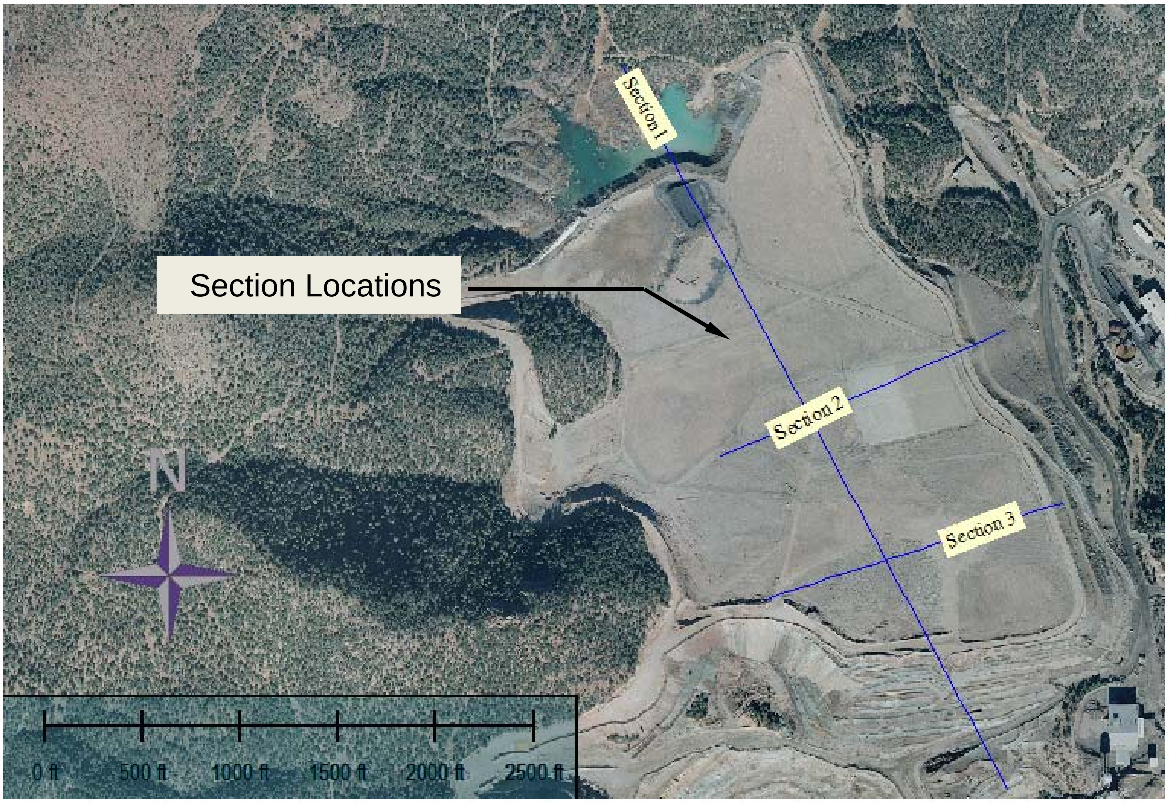
Calculations:

1. The previous drain down model is:
   a. The model is a mass balance approach that estimates the change in storage term by considering the relationship between the unsaturated and saturated zone within the MTI
   b. Inflows considered are net precipitation infiltration
   c. Outflows are a sum of the bottom seepage, and toe seepage
   d. It is "calibrated" to flows measured at the toe seeps plus the amount presumed to leak vertically to the underlying formations
   e. Results are summed here (Assuming predictions start at 1/1/2009):



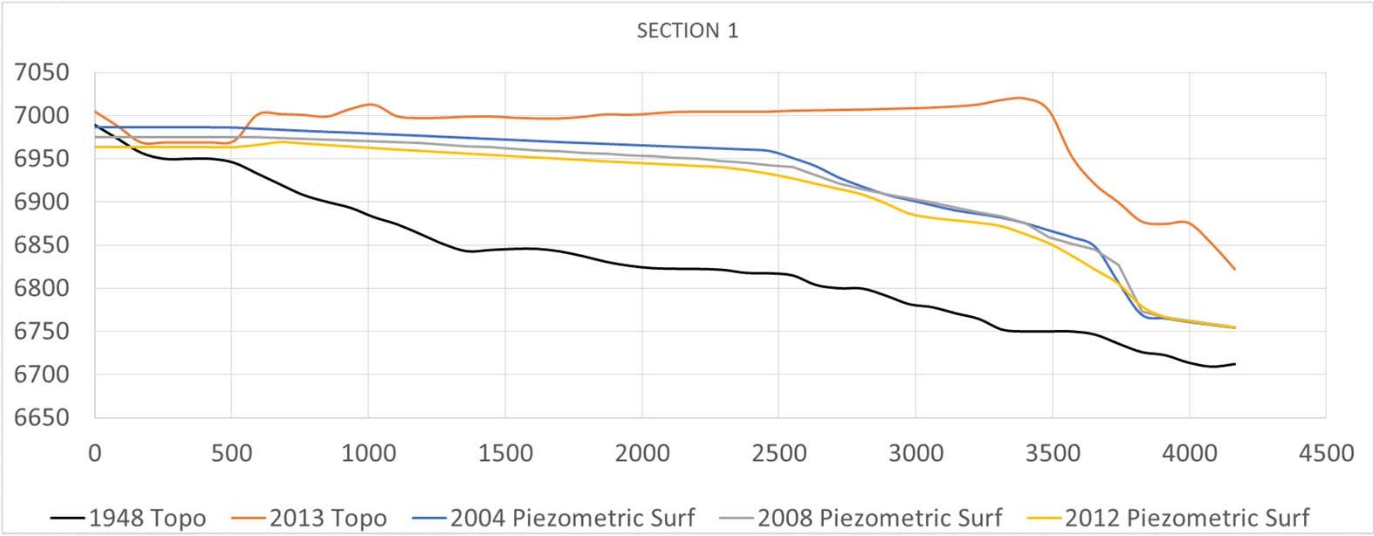
Calculations Continued:

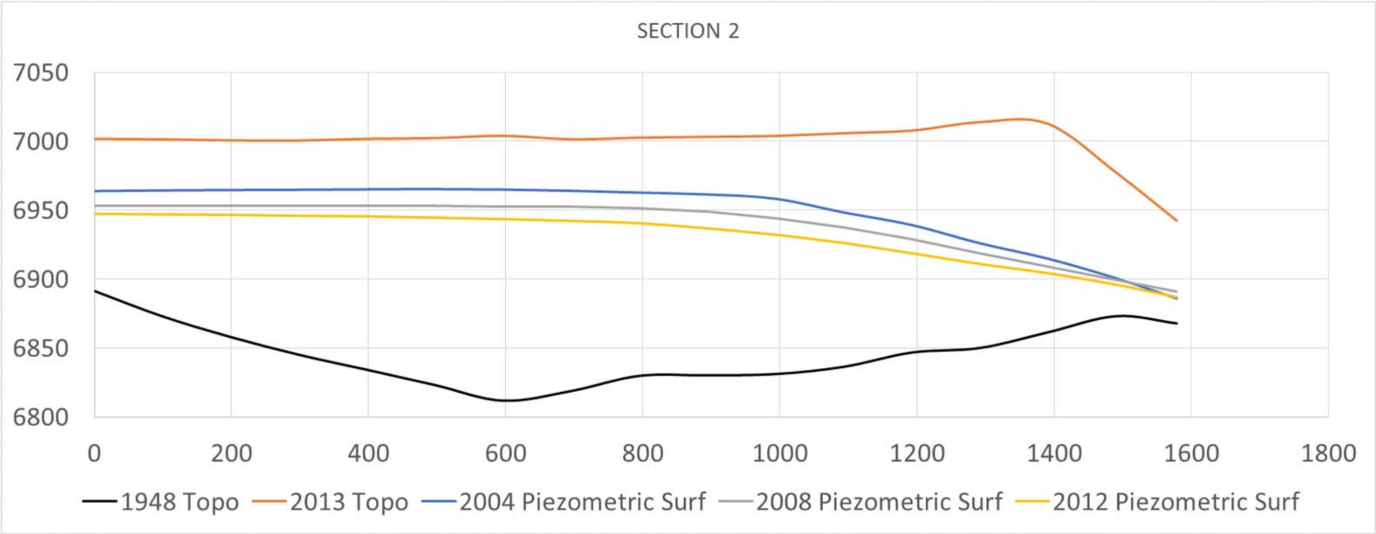
2. Using Global Mapper, terrain models were built for the current and 1948 topography (also the approach used in 2004 and 2009, FYI), and for 2004, 2008 and 2012 piezimetric surfaces from URS:
    a. Cross-sections were developed and plotted for each surface as shown herein
    b. The terrain models had roughly the same areal extent to each other and extended beyond the eastern and southern ends of the MTI
    c. Volumetric estimates were made of the total water in storage (beginning water volume in the Unsaturated zone was estimated at 30% volumetric moisture content)
    d. Initial volume calculations and relationships to saturated thickness are documented herein:

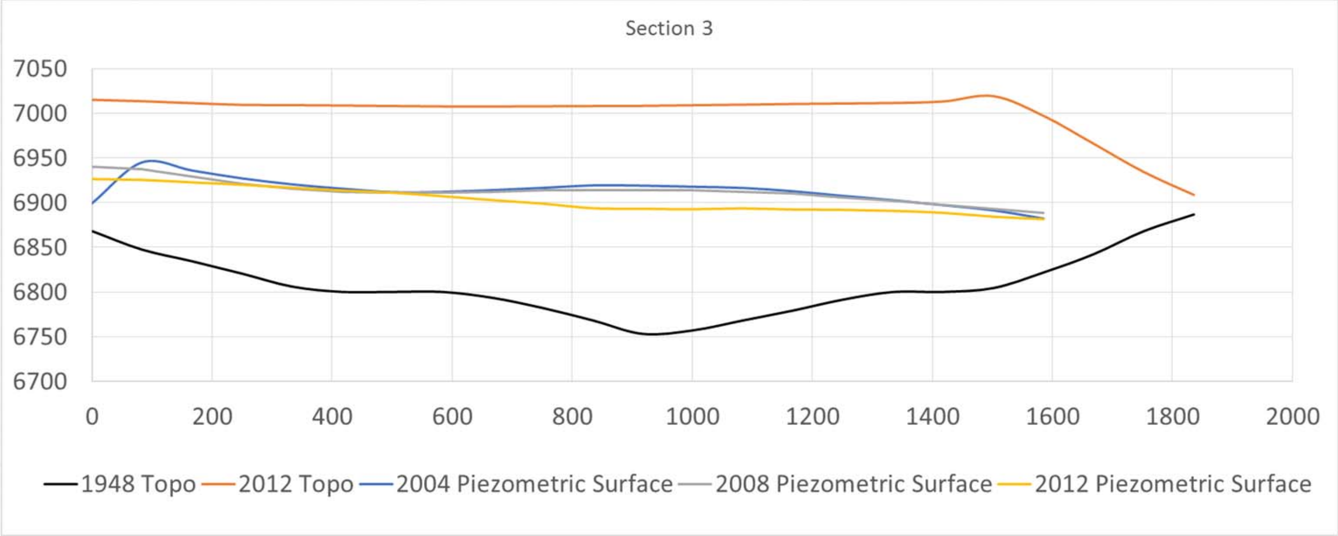


TELESTO SOLUTIONS • INCORPORATED	Job No.: 200189-002-02	Client: FCX-Cobre Mining Co.	Page 4 of 15
	Task: MTI Drain Down	Computed By: W. Niccoli	Date: 10/07/14
		Checked By: D. Bauer	Date: 10/10/14

Calculations Continued:

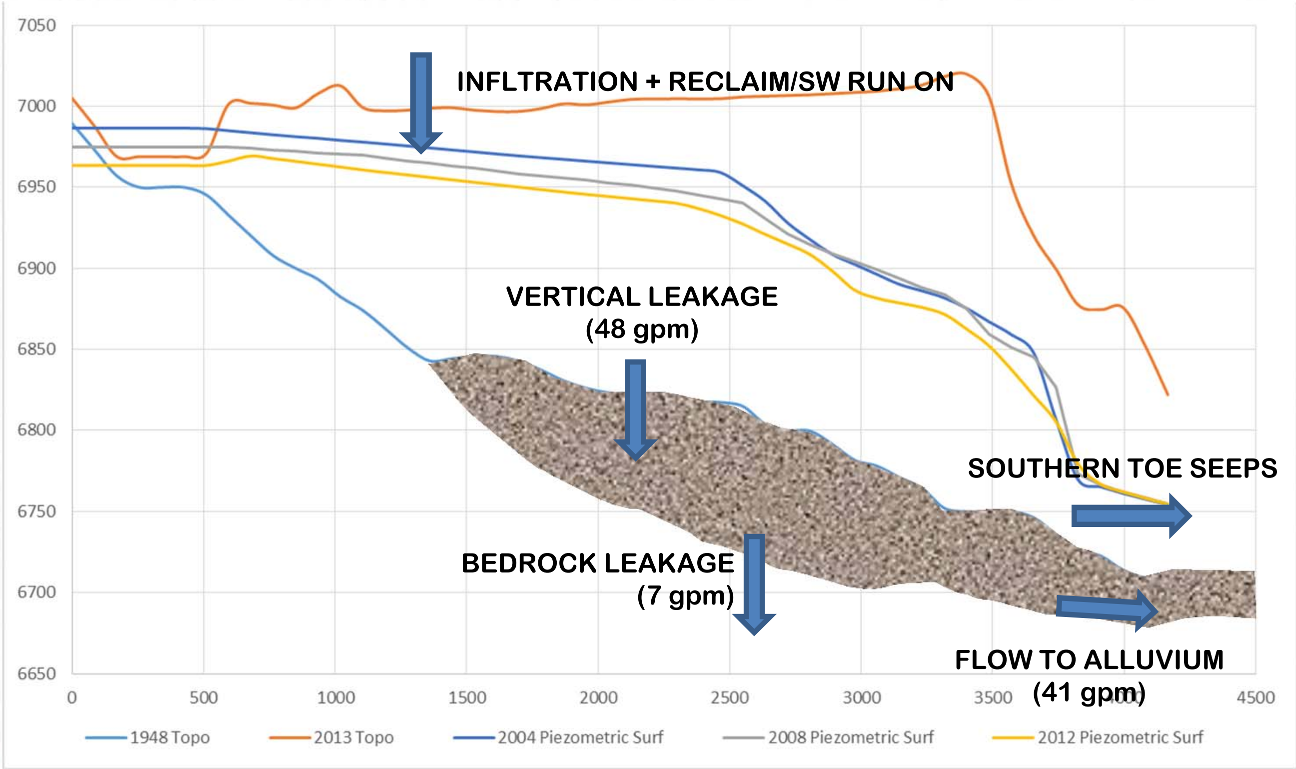


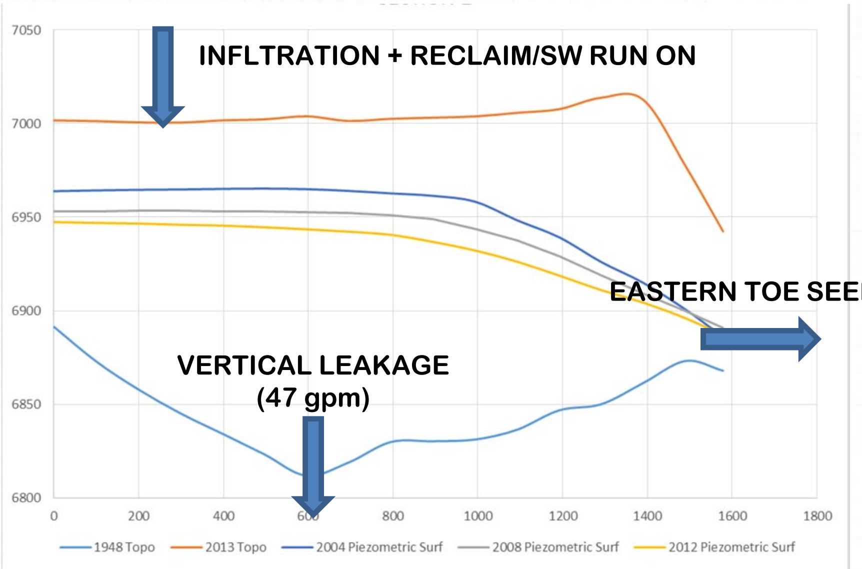




Calculations Con'd:

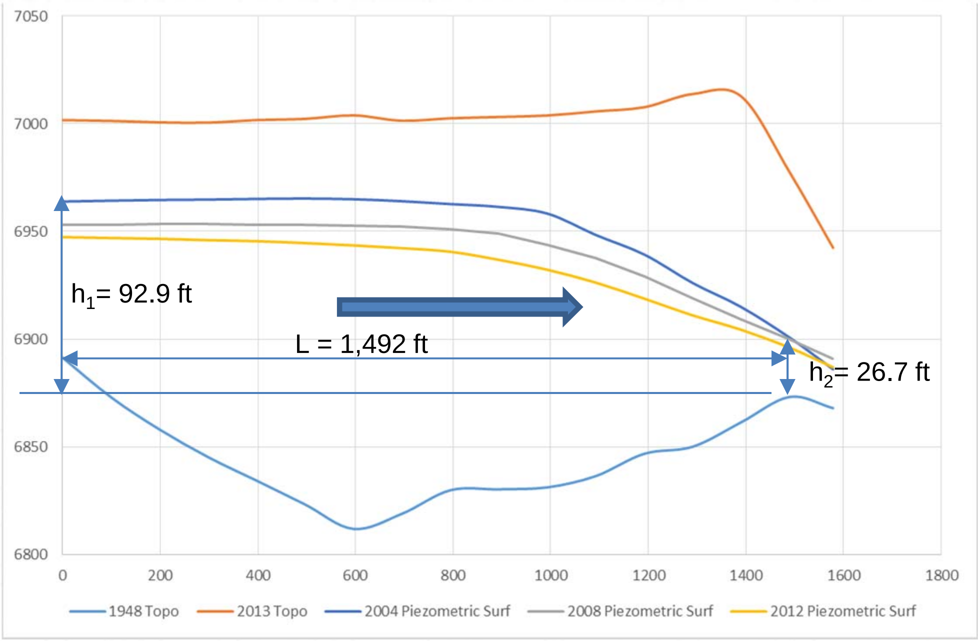
3. Update to the Conceptual Model used in 2009
   a. The 2009 Conceptual Model assumed that all drainage water moved vertically and then was distributed amongst the known (MTI seeps)
   b. For the update, separate the components into the eastern tailings seeps (those reporting to Upper Creek Pond), southern seeps (Dam Toe, Peach Tree, Weber), and bottom drainage

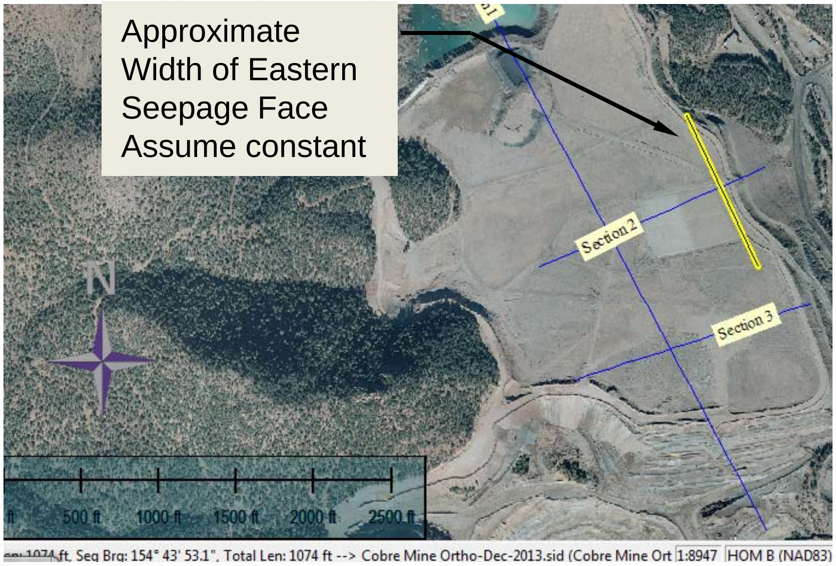




Calculations Con'd:

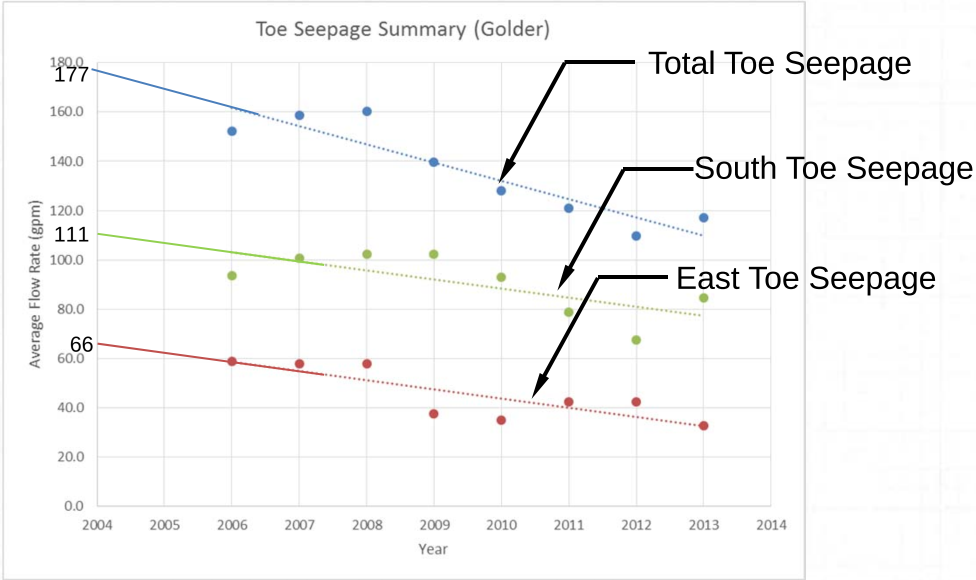
4. Build mathematical relationships to represent the three main drainage components
   a. Eastern Seeps: 2-D Darcy's Law based on non-confined conditions. Use water balance (adjust 2009 spreadsheet) to update for vertical infiltration. Assume only saturated portion above seep outlet is available for horizontal flow and h_2 = .0.288 h_1





Calculations Continued:

4. Build mathematical relationships to represent the three main drainage components
   a. Eastern Seeps: continued – project 2004 seepage rates (dots are from Golder, lines are projections)



Section 2 in 2004

$h_1 := 92.9 \cdot ft$

$h_2 := h_1 \cdot 0.288$

Back calculate the horizontal hydraulic conductivity

$W_{East} := 1075 \cdot ft$ $\qquad L_{East} := 1492 \cdot ft$

$Q_{2004\_est} := 66 \cdot gpm$

$$K_{East} := \frac{Q_{2004\_est} \cdot 2 \cdot L_{East}}{(h_1 - h_2)^2 \cdot W_{East}}$$

$$\boxed{K_{East} = 2.844 \times 10^{-3} \frac{cm}{s}}$$

Section 2 in 2012

$h_1 := \frac{42 \cdot 50}{28} \cdot ft$ $\qquad h_1 = 75\,ft$

$h_2 := h_1 \cdot 0.288$ $\qquad h_2 = 21.6\,ft$

Project what the mathematical relationship would yield with 2012 data. (Golder measured 42 gpm)

$$Q_{2012} := \frac{(h_1 - h_2)}{2} \cdot \frac{(h_1 - h_2)}{L_{East}} \cdot K_{East} \cdot W_{East}$$

$$\boxed{Q_{2012} = 43.016\,gpm}$$

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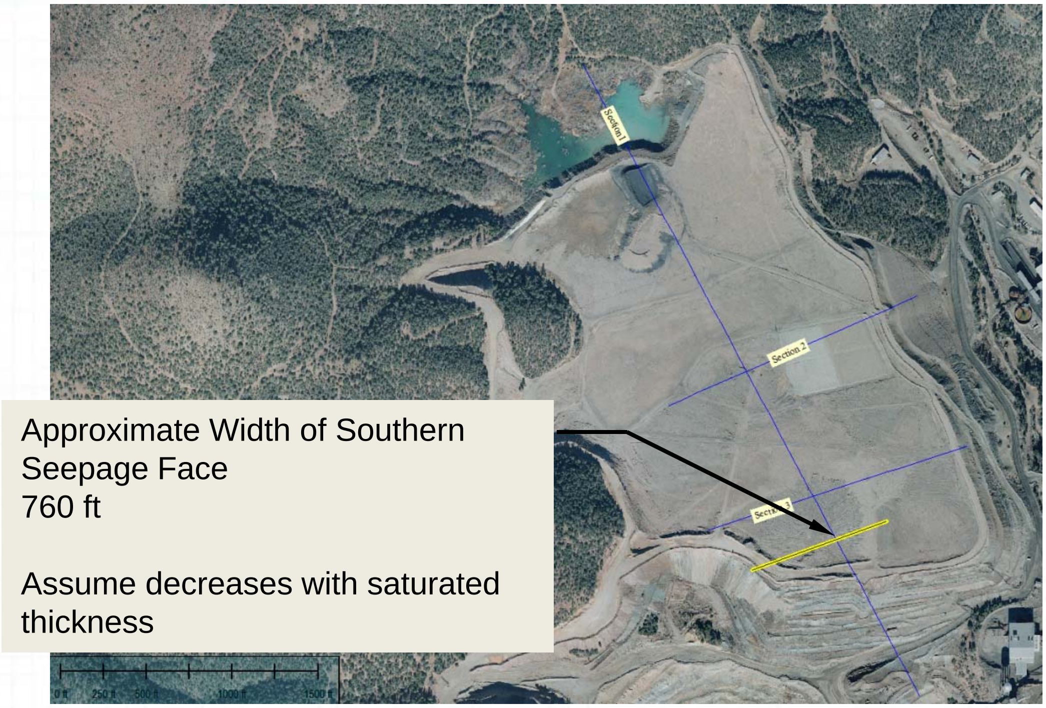
Job No.: 200189-002-02 | Client: FCX-Cobre Mining Co. | Page 8 of 15

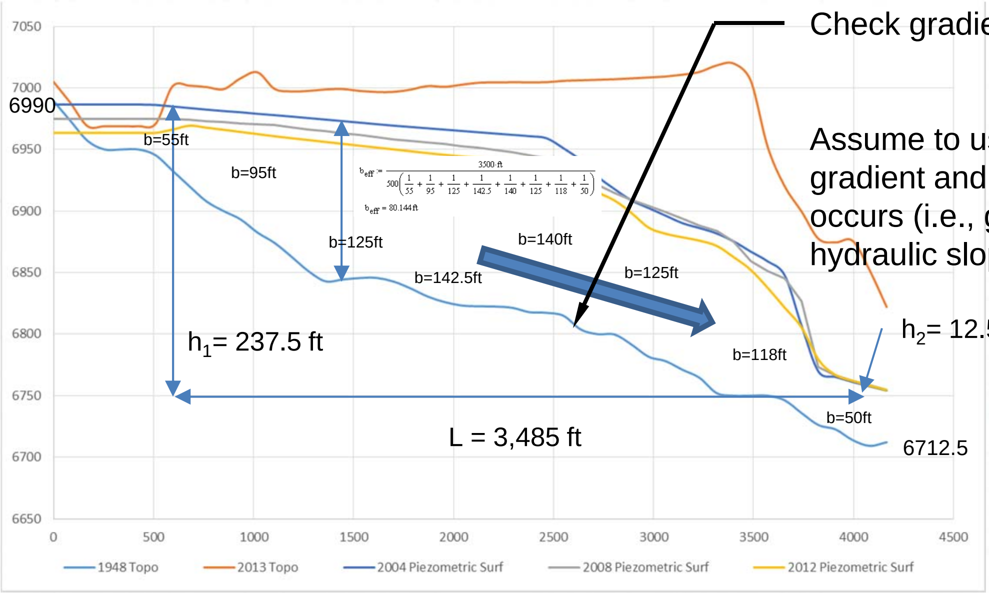
Task: MTI Drain Down | Computed By: W. Niccoli | Date: 10/07/14

Checked By: D. Bauer | Date: 10/10/14

Calculations Continued:

4. Build mathematical relationships to represent the three main drainage components
   b. Southern Seeps: continued – project 2004 seepage rate





Check gradient influence from slope

$$i_{grnd\_slope} := \frac{6990 - 6712.5}{3485} \qquad i_{grnd\_slope} = 0.08$$

$$i_{h2o} := \frac{237.5 - 12.5}{3485} \qquad i_{h2o} = 0.065$$

Assume to use ground slope as gradient and vary “b_{eff}” as drainage occurs (i.e., geologic slope is > than hydraulic slope)

Calculations Continued:

4. Build mathematical relationships to represent the three main drainage components
   b. Southern Seeps: continued – project 2004 seepage rate

Section 1 in 2004

$W_{south} := 760 \cdot ft$

$Q_{2004\_south\_est} := 111 \cdot gpm$

$K_{south} := \dfrac{Q_{2004\_south\_est}}{b_{eff} \cdot W_{south} \cdot i_{grnd\_slope}}$ $\boxed{K_{south} = 1.554 \times 10^{-3} \cdot \dfrac{cm}{s}}$

Back calculate the horizontal hydraulic conductivity. Very close to the K east calculated earlier – good!

Section 1 in 2012

$$b_{eff\_2012} := \frac{3500 \cdot ft}{500\left(\frac{1}{35} + \frac{1}{77.5} + \frac{1}{107.5} + \frac{1}{120} + \frac{1}{115} + \frac{1}{112.5} + \frac{1}{100} + \frac{1}{50}\right)}$$

$b_{eff\_2012} = 65.608\,ft$

$Q_{south\_2012} := b_{eff\_2012} \cdot W_{south} \cdot i_{grnd\_slope} \cdot K_{south}$ $\boxed{Q_{south\_2012} = 90.867 \cdot gpm}$

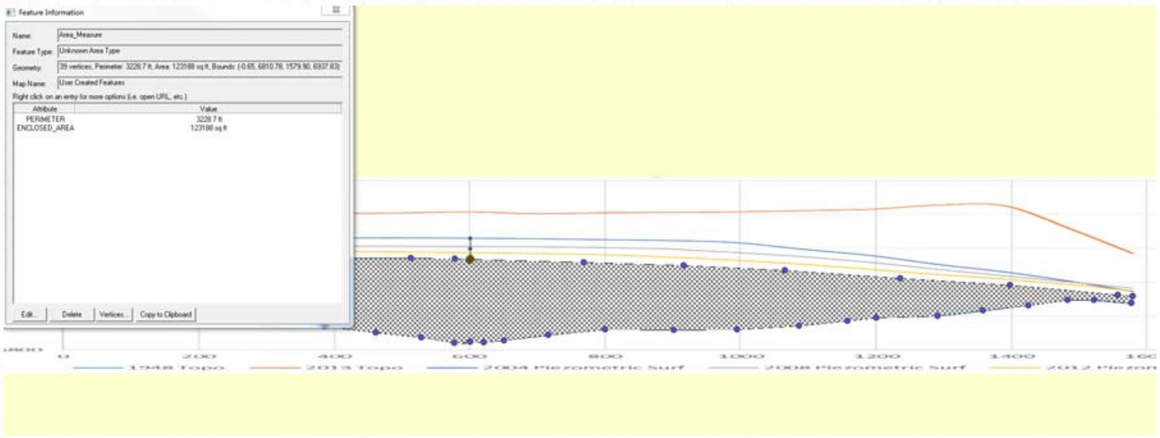
Project what the mathematical relationship would yield with 2012 data. Golder measured 67.3 gpm. 30% rpd…. May have to revisit this relationship. - likely have to vary the width because it gets smaller with shallower depths

Calculations Con'd:

4. Build mathematical relationships to represent the three main drainage components
   c. Vertical leakage – use previous one-dimensional analysis and fit to the 48 gpm estimated vertical leakage rate.

Relate b_{eff} to saturated volume curve:

Assume Section 2 and that its cross-sectional area is proportional to beff and the total saturated volume
Divide beff into 10 even sections and relate to the saturated volume
Show example area calculation (global mapper) and resulting table.



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Job No.: 200189-002-02	Client: FCX-Cobre Mining Co.	Page 10 of 15	
Task: MTI Drain Down	Computed By: W. Niccoli	Date: 10/07/14	
	Checked By: D. Bauer	Date: 10/10/14	

Calculations Continued:

Relate b_{eff} to saturated volume curve as a starting point – this relationship will become one calibration parameter:

b_eff	Length Reduction Factor	Relative xsect area	Volume Factor	V (ft3)	V^2	V^3	V^4	V^5	predicted b_eff
80.144	1	169717	169717	232,593,015	5.41E+16	1.26E+25	2.93E+33	6.81E+41	80.26
72.1296	1	146119	146119	200,252,531	4.01E+16	8.03E+24	1.61E+33	3.22E+41	71.67
64.1152	1	123188	123188	168,826,154	2.85E+16	4.81E+24	8.12E+32	1.37E+41	64.35
56.1008	1	105846	105846	145,059,365	2.10E+16	3.05E+24	4.43E+32	6.42E+40	56.90
48.0864	1	86444	86444	118,469,397	1.40E+16	1.66E+24	1.97E+32	2.33E+40	47.48
40.072	1	68495	68495	93,870,729	8.81E+15	8.27E+23	7.76E+31	7.29E+39	39.45
32.0576	1	47669	47669	65,329,204	4.27E+15	2.79E+23	1.82E+31	1.19E+39	32.15
24.0432	1	28146	28146	38,573,407	1.49E+15	5.74E+22	2.21E+30	8.54E+37	25.39
16.0288	1	12722	12722	17,435,191	3.04E+14	5.30E+21	9.24E+28	1.61E+36	15.68
8.0144	1	2656.9	2656.9	3,641,217	1.33E+13	4.83E+19	1.76E+26	6.40E+32	4.11
0			0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-

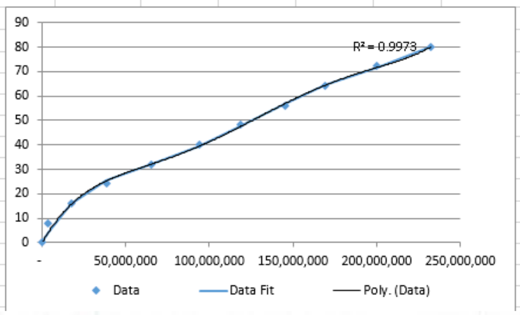
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999619475
R Square	0.999239095
Adjusted R Squ:	0.832065158
Standard Error	1.770888003
Observations	11

ANOVA

	df
Regression	5
Residual	6
Total	11

	Coefficients
Intercept	0
X Variable 1	1.20158E-06
X Variable 2	-2.04999E-14
X Variable 3	1.96227E-22
X Variable 4	-8.27397E-31
X Variable 5	1.26664E-39



Calculations Continued:

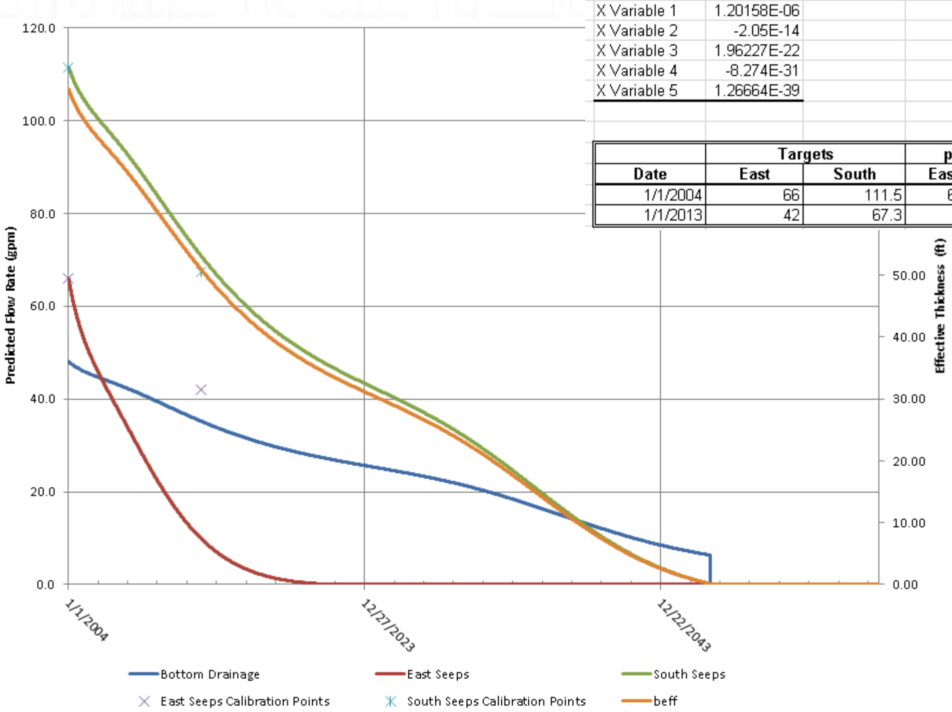
5. Update the water balance and calibrate to the two known drainage values. (Adjust previous xcel sheet)

Try 1

to calculate b_eff

	Coefficients
Intercept	0
X Variable 1	1.20158E-06
X Variable 2	-2.05E-14
X Variable 3	1.96227E-22
X Variable 4	-8.274E-31
X Variable 5	1.26664E-39

Date	Targets East	Targets South	prediction East	prediction South	RPD East	RPD South
1/1/2004	66	111.5	66.0	111.5	0%	0%
1/1/2013	42	67.3	9.8	70.7	-124%	5%



Under predicts drainage rates for east seeps and slightly over predicts south seeps in 2012

Try "flattening" out b_eff relationship

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Job No.: 200189-002-02 | Client: FCX-Cobre Mining Co. |

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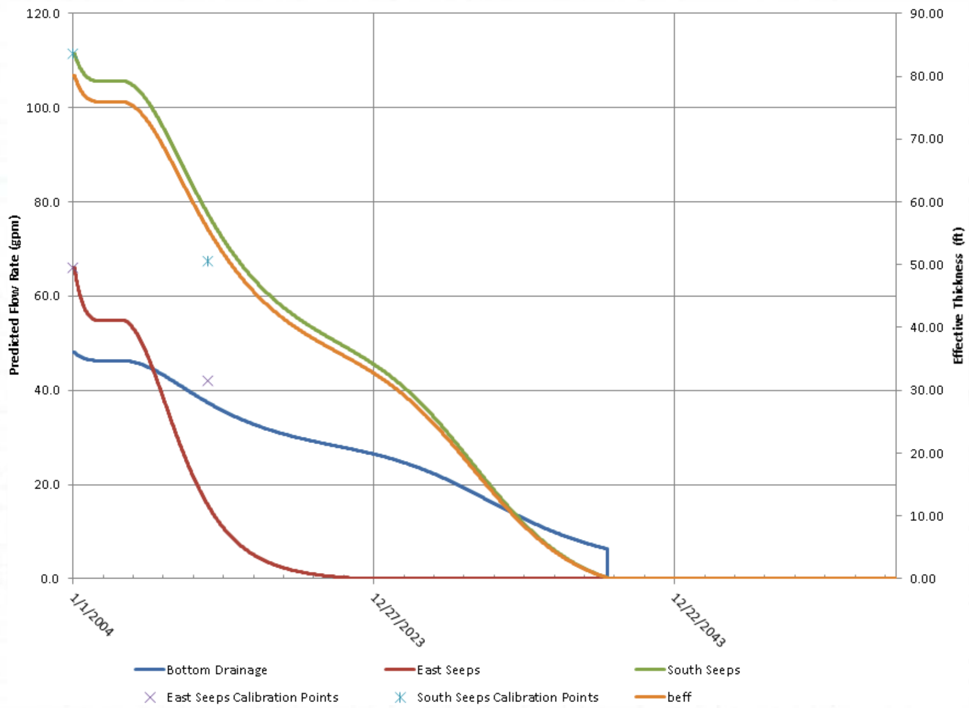
Checked By: D. Bauer | Date: 10/10/14

Calculations Continued:

5. Update the water balance and calibrate to the two known drainage values. (Adjust previous xcel sheet)

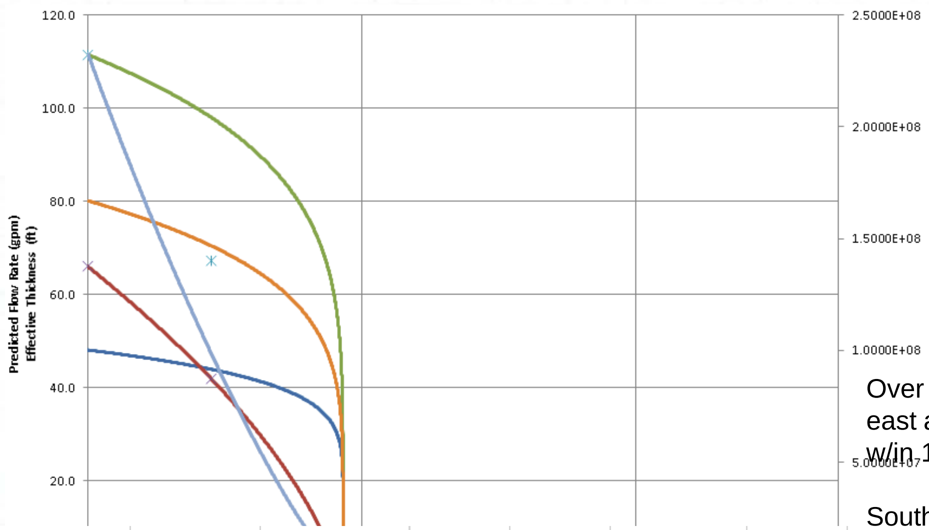
Try 2



Slight improvement over Try 1 - funky

Try flattening in a smoother function

Try 3 – last modification of the b_eff relationship – use power function to flatten out more at upper elevations



	Targets		prediction		RPD	
Date	East	South	East	South	East	South
1/1/2004	66	111.5	66.0	111.5	0%	0%
1/1/2013	42	67.3	41.9	98.0	0%	37%

Over predicts drainage rates for east and south seeps. East seeps w/in 10% rpd thus acceptable.

South seeps – evaluate width relationship

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Calculations Continued:

5. Update the water balance and calibrate to the two known drainage values. (Adjust previous xcel sheet)

Try 4 – make the width of south seepage flow a function of b_eff (i.e., the valley narrows as depth / thickness drops) - try directly proportional first. Use Tr y 3 as a basis.

Improvement in the south seepage prediction, not within acceptable error

Try 5 – try 1/(X-y)

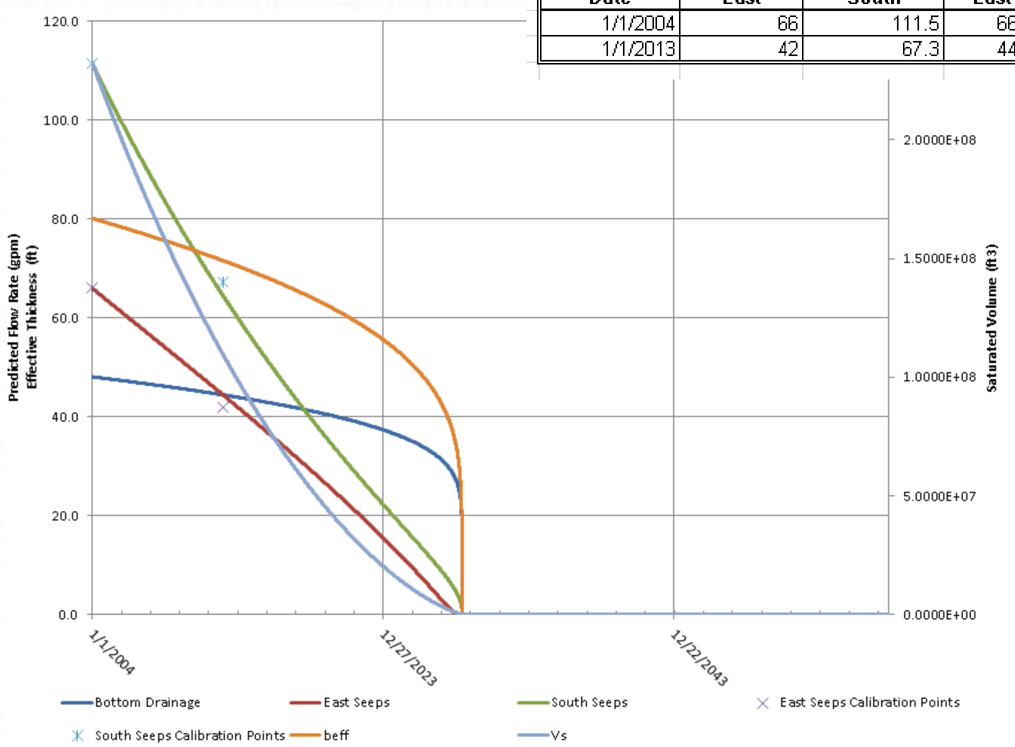
Under predict s south seepage rate - too extreme

Try 6 – a*exp(b*b_eff)

Under predict s south seepage rate – better but not w/in acceptable error

Try 7 – a*exp(b*b_eff+c)

	Targets		prediction		RPD	
Date	East	South	East	South	East	South
1/1/2004	66	111.5	66.0	111.5	0%	0%
1/1/2013	42	67.3	44.4	64.4	6%	-4%



Good error on both east and south seepage predictions – keep this solution.

Results:

The yearly seepage rates , based on try 7, combined east and south, needed in the water management cost estima

Post Cover	Current Average Seepage (gpm)
0	62.7
1	56.4
2	50.2
3	43.9
4	37.7
5	31.4
6	25.1
7	18.6
8	11.8
9	4.7
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0

Other results indirectly related to the predicted toe seepage rates are:

- Approximately 1.5 billion gallons of water are stored in the saturated zone of the MTI
- There are only approximately 20 more years for drain down to of interstitial water to occur

Discussion and Recommendations:

1. The calculation provides a comprehensive update to the 2009 predictions. The update more accurately represents the components of the conceptual model put forth in 2004 and that which is represented in other documents (e.g., Stage 1 GWAP)
2. The model was calibrated to two measured data points (outflows from the east and southern toe seepage areas), and to predictions of the bottom drainage. The model is not intricate enough to match the fluctuations measured in the toe seeps, but represents the average reduction in flows over the measurement period. While the bottom seepage rates cannot be measured, enough anecdotal information and other evidence exists to know that the range is fairly tight. Thus, these three calibration points in space and two in time provide an adequate measure upon which to gauge the current model's appropriateness in light of its intended use (provide drainage predictions for cost estimating)
3. The sensitivity of the model to various parameters was shown in the calculation section. Additionally, the model sensitivity to the following parameters was tested (results are in 20141003_Section.xlsx):
   a. Initial moisture content – not sensitive to calibration or long-term drainage
   b. Saturated moisture content – not sensitive to calibration or long-term drainage
   c. Residual moisture content – not sensitive to calibration or long-term drainage
   d. Calibration parameters – sensitive to calibration and long-term drainage
   e. Infiltration percentage – not sensitive to calibration or long-term drainage

   The model is most sensitivity to the vertical hydraulic conductivity (Kv) of the tailings material. The Kv dictates the bottom seepage rate and in turn impacts the volume of water stored in the tailings, which affects toe seepage rates. Because the bottom seepage rate cannot be measured, the sensitivity of the model to Kv introduces uncertainty. However, for the intent of the model (predicting toe seep quantities for costing purposes), the uncertainty is such that long-term closure water management costs are not greatly affected even if bottom seepage (very low Kv) were zero.
4. The 2004 through 2013 precipitation record used in the model was stochastically generated. Using the actual precipitation record, while more accurate, would not impact the results because the model is not sensitive to precipitation infiltration (as shown by the insensitivity to the infiltration factor).
5. One of the key calculations presented in this document is the total saturated volume in MTI (1.5 billion gallons). This estimate may be less, but probably not more because it is based on the assumed saturated volumetric moisture content (close to the total porosity). For fine grained, densified material 50% is an typical value. It may be as low as 30% , which results in approximately 1 billion gallons of water stored. A lower value would reduce the total water treated and result in a lower cost estimate.

Discussion and Recommendations Continued:

7. Recommend adding a process to describe the fluctuations in toe seepage rates. The measured toe seepage data appears to have a seasonal fluctuation to it, and also appears to correlate to the total precipitation. This model assumes that all of the toe seep flow is from the release of interstitial tailing water. It is likely a combination of infiltrating water on the outslopes and interstitial tailing water release. We know that the seasonal and yearly fluctuations are not large, and thus assuming that the seeps source totally from the interstitial water release will not have a large impact on the estimate of the water volume requiring management after reclamation.
8. Recommend updating the site wide water balance model with this approach as it will allow more accurate predictions of toe seeps and water that can be collected and managed.
9. Recommend repeating this exercise after another 4 or 5 years of data are collected. The passing of time and acquisition of precipitation and toe seepage data will make the analysis more robust and help distinguish the proportion of the different sources contributing to toe seepage.

Conclusions:

The objectives of this calculation set were to:

1. Provide a reasonable estimate of the drain down rates from the MTI
2. Support the 2014 CCP Update cost estimate

The calculation set met the objectives set forth as documented herein. The links in the cost estimating spreadsheets were updated and verified. The model provides a robust estimate of seepage from the MTI and is adequate for closure costing purposes.

APPENDIX C.3
COST CALCULATIONS

Water Treatment Unit Costs

	Activity	Base[1] Unit Cost $/unit	Units	Scaled Cost Las Cruces 85.6%[2]	Means Line Item	Means Page	Reference
1	Utility Pole Demo	$214.50	ea	$183.61	02 41 13.80 0100	36	Professional Judgment 15 to 30 gpm - includes pump control, control panel, installation, and flow meter.
2	Cross Arm Demo	$93.00	ea	$79.61	02 41 13.80 0300	36	Professional Judgment 50 gpm - includes pump control, control panel, installation, and flow meter.
3	Wood Electrical Utility Poles a.)	$696.5	ea	$596	33 71 16.33 6020	399	Professional Judgment 100 to 700 gpm - includes pump control, control panel, installation, and flow meter.
4	Utility Pole Installation b.)	$1,259	ea	$1,078	33 71 16.23 6010	398	Professional Judgment 800 to 2000 gpm - includes pump control, control panel, installation, and flow meter.
5	Utility Pole Installation c.)	$1.95	ea	$1.67	33 71 16.33 9000	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 3/4"-4" diameter
6	Utility Pole Installation d.)	$335.00	ea	$287	33 71 16.33 7600	399	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 6"-8" diameter
7	Electrical Wiring Installation a.)	$579.00	wire mi	$496	33 71 39.13 0110	402	Site Demo, pipe removal, sewer/water no excavation, plastic pipe, 10"-18" diameter
8	Electrical Wiring Installation b.)	$15,295.00	wire mi	$13,093	33 71 39.13 0150	402	Selective Demo, utility poles, wood, 20'-30' high
9	Electrical Wiring Installation c.)	$309.00	wire mi	$265	33 71 39.13 0810	403	Selective Demo, cross arms, wood, 4'-6' long
10	Potential Transformers	$5,261.00	ea	$4,503	33 71 26.26 4100	402	Steel Pipe Schedule 40, black 24" diameter (221113.48 1210) without coupling and hanger
11	Pipe Removal	$1.95	lf	$1.67	02 41 13.38-1600	29	Membrane lining, 2X60 mil thick
12	Pipe Removal	$2.73	lf	$2.34	02 41 13.38-1700	29	Assume similar to 10' high 33 degree slope concrete retaining wall, cast concrete reinforced concrete cantilever, including excavation, backfill & reinforced.
13	Pipe Removal	$4.53	lf	$3.88	02 41 13.38-1800	29	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 4" diameter
14	Excavation of Soil	$8.28	cy	$7.088	G1030 120 1600	498	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 6" diameter
15	Reservoir Liners HDPE	$2.74	sf	$2.34544	31 05 19.53 1200	218	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 8" diameter
16	Small Concrete Dam	$92,125	ea	$78,859	32 32 13.10 3100	323	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 10" diameter
17	Water Treatment Tank	$295,500	ea	$252,948	33 16 23.13 1000	358	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 12" diameter
18	Pump	$10,000	ea	$10,298.21	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 14" diameter
19	Pump	$15,000	ea	$15,447.32	-	-	Butt fusion joints, SDR 21, HDPE 40' lengths not including excavation or backfill, 16" diameter
20	Pump	$25,000	ea	$25,745.53	-	-	250,000 gallon steel tank, not including foundation., height/diameter Less than 1
21	Pump	$30,000	ea	$30,894.63	-	-	Digging holes in rock
22	Water Supply Piping	$8.81	lf	$7.54	33 14 13.35 0100	352	Wood, class 1 type C, CCA/ACA-treated, 30' high, excludes excavation, backfill and cast-in-place concrete
23	Water Supply Piping	$12.29	lf	$10.52	33 14 13.35 0200	352	Cross arms 4' long, includes hardware and insulators
24	Water Supply Piping	$16.74	lf	$14.33	33 14 13.35 0300	352	Disposal of pole and hardware surplus material, assumes 100 feet of wire per pole
25	Water Supply Piping	$19.93	lf	$17.06	33 14 13.35 0400	352	13 to 26 kV
26	Water Supply Piping	$22.73	lf	$19.46	33 14 13.35 0500	352	Material handling and spotting-conductors, primary circuits
27	Water Supply Piping	$33.55	lf	$28.72	33 14 13.35 0600	352	Conductors, per wire, 210-636 kcmil
28	Water Supply Piping	$41.15	lf	$35.22	33 14 13.35 0700	352	Disposal of surplus material, high voltage conductors
29	Facility Water Distribution Piping	$218.35	lf	$187	22 11 13.48 1780 and 1210	168	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mi round trip. This value removes the overhead and profit (34% based on RS Means Crews O&P markup)
30	Electric Rate	$0.0502	kWh	0.0502	-	-	Industrial rate date looked up 3/01/2018 (http://www.electricitylocal.com/states/new-mexico/silver-city/) Subtracting indirect costs
31	Pump Removal Cost	$5,000	ea	$5,149.11	-	-	Engineering Judgment
32	Electric Panel Cost	$10,000	ea	$10,298.21	-	-	Engineering Judgment
33	Diesel Fuel Cost ($/gal)	$2.350	gal	$2.350	-	-	Griffin Propane verbal Quote, Silver City, NM (March, 2018) less indirect cost of 17% .
34	Environmental Sampler	$60	hr	$61.79	-	-	Engineering Judgment
35	Environmental Sampling Reviewer	$70	hr	$72.09	-	-	Engineering Judgment
36	Environmental Sampling	$239	sample	$239.32	-	-	23 Constituents. Energy Laboratories, Inc., Quote March 2018 (www.energylab.com).
37	Shipping Environmental Sampling	$59.83	cooler	$59.83	-	-	Overnight FedEx $70 for a 10 lb. package 30”x18”x18” Silver City, NM to Casper, WY Energy Labs

38 Description Notes:

39 1) Overhead and Profit are added in with the indirect costs.

40 2) City Cost Index Las Cruces-Total 85.6% (weighted average) R.S. Means Heavy Construction Cost Data, 32nd Annual Edition, 2018, pg. 21.

41 3) Griffin's Propane verbal quote March 12, 2018 of $ 2.75/gal from which the indirect costs are then subtracted.

42 4) https://edzarenski.com/2016/10/24/construction-inflation-index-tables-2017/ Inflation Adjustment 2014 to 2018 1.0298

Water Management Cost Estimate

Variables

Description	Variable
2018 RSMeans NM Discount Rate	0.856
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
Spreadsheet Year (2014)	-6
Reclamation Start Year (2020)	0
Reclamation Finished	5
Vegetation Established Assume stormwater released	12

Ponds / 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 ($/ea)**	**Direct Cost New and Replacement ($)**	**Direct Cost Maintenance Ponds Closed Post Closure ($/yr)**	**Direct Cost Maintenance Ponds Closed Post Closure ($)**	**Direct Cost ($)**
SWRF Dam 1 (181-2003-Dam 1)	concrete dar	1,116,800	5,530	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
SWRF Dam 2 (181-2003-Dam 2)	concrete dar	827,700	4,098	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
SWRF Dam 3 (181-2003-Dam 3)	concrete dar	2,925,300	14,485	-	19	25	12	-	0	$78,859	$0	$1,183	$15,378	$15,378
Decant Pond #4	HDPE lined	972,500	4,815.310	0.62	19	25	12	5	1	$138,064	$138,064	$2,071	$26,922	$164,986
Upper Creek Containment Pond #1	HDPE lined	1,879,200	9,304.813	1.29	0	6	12	-	0	$285,575	$0	$4,284	$55,687	$55,687
Grape Gulch Pond #3	HDPE lined	911,600	4,513.765	0.38	29	35	12	0	1	$88,311	$88,311	$1,325	$17,221	$105,532
Blackman's Seep (Pond #2)	unlined	25,000	123.787	-	29	35	9	0	1	$292	$292	$4.39	$43.87	$336
Surge Tank***	steel	352,500	1,745.395	-	49	55	12	0	1	$252,948	$252,948	$3,794	$49,325	$302,273
Magnetite Seepage Pond	HDPE lined	9,600	47.534	0.20	29	35	12	0	1	$40,979	$40,979	$615	$7,991	$48,970
East WRF Containment	concrete	900,000	4,456.328	0.50	-1	5	12	-	0	$112,696	$0	$1,690	$21,976	$21,976
									Direct Annual Costs:	-	-	$17,332	-	-
									Direct Cost Subtotals:	-	$520,595	-	$225,298	**$745,893**

*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.

1

Water Management Cost Estimate

$$H_f = \frac{10.44\,Q^{1.85}}{C^{1.85}\,D_i^{4.865}}$$

Pumps

From	To	Number	Age Today (yr)	Age at Reclamation (yr)	Removal Year (yr)	First Replacement Year (yr)	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	SWRF Dam	2	15	21	12	0	1	1760	6650	6719	61	130	82	61	120.9	0	$61,789
SWRF Dam 2 (181	SWRF Dam	2	15	21	12	0	1	1940	6613	6715	54	156	109	81	48.7	0	$61,789
SWRF Dam 3 (181	Bullfrog pip	2	15	21	12	0	1	940	6556	6745	11	200	68	51	96.9	0	$51,491
Decant Pond #4	Booster Pur	2	24	30	12	0	1	3000	6688	6700	1	13	14	10	0	18001800	$51,491
Booster Pump 2	Surge Tank	2	24	30	12	0	1	3000	6700	6925	10	235	254	189	0	0	$51,491
Decant Pond #4	Reclaim Po	2	24	30	5	0	1	1760	6688	7000	31	343	218	162	0	0	$61,789
Magnetite Intercept	Magnetite T	1	24	30	5	0	1	100	6670	6695	0	25	1	1	0	146643	$15,447
Magnetite Seepage	Decant Pon	2	24	30	12	0	1	100	6695	6750	7	62	2	2	13.1	0	$30,895
Estrada Seep	Decant Pon	2	9	15	5	5	1	45	6575	6688	19	132	2	2	0	762541	$20,596
Union Hill Adit Se	Decant Pon	2	9	15	5	5	1	30	6575	6688	96	209	2	2	0	169454	$20,596
Upper Creek Conta	Surge Tank	2	24	30	12	0	1	1980	6810	6925	358	473	338	252	53.7	0	$61,789
Grape Gulch Pond	Surge Tank	2	24	30	12	0	1	1100	6775	6925	14	164	65	49	6.5	0	$61,789
Blackman's Seep (I	Upper Creel	1	24	30	9	0	1	125	6775	6810	0	35	2	1	0	0	$15,447
Surge Tank	Reclaim Po	2	10	16	9	4	1	3497	6925	7000	26	101	128	95	0	0	$61,789
Reclaim Pond	Surge Tank	1	10	16	5	4	1	1240	7000	7010	46	56	25	19	316.1	0	$30,895
East WRF Contain	Decant Pon	2	-1	5	12	-	0	2000	6560	6688	70	198	143	106	69.8	423634	$20,596
tailings pipeline flushing																	
Mill No 1	Tailings Im	1						4318	6825	7000	13	188	293	219			
Mill No 2	Tailings Im	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 ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**	**Direct Cost Electricity and Fuel ($)**
SWRF Dam 1 (181	SWRF Dam	5,821,936	55.1	3,381	170	1,018	305,888	3	178	$9	$62	$61,789	$927	$12,049	$10,298	$84,136	$1,080
SWRF Dam 2 (181	SWRF Dam	2,345,147	20.1	1,636	82	492	123,216	1	86	$4	$30	$61,789	$927	$12,049	$10,298	$84,136	$523
SWRF Dam 3 (181	Bullfrog pip	12,833,300	227.5	11,520	578	3,468	8,412,249	149	7,552	$379	$2,652	$51,491	$772	$10,041	$10,298	$71,830	$6,120
Decant Pond #4	Booster Pur	23,496,119	130.5	1,317	66	397	5,494,319	31	308	$15	$108	$51,491	$772	$10,041	$10,298	$71,830	$505
Booster Pump 2	Surge Tank	23,496,119	130.5	24,734	1,241	7,446	23,496,119	131	24,734	$1,241	$8,687	$51,491	$772	$10,041	$10,298	$71,830	$16,132
Decant Pond #4	Reclaim Po	0	0.0	0	0	0	0	0	0	$0	$0	$61,789	$927	$5,561	$10,298	$77,649	$0
Magnetite Intercept	Magnetite T	146,643	24.4	17	1	5	146,643	24	17	$1	$0	$15,447	$232	$1,390	$5,149	$21,987	$5
Magnetite Seepage	Decant Pon	777,473	129.6	216	11	65	179,787	30	50	$3	$18	$30,895	$463	$6,024	$10,298	$47,217	$82
Estrada Seep	Decant Pon	762,541	282.4	450	23	135	0	0	0	$0	$0	$20,596	$309	$1,854	$10,298	$32,748	$135
Union Hill Adit Se	Decant Pon	169,454	94.1	159	8	48	0	0	0	$0	$0	$20,596	$309	$1,854	$10,298	$32,748	$48
Upper Creek Conta	Surge Tank	2,585,922	21.8	5,485	275	1,651	135,866	1	288	$14	$101	$61,789	$927	$12,049	$10,298	$84,136	$1,752
Grape Gulch Pond	Surge Tank	313,007	4.7	231	12	69	16,446	0	12	$1	$4	$61,789	$927	$12,049	$10,298	$84,136	$74
Blackman's Seep (I	Upper Cree	0	0.0	0	0	0	0	0	0	$0	$0	$15,447	$232	$2,317	$5,149	$22,914	$0
Surge Tank	Reclaim Po	0	0.0	0	0	0	0	0	0	$0	$0	$61,789	$927	$9,268	$10,298	$81,356	$0
Reclaim Pond	Surge Tank	15,221,786	204.6	-	481	2,885	799,763	11	25	$1	$0	$30,895	$463	$2,781	$5,149	$38,824	$2,885
East WRF Contain	Decant Pon	3,784,851	31.5	3,359	169	1,011	176,601	1	157	$8	$55	$0	$309	$4,016	$10,298	$14,315	$1,066
tailings pipeline flushing																$0	$0
Mill No 1	Tailings Im	5,764,479	22.2	4,865								$244				$244	$0
Mill No 2	Tailings Im	6,800,790	26.2	1,928								$97				$97	$0
Direct Annual Costs:		-	-	-	$3,115	-	-	-	-	$1,676	-	-	$10,195	-	-	-	-
Direct Cost Subtotals:		-	-	-	-	$18,691	-	-	-	-	$11,717	$659,426.27	-	$113,383.30	$149,324.06	**$922,134**	**$30,408.18**

Water Management Cost Estimate

Pipelines

From	To	Material	Length (ft)	Inside Diameter (in)	Age Today (yr)	Age at Reclamation (yr)	Removal Year (yr)	Reclamation Replacement Year (yr)	Number of Replacements	Direct Cost New and Replacement ($/ft)	Direct Cost Removal ($/ft)	Direct Cost New and Replacement ($/ea)	**Direct Cost New and Replacement ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**
SWRF Dam 1 (181	SWRF Dam	HDPE	4,466	10	15	21	12	-	0	$17.06	$3.32	$76,190	$0	$762	$9,905	$14,824	$24,728.71
SWRF Dam 2 (181	SWRF Dam	HDPE	3,300	10	15	21	12	-	0	$17.06	$3.32	$56,298	$0	$563	$7,319	$10,954	$18,272.44
SWRF Dam 3 (181	Bullfrog pip	HDPE	220	6	15	21	12	-	0	$10.52	$2.00	$2,314	$0	$23	$301	$440	$740.96
Decant Pond #4	Booster Pur	HDPE	100	15	24	30	12	-	0	$35.22	$3.32	$3,522	$0	$35	$458	$332	$789.85
Booster Pump 2	Surge Tank	HDPE	1,936	15	24	30	12	-	0	$35.22	$3.32	$68,194	$0	$682	$8,865	$6,426	$15,291.43
Decant Pond #4	Reclaim Po	HDPE	5,502	12	24	30	5	-	0	$19.46	$3.32	$107,052	$0	$1,071	$6,423	$18,263	$24,685.86
Magnetite Intercept	Magnetite T	HDPE	200	5	24	30	5	-	0	$10.52	$2.00	$2,104	$0	$21	$126	$400	$526.32
Magnetite Seepage	Decant Pon	HDPE	1,188	4	24	30	12	-	0	$7.54	$1.43	$8,959	$0	$90	$1,165	$1,697	$2,862.14
Estrada Seep	Decant Pon	HDPE	3,470	3	24	30	5	-	0	$7.54	$1.43	$26,169	$0	$262	$1,570	$4,958	$6,528.17
Union Hill Adit Se	Decant Pon	HDPE	5,250	2	24	30	5	-	0	$7.54	$1.43	$39,592	$0	$396	$2,376	$7,501	$9,876.91
Upper Creek Conta	Surge Tank	HDPE	1,770	6	24	30	12	-	0	$10.52	$2.00	$18,621	$0	$186	$2,421	$3,541	$5,961.36
Upper Creek Conta	Surge Tank	HDPE	1,770	8	24	30	12	-	0	$14.33	$2.00	$25,363	$0	$254	$3,297	$3,541	$6,837.86
Grape Gulch Pond	Surge Tank	HDPE	861	8	24	30	12	-	0	$14.33	$2.00	$12,338	$0	$123	$1,604	$1,722	$3,326.21
Blackman's Seep (F	Upper Cree	HDPE	100	5	24	30	9	-	0	$10.52	$2.00	$1,052	$0	$11	$105	$200	$305.24
Surge Tank	Bullfrog pip	HDPE	31,850	8	7	13	12	-	0	$14.33	-	$456,393	$0	$4,564	$59,331	$0	$59,331.05
Surge Tank	Reclaim Po	HDPE	3,923	15	24	30	9	-	0	$28.72	$3.32	$112,664	$0	$1,127	$11,266	$13,022	$24,287.98
Reclaim Pond	Surge Tank	HDPE	3,855	9	24	30	5	-	0	$14.33	$3.32	$55,240	$0	$552	$3,314	$12,796	$16,110.28
East WRF Contain	Decant Pon	HDPE	4,073	10	3	9	12	-	0	$17.06	$3.32	$69,486	$0	$695	$9,033	$13,519	$22,552.63
tailings pipeline flushing																	
Mill No 1	Tailings Im	HDPE	6,850	21													
Mill No 2	Tailings Im	HDPE	6,850	21													
												Direct Annual Costs:	-	$11,416	-	-	-
												Direct Cost Subtotals:	$0	-	$128,879	$114,136	**$243,015**

*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 Maintenance ($)**	**Direct Cost Removal ($)**	**Direct Cost ($)**
SWRF Dam 1 (181	SWRF Dam	1,166	13	12.0	$25,510.38	$3,059.13	2	$9,007	$20,596	$58,173	$873	$11,343.69	$3,422	$14,766
SWRF Dam 2 (181	SWRF Dam	3,300	34	12.0	$66,719.46	$8,657.91	2	$9,007	$20,596	$104,981	$1,575	$20,471.22	$8,949	$29,421
SWRF Dam 3 (181	Road	220	4	12.0	$7,849.35	$577.19	2	$9,007	$20,596	$38,030	$570	$7,415.81	$1,053	$8,469
Decant Pond #4	Surge Tank	2,036	22	12.0	$43,171.41	$5,341.67	2	$9,007	$20,596	$78,116	$1,172	$15,232.68	$5,791	$21,024
Upper Creek Containment Pond #1, Grape Gulch Pond #3, and	Office Area	582	7	12.0	$13,736.36	$1,526.94	1	$4,503	$10,298	$30,065	$451	$5,862.66	$1,843	$7,705
Surge Tank	Upper Cree	1,770	19	12.0	$37,284.40	$4,643.79	1	$4,503	$10,298	$56,730	$851	$11,062.31	$5,001	$16,063
Magnetite Tailings	Decant Pon	1,188	13	5.0	$25,510.38	$3,116.85	1	$4,503	$10,298	$43,429	$651	$3,908.60	$3,422	$7,330
Estrada Seep	Road	500	6	5.0	$11,774.02	$1,311.80	1	$4,503	$10,298	$27,887	$418	$2,509.87	$1,579	$4,089
Union Hill Adit Se	Road	727	9	5.0	$17,661.03	$1,907.36	1	$4,503	$10,298	$34,370	$516	$3,093.30	$2,369	$5,462
East WRF Contain	Decant Pon	4,582	47	12.0	$92,229.84	$12,021.37	1	$4,503	$10,298	$119,053	$1,786	$23,215.30	$12,371	$35,587
Office Area	Road	2,327	25	12.0	$49,058.43	$6,105.13	1	$4,503	$10,298	$69,965	$1,049	$13,643.21	$6,581	$20,224
									Direct Annual Costs:	-	$9,912		-	-
									Direct Cost Subtotals:	-	-	$117,758.66	$52,380.78	**$170,139**

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	$ 60	$ 9	$ 239	$ 248	1.0	0.5	$ 60	0.1	$ 70	$ 100	$ 348

[(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	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	$ 348	$ 9,744
5 - 12		1			4			2		7	2	$ 348	$ 4,872
12-99			1			4			2	7	1	$ 348	$ 2,436
												Total Cost Years 0-99	**$ 297,192**

Energy Labs Unit Rates:
23 Constituents. Energy Laboratories, Inc., Quote March 2018 (www.energylab.com).

Alkalinity Total as CaCO3	$ 10.00
Anions by Ion Chromatography	$ 30.00
Chloride	
Fluoride	
Sulfate	
Total Dissolved Solids	$ 20.00
Nitrogen - Nitrate+Nitrite as N	$ 45.00
Metals by ICP/ICPMS, total	$ 160.00
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

Capital Indirect Costs Percentage	28.3%
O&M Indirect Costs Percentage	17%
Electricity, Fuel, and Environmental Sampling Indirect Costs Percentage	17%

PONDS & TANKS			PUMPS					PIPELINES				ELECTRICAL INFRASTRUCTURE			ENVIROMENTAL SAMPLING		
Year	Capital Annual Cost	O&M Annual Cost ($)	Year	Capital Annual Cost	Removal Annual Cost	Electricity and Fuel Annual Cost ($)	O&M Annual Cost ($)	Year	Capital Annual Cost	Removal Annual Cost	Maintenance Annual Cost ($)	Year	Removal Annual Cost	Maintenance Annual Cost ($)	Year	Annual Cost ($)	Total Cash Flow ($)
0	$490,787	$20,278	0	$674,280	$0	$3,645	$11,928	0	$0	$0	$13,356	0	$0	$11,597	0	$11,400	$1,237,272
1	$0	$20,278	1	$0	$0	$3,645	$11,928	1	$0	$0	$13,356	1	$0	$11,597	1	$11,400	$72,205
2	$0	$20,278	2	$0	$0	$3,645	$11,928	2	$0	$0	$13,356	2	$0	$11,597	2	$11,400	$72,205
3	$0	$20,278	3	$0	$0	$3,645	$11,928	3	$0	$0	$13,356	3	$0	$11,597	3	$11,400	$72,205
4	$0	$20,278	4	$118,913	$0	$3,645	$11,928	4	$0	$0	$13,356	4	$0	$11,597	4	$11,400	$191,118
5	$177,136	$20,278	5	$52,850	$52,850	$3,645	$11,928	5	$0	$56,347	$13,356	5	$9,456	$11,597	5	$5,700	$415,144
6	$0	$20,278	6	$0	$0	$1,958	$9,308	6	$0	$0	$10,663	6	$0	$9,742	6	$5,700	$57,650
7	$0	$20,278	7	$0	$0	$1,958	$9,308	7	$0	$0	$10,663	7	$0	$9,742	7	$5,700	$57,650
8	$0	$20,278	8	$0	$0	$1,958	$9,308	8	$0	$0	$10,663	8	$0	$9,742	8	$5,700	$57,650
9	$0	$20,278	9	$0	$19,819	$1,958	$9,308	9	$0	$16,963	$10,663	9	$0	$9,742	9	$5,700	$94,432
10	$0	$20,273	10	$0	$0	$1,958	$7,952	10	$0	$0	$9,333	10	$0	$9,742	10	$5,700	$54,959
11	$0	$20,273	11	$0	$0	$1,958	$7,952	11	$0	$0	$9,333	11	$0	$9,742	11	$5,700	$54,959
12	$0	$20,273	12	$0	$118,913	$1,958	$7,952	12	$0	$73,126	$9,333	12	$57,749	$9,742	12	$2,850	$301,897
13	$0	$0	13	$0	$0	$0	$0	13	$0	$0	$0	13	$0	$0	13	$2,850	$2,850
14	$0	$0	14	$0	$0	$0	$0	14	$0	$0	$0	14	$0	$0	14	$2,850	$2,850
15	$0	$0	15	$0	$0	$0	$0	15	$0	$0	$0	15	$0	$0	15	$2,850	$2,850
16	$0	$0	16	$0	$0	$0	$0	16	$0	$0	$0	16	$0	$0	16	$2,850	$2,850
17	$0	$0	17	$0	$0	$0	$0	17	$0	$0	$0	17	$0	$0	17	$2,850	$2,850
18	$0	$0	18	$0	$0	$0	$0	18	$0	$0	$0	18	$0	$0	18	$2,850	$2,850
19	$0	$0	19	$0	$0	$0	$0	19	$0	$0	$0	19	$0	$0	19	$2,850	$2,850
20	$0	$0	20	$0	$0	$0	$0	20	$0	$0	$0	20	$0	$0	20	$2,850	$2,850
21	$0	$0	21	$0	$0	$0	$0	21	$0	$0	$0	21	$0	$0	21	$2,850	$2,850
22	$0	$0	22	$0	$0	$0	$0	22	$0	$0	$0	22	$0	$0	22	$2,850	$2,850
23	$0	$0	23	$0	$0	$0	$0	23	$0	$0	$0	23	$0	$0	23	$2,850	$2,850
24	$0	$0	24	$0	$0	$0	$0	24	$0	$0	$0	24	$0	$0	24	$2,850	$2,850
25	$0	$0	25	$0	$0	$0	$0	25	$0	$0	$0	25	$0	$0	25	$2,850	$2,850
26	$0	$0	26	$0	$0	$0	$0	26	$0	$0	$0	26	$0	$0	26	$2,850	$2,850
27	$0	$0	27	$0	$0	$0	$0	27	$0	$0	$0	27	$0	$0	27	$2,850	$2,850
28	$0	$0	28	$0	$0	$0	$0	28	$0	$0	$0	28	$0	$0	28	$2,850	$2,850
29	$0	$0	29	$0	$0	$0	$0	29	$0	$0	$0	29	$0	$0	29	$2,850	$2,850
30	$0	$0	30	$0	$0	$0	$0	30	$0	$0	$0	30	$0	$0	30	$2,850	$2,850
31	$0	$0	31	$0	$0	$0	$0	31	$0	$0	$0	31	$0	$0	31	$2,850	$2,850
32	$0	$0	32	$0	$0	$0	$0	32	$0	$0	$0	32	$0	$0	32	$2,850	$2,850
33	$0	$0	33	$0	$0	$0	$0	33	$0	$0	$0	33	$0	$0	33	$2,850	$2,850
34	$0	$0	34	$0	$0	$0	$0	34	$0	$0	$0	34	$0	$0	34	$2,850	$2,850
35	$0	$0	35	$0	$0	$0	$0	35	$0	$0	$0	35	$0	$0	35	$2,850	$2,850
36	$0	$0	36	$0	$0	$0	$0	36	$0	$0	$0	36	$0	$0	36	$2,850	$2,850
37	$0	$0	37	$0	$0	$0	$0	37	$0	$0	$0	37	$0	$0	37	$2,850	$2,850
38	$0	$0	38	$0	$0	$0	$0	38	$0	$0	$0	38	$0	$0	38	$2,850	$2,850
39	$0	$0	39	$0	$0	$0	$0	39	$0	$0	$0	39	$0	$0	39	$2,850	$2,850
40	$0	$0	40	$0	$0	$0	$0	40	$0	$0	$0	40	$0	$0	40	$2,850	$2,850
41	$0	$0	41	$0	$0	$0	$0	41	$0	$0	$0	41	$0	$0	41	$2,850	$2,850
42	$0	$0	42	$0	$0	$0	$0	42	$0	$0	$0	42	$0	$0	42	$2,850	$2,850
43	$0	$0	43	$0	$0	$0	$0	43	$0	$0	$0	43	$0	$0	43	$2,850	$2,850
44	$0	$0	44	$0	$0	$0	$0	44	$0	$0	$0	44	$0	$0	44	$2,850	$2,850
45	$0	$0	45	$0	$0	$0	$0	45	$0	$0	$0	45	$0	$0	45	$2,850	$2,850
46	$0	$0	46	$0	$0	$0	$0	46	$0	$0	$0	46	$0	$0	46	$2,850	$2,850
47	$0	$0	47	$0	$0	$0	$0	47	$0	$0	$0	47	$0	$0	47	$2,850	$2,850
48	$0	$0	48	$0	$0	$0	$0	48	$0	$0	$0	48	$0	$0	48	$2,850	$2,850
49	$0	$0	49	$0	$0	$0	$0	49	$0	$0	$0	49	$0	$0	49	$2,850	$2,850
50	$0	$0	50	$0	$0	$0	$0	50	$0	$0	$0	50	$0	$0	50	$2,850	$2,850
51	$0	$0	51	$0	$0	$0	$0	51	$0	$0	$0	51	$0	$0	51	$2,850	$2,850
52	$0	$0	52	$0	$0	$0	$0	52	$0	$0	$0	52	$0	$0	52	$2,850	$2,850
53	$0	$0	53	$0	$0	$0	$0	53	$0	$0	$0	53	$0	$0	53	$2,850	$2,850
54	$0	$0	54	$0	$0	$0	$0	54	$0	$0	$0	54	$0	$0	54	$2,850	$2,850
55	$0	$0	55	$0	$0	$0	$0	55	$0	$0	$0	55	$0	$0	55	$2,850	$2,850
56	$0	$0	56	$0	$0	$0	$0	56	$0	$0	$0	56	$0	$0	56	$2,850	$2,850
57	$0	$0	57	$0	$0	$0	$0	57	$0	$0	$0	57	$0	$0	57	$2,850	$2,850
58	$0	$0	58	$0	$0	$0	$0	58	$0	$0	$0	58	$0	$0	58	$2,850	$2,850
59	$0	$0	59	$0	$0	$0	$0	59	$0	$0	$0	59	$0	$0	59	$2,850	$2,850

Water Management Cash Flow

Capital Indirect Costs Percentage	28.3%
O&M Indirect Costs Percentage	17%
Electricity, Fuel, and Environmental Sampling Indirect Costs Percentage	17%

PONDS & TANKS

Year	Capital Annual Cost	O&M Annual Cost ($)
60	$0	$0
61	$0	$0
62	$0	$0
63	$0	$0
64	$0	$0
65	$0	$0
66	$0	$0
67	$0	$0
68	$0	$0
69	$0	$0
70	$0	$0
71	$0	$0
72	$0	$0
73	$0	$0
74	$0	$0
75	$0	$0
76	$0	$0
77	$0	$0
78	$0	$0
79	$0	$0
80	$0	$0
81	$0	$0
82	$0	$0
83	$0	$0
84	$0	$0
85	$0	$0
86	$0	$0
87	$0	$0
88	$0	$0
89	$0	$0
90	$0	$0
91	$0	$0
92	$0	$0
93	$0	$0
94	$0	$0
95	$0	$0
96	$0	$0
97	$0	$0
98	$0	$0
99	$0	$0
Total Cost	$667,923	$263,599
al Direct Cost	$520,595	$225,298

PUMPS

Year	Capital Annual Cost	Removal Annual Cost	Electricity and Fuel Annual Cost ($)	O&M Annual Cost ($)
60	$0	$0	$0	$0
61	$0	$0	$0	$0
62	$0	$0	$0	$0
63	$0	$0	$0	$0
64	$0	$0	$0	$0
65	$0	$0	$0	$0
66	$0	$0	$0	$0
67	$0	$0	$0	$0
68	$0	$0	$0	$0
69	$0	$0	$0	$0
70	$0	$0	$0	$0
71	$0	$0	$0	$0
72	$0	$0	$0	$0
73	$0	$0	$0	$0
74	$0	$0	$0	$0
75	$0	$0	$0	$0
76	$0	$0	$0	$0
77	$0	$0	$0	$0
78	$0	$0	$0	$0
79	$0	$0	$0	$0
80	$0	$0	$0	$0
81	$0	$0	$0	$0
82	$0	$0	$0	$0
83	$0	$0	$0	$0
84	$0	$0	$0	$0
85	$0	$0	$0	$0
86	$0	$0	$0	$0
87	$0	$0	$0	$0
88	$0	$0	$0	$0
89	$0	$0	$0	$0
90	$0	$0	$0	$0
91	$0	$0	$0	$0
92	$0	$0	$0	$0
93	$0	$0	$0	$0
94	$0	$0	$0	$0
95	$0	$0	$0	$0
96	$0	$0	$0	$0
97	$0	$0	$0	$0
98	$0	$0	$0	$0
99	$0	$0	$0	$0
	$846,044	$191,583	$35,578	$132,658
	$659,426	$149,324	$30,408	$113,383

PIPELINES

Year	Capital Annual Cost	Removal Annual Cost	Maintenance Annual Cost ($)
60	$0	$0	$0
61	$0	$0	$0
62	$0	$0	$0
63	$0	$0	$0
64	$0	$0	$0
65	$0	$0	$0
66	$0	$0	$0
67	$0	$0	$0
68	$0	$0	$0
69	$0	$0	$0
70	$0	$0	$0
71	$0	$0	$0
72	$0	$0	$0
73	$0	$0	$0
74	$0	$0	$0
75	$0	$0	$0
76	$0	$0	$0
77	$0	$0	$0
78	$0	$0	$0
79	$0	$0	$0
80	$0	$0	$0
81	$0	$0	$0
82	$0	$0	$0
83	$0	$0	$0
84	$0	$0	$0
85	$0	$0	$0
86	$0	$0	$0
87	$0	$0	$0
88	$0	$0	$0
89	$0	$0	$0
90	$0	$0	$0
91	$0	$0	$0
92	$0	$0	$0
93	$0	$0	$0
94	$0	$0	$0
95	$0	$0	$0
96	$0	$0	$0
97	$0	$0	$0
98	$0	$0	$0
99	$0	$0	$0
	$0	$146,437	$150,789
	$0	$114,136	$128,879

ELECTRICAL INFRASTRUCTURE

Year	Removal Annual Cost	Maintenance Annual Cost ($)
60	$0	$0
61	$0	$0
62	$0	$0
63	$0	$0
64	$0	$0
65	$0	$0
66	$0	$0
67	$0	$0
68	$0	$0
69	$0	$0
70	$0	$0
71	$0	$0
72	$0	$0
73	$0	$0
74	$0	$0
75	$0	$0
76	$0	$0
77	$0	$0
78	$0	$0
79	$0	$0
80	$0	$0
81	$0	$0
82	$0	$0
83	$0	$0
84	$0	$0
85	$0	$0
86	$0	$0
87	$0	$0
88	$0	$0
89	$0	$0
90	$0	$0
91	$0	$0
92	$0	$0
93	$0	$0
94	$0	$0
95	$0	$0
96	$0	$0
97	$0	$0
98	$0	$0
99	$0	$0
	$67,205	$137,778
	$52,381	$117,759

ENVIROMENTAL SAMPLING

Year	Annual Cost ($)	Total Cash Flow ($)
60	$2,850	$2,850
61	$2,850	$2,850
62	$2,850	$2,850
63	$2,850	$2,850
64	$2,850	$2,850
65	$2,850	$2,850
66	$2,850	$2,850
67	$2,850	$2,850
68	$2,850	$2,850
69	$2,850	$2,850
70	$2,850	$2,850
71	$2,850	$2,850
72	$2,850	$2,850
73	$2,850	$2,850
74	$2,850	$2,850
75	$2,850	$2,850
76	$2,850	$2,850
77	$2,850	$2,850
78	$2,850	$2,850
79	$2,850	$2,850
80	$2,850	$2,850
81	$2,850	$2,850
82	$2,850	$2,850
83	$2,850	$2,850
84	$2,850	$2,850
85	$2,850	$2,850
86	$2,850	$2,850
87	$2,850	$2,850
88	$2,850	$2,850
89	$2,850	$2,850
90	$2,850	$2,850
91	$2,850	$2,850
92	$2,850	$2,850
93	$2,850	$2,850
94	$2,850	$2,850
95	$2,850	$2,850
96	$2,850	$2,850
97	$2,850	$2,850
98	$2,850	$2,850
99	$2,850	$2,850
	$347,715	$2,987,307
	$297,192	-

Total Cost	**$2,987,307**
Total Direct Cost	**$2,408,782**

Water Management Summary

Cobre Mining Company

Based on Projected 2019 Mine Plan			Current Value
DIRECT COSTS			
	Capital		**$1,495,862**
	Operations and Maintenance		**$585,319**
Capital			
INDIRECT COSTS[1]	Mobilization and Demobilization	3.8%	$56,843
	Contingencies	4.0%	$59,834
	Engineering Redesign Fee	2.5%	$37,397
	Contractor Profit and Overhead	15.0%	$224,379
	Project Management Fee	3.0%	$44,876
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	28.3%	
	Subtotal, Indirect Costs		**$423,329**
Operations and Maintenance			
INDIRECT COSTS[1]	Mobilization and Demobilization	0.0%	$0
	Contingencies	4.0%	$23,413
	Engineering Redesign Fee	0.0%	$0
	Contractor Profit and Overhead	10.0%	$58,532
	Project Management Fee	3.0%	$17,560
	State Procurement Cost	0.0%	$0
	Indirect Percentage Sum =	17.0%	
	Subtotal, Indirect Costs		**$99,504**
ELECTRICITY, FUEL, AND SAMPLING			**$383,292**
TOTAL COST			**$2,987,307**

Data Sources:

MMD. 1996. Closeout Plan Guidelines for Existing Mines, Mining Act Reclamation Bureau Mining and Minerals Division New Mexico Energy, Minerals and Natural Resources Department. April 30, 1996.

OSM. 2000. U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement Handbook for Calculation of Reclamation Bond Amounts. April 5, 2000.

Notes:

1) Indirect costs are based on the guidance available from MMD (1996) and OSM (2000).

Water Management Summary

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement		**28.3%**	
Ponds and Tanks	$520,594.94	$147,328	$667,923
Pumps	$659,426.27	$186,618	$846,044
Pipelines	$0.00	$0	$0
Electrical	$0.00	$0	$0
Subtotal	**$1,180,021.20**	**$333,946**	**$1,513,967**
Removal[1]		**28.3%**	
Pumps	$149,324.06	$42,259	$191,583
Pipelines	$114,136.15	$32,301	$146,437
Electrical	$52,380.78	$14,824	$67,205
Subtotal	**$315,840.98**	**$89,384**	**$405,225**
Operations and Maintenance		**17%**	
Ponds and Tanks	$225,298.15	$38,301	$263,599
Pumps	$113,383.30	$19,275	$132,658
Pipelines	$128,879.24	$21,909	$150,788
Electrical Infrastructure	$117,758.66	$20,019	$137,778
Materials		**17%**	
Electricity and Fuel	$30,408.18	$5,169	$35,578
Environmental Sampling	$297,192.00	$50,523	$347,715
Subtotal	**$912,919.54**	**$155,196**	**$1,068,116**
Total Estimated Cost	**$2,408,781.72**	**$579,000**	**$2,987,308**

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

APPENDIX C.4
SUPPORTING DOCUMENTATION

05 Common Work Results for Earthwork

5 19 – Geosynthetics for Earthwork

19.53 Reservoir Liners HDPE	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	In
ESERVOIR LINERS HDPE									
Membrane lining									
30 mil thick	3 Skwk	1850	.013	S.F.	.41	.68		1.09	
60 mil thick		1600	.015		.58	.79		1.37	
120 mil thick		1440	.017		.67	.87		1.54	

23 – Cement and Concrete for Earthwork

3.30 Plant Mixed Bituminous Concrete	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	In
ANT MIXED BITUMINOUS CONCRETE									
Asphaltic concrete plant mix (145 lb./C.F.)				Ton	65			65	
Asphaltic concrete less than 300 tons add trucking costs									
See Section 31 23 23.20 for hauling costs									
All weather patching mix, hot									

02 41 Demolition

02 41 13 – Selective Site Demolition

02 41 13.33 Railtrack Removal		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
3800	Turnouts using new bolts and spikes	B-14	1	48	Ea.		2,025	310	2,335	3,425

02 41 13.34 Selective Demolition, Utility Materials

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, UTILITY MATERIALS R024119-10									
0015	Excludes excavation									
0020	See other utility items in Section 02 41 13.33									
0100	Fire hydrant extensions	B-20	14	1.714	Ea.		76.50		76.50	117
0200	Precast utility boxes up to 8′ x 14′ x 7′	B-13	2	28			1,225	295	1,520	2,175
0300	Handholes and meter pits	B-6	2	12			525	156	681	965
0400	Utility valves 4″-12″	B-20	4	6			268		268	410
0500	14″-24″	B-21	2	14			650	65	715	1,050

02 41 13.36 Selective Demolition, Utility Valves and Accessories

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, UTILITY VALVES & ACCESSORIES									
0015	Excludes excavation									
0100	Utility valves 4″-12″ diam.	B-20	4	6	Ea.		268		268	410
0200	14″-24″ diam.	B-21	2	14			650	65	715	1,050
0300	Crosses 4″-12″ diam.	B-20	8	3			134		134	205
0400	14″-24″ diam.	B-21	4	7			325	32.50	357.50	530
0500	Utility cut-in valves 4″-12″ diam.	B-20	20	1.200			53.50		53.50	82
0600	Curb boxes	″	20	1.200			53.50		53.50	82

02 41 13.38 Selective Demo., Water & Sewer Piping & Fittings

		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, WATER & SEWER PIPING AND FITTINGS									
0015	Excludes excavation									
0020	See other utility items in Section 02 41 13.23									
0090	Concrete pipe 4″-10″ diameter	B-6	250	.096	L.F.		4.19	1.25	5.44	7.70
0100	42″-48″ diameter	B-13B	96	.583			25.50	10.35	35.85	50
0200	60″-84″ diameter	″	80	.700			30.50	12.45	42.95	60
0300	96″ diameter	B-13C	80	.700			30.50	23.50	54	72
0400	108″-144″ diameter	″	64	.875			38.50	29.50	68	90
0450	Concrete fittings 12″ diameter	B-6	24	1	Ea.		43.50	13	56.50	81
0480	Concrete end pieces 12″ diameter		200	.120	L.F.		5.25	1.56	6.81	9.65
0485	15″ diameter		150	.160			7	2.08	9.08	12.90
0490	18″ diameter		150	.160			7	2.08	9.08	12.90
0500	24″-36″ diameter		100	.240			10.50	3.12	13.62	19.35
0600	Concrete fittings 24″-36″ diameter		12	2	Ea.		87.50	26	113.50	162
0700	48″-84″ diameter	B-13B	12	4.667			204	83	287	400
0800	96″ diameter	″	8	7			305	124	429	600
0900	108″-144″ diameter	B-13C	4	14			610	470	1,080	1,450
1000	Ductile iron pipe 4″ diameter	B-21B	200	.200	L.F.		8.70	2.48	11.18	15.95
1100	6″-12″ diameter		175	.229			9.95	2.83	12.78	18.20
1200	14″-24″ diameter		120	.333			14.50	4.13	18.63	26.50
1300	Ductile iron fittings 4″-12″ diameter		24	1.667	Ea.		72.50	20.50	93	133
1400	14″-16″ diameter		18	2.222			96.50	27.50	124	178
1500	18″-24″ diameter		12	3.333			145	41.50	186.50	266
1600	Plastic pipe 3/4″-4″ diameter	B-6	700	.034	L.F.		1.50	.45	1.95	2.76
1700	6″-8″ diameter		500	.048			2.10	.63	2.73	3.87
1800	10″-18″ diameter		300	.080			3.49	1.04	4.53	6.45
1900	20″-36″ diameter		200	.120			5.25	1.56	6.81	9.65
1910	42″-48″ diameter		180	.133			5.80	1.74	7.54	10.75
1920	54″-60″ diameter		160	.150			6.55	1.95	8.50	12.10
2000	Plastic fittings 4″-8″ diameter		75	.320	Ea.		13.95	4.17	18.12	25.50
2100	10″-14″ diameter		50	.480			21	6.25	27.25	39
2200	16″-24″ diameter		20	1.200			52.50	15.60	68.10	96.50

02 41 13 – Selective Site Demolition

02 41 13.78 Selective Demolition, Radio Towers		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0800	120′	K-2	.80	30	Ea.		1,550	298	1,848	2,825
0900	190′		.40	60			3,125	595	3,720	5,625

02 41 13.80 Selective Demo., Utility Poles and Cross Arms		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, UTILITY POLES & CROSS ARMS									
0100	Utility poles, wood, 20′-30′ high	R-3	6	3.333	Ea.		193	21.50	214.50	315
0200	35′-45′ high	"	5	4			232	26	258	375
0300	Cross arms, wood, 4′-6′ long	1 Elec	5	1.600			93		93	139

02 41 13.82 Selective Removal, Pavement Lines and Markings		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE REMOVAL, PAVEMENT LINES & MARKINGS									
0015	Does not include traffic control costs									
0020	See other items in Section 32 17 23.13									
0100	Remove permanent painted traffic lines and markings	B-78A	500	.016	C.L.F.		.82	1.71	2.53	3.12
0200	Temporary traffic line tape	2 Clab	1500	.011	L.F.		.43		.43	.65
0300	Thermoplastic traffic lines and markings	B-79A	500	.024	C.L.F.		1.23	2.62	3.85	4.75
0400	Painted pavement markings	B-78B	500	.036	S.F.		1.48	.70	2.18	3.02

02 41 13.84 Selective Demolition, Walks, Steps and Pavers		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, WALKS, STEPS AND PAVERS									
0100	Splash blocks	1 Clab	300	.027	S.F.		1.06		1.06	1.62
0200	Tree grates	"	50	.160	Ea.		6.40		6.40	9.70
0300	Walks, limestone pavers	2 Clab	150	.107	S.F.		4.25		4.25	6.45
0400	Redwood sections		600	.027			1.06		1.06	1.62
0500	Redwood planks		480	.033			1.33		1.33	2.02
0600	Shale paver		300	.053			2.13		2.13	3.24
0700	Tile thinset paver		675	.024			.94		.94	1.44
0800	Wood round	B-1	350	.069	Ea.		2.78		2.78	4.23
0900	Asphalt block	2 Clab	450	.036	S.F.		1.42		1.42	2.16
1000	Bluestone		450	.036			1.42		1.42	2.16
1100	Slate, 1″ or thinner		675	.024			.94		.94	1.44
1200	Granite blocks		300	.053			2.13		2.13	3.24
1300	Precast patio blocks		450	.036			1.42		1.42	2.16
1400	Planter blocks		600	.027			1.06		1.06	1.62
1500	Brick paving, dry set		300	.053			2.13		2.13	3.24
1600	Mortar set		180	.089			3.54		3.54	5.40
1700	Dry set on edge		240	.067			2.66		2.66	4.05
1800	Steps, brick		200	.080	L.F.		3.19		3.19	4.86
1900	Railroad tie		150	.107			4.25		4.25	6.45
2000	Bluestone		180	.089			3.54		3.54	5.40
2100	Wood/steel edging for steps		1000	.016			.64		.64	.97
2200	Timber or railroad tie edging for steps		400	.040			1.59		1.59	2.43

02 41 13.86 Selective Demolition, Athletic Surfaces		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, ATHLETIC SURFACES									
0100	Synthetic grass	2 Clab	2000	.008	S.F.		.32		.32	.49
0200	Surface coat latex rubber	"	2000	.008	"		.32		.32	.49
0300	Tennis court posts	B-11C	16	1	Ea.		47	19.55	66.55	92.50

02 41 13.88 Selective Demolition, Lawn Sprinkler Systems		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, LAWN SPRINKLER SYSTEMS									
0100	Golf course sprinkler system, 9 hole	4 Clab	.10	320	Ea.		12,800		12,800	19,400
0200	Sprinkler system, 24′ diam. @ 15′ OC, per head	B-20	110	.218	Head		9.75		9.75	14.90
0300	60′ diam. @ 24′ OC, per head	"	52	.462	"		20.50		20.50	31.50
0400	Sprinkler heads, plastic	2 Clab	150	.107	Ea.		4.25		4.25	6.45
0500	Impact circle pattern, 28′-76′ diam.		75	.213			8.50		8.50	12.95

02 41 13 – Selective Site Demolition

02 41 13.88 Selective Demolition, Lawn Sprinkler Systems		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0600	Pop-up, 42′-76′ diam.	2 Clab	50	.320	Ea.		12.75		12.75	19.40
0700	39′-99′ diam.		50	.320			12.75		12.75	19.40
0800	Sprinkler valves		40	.400			15.95		15.95	24.50
0900	Valve boxes		40	.400			15.95		15.95	24.50
1000	Controls		2	8			320		320	485
1100	Backflow preventer		4	4			159		159	243
1200	Vacuum breaker		4	4			159		159	243

02 41 13.90 Selective Demolition, Retaining Walls		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, RETAINING WALLS									
0020	See other retaining wall items in Section 32 32									
0100	Concrete retaining wall, 6′ high, no reinforcing	B-13K	200	.080	L.F.		4.49	8.30	12.79	15.90
0200	8′ high		150	.107			6	11.10	17.10	21
0300	10′ high		150	.107			6	11.10	17.10	21
0400	With reinforcing, 6′ high		200	.080			4.49	8.30	12.79	15.90
0500	8′ high		150	.107			6	11.10	17.10	21
0600	10′ high		120	.133			7.50	13.85	21.35	26.50
0700	20′ high		60	.267			14.95	27.50	42.45	53
0800	Concrete cribbing, 12′ high, open/closed face		150	.107	S.F.		6	11.10	17.10	21
0900	Interlocking segmental retaining wall	B-62	800	.030			1.31	.22	1.53	2.23
1000	Wall caps	"	600	.040			1.75	.29	2.04	2.97
1100	Metal bin retaining wall, 10′ wide, 4′-12′ high	B-13	1200	.047			2.04	.49	2.53	3.64
1200	10′ wide, 16′-28′ high		1000	.056			2.45	.59	3.04	4.37
1300	Stone filled gabions, 6′ x 3′ x 1′		170	.329	Ea.		14.40	3.48	17.88	26
1400	6′ x 3′ x 1′-6″		75	.747			32.50	7.90	40.40	58
1500	6′ x 3′ x 3′		25	2.240			98	23.50	121.50	175
1600	9′ x 3′ x 1′		75	.747			32.50	7.90	40.40	58
1700	9′ x 3′ x 1′-6″		33	1.697			74	17.90	91.90	133
1800	9′ x 3′ x 3′		12	4.667			204	49	253	365
1900	12′ x 3′ x 1′		42	1.333			58.50	14.05	72.55	104
2000	12′ x 3′ x 1′-6″		20	2.800			122	29.50	151.50	219
2100	12′ x 3′ x 3′		6	9.333			410	98.50	508.50	730

02 41 13.92 Selective Demolition, Parking Appurtenances		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	SELECTIVE DEMOLITION, PARKING APPURTENANCES									
0100	Bumper rails, garage, 6″ wide	B-6	300	.080	L.F.		3.49	1.04	4.53	6.45
0200	12″ channel rail		300	.080			3.49	1.04	4.53	6.45
0300	Parking bumper, timber		1000	.024			1.05	.31	1.36	1.93
0400	Folding, with locks	B-1	100	.240	Ea.		9.70		9.70	14.80
0500	Flexible fixed garage stanchion	B-6	150	.160			7	2.08	9.08	12.90
0600	Wheel stops, precast concrete		120	.200			8.75	2.60	11.35	16.10
0700	Thermoplastic		120	.200			8.75	2.60	11.35	16.10
0800	Pipe bollards, 6″-12″ diam.		80	.300			13.10	3.91	17.01	24

02 41 16 – Structure Demolition

02 41 16.13 Building Demolition		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	BUILDING DEMOLITION Large urban projects, incl. 20 mi. haul R024119-10									
0011	No foundation or dump fees, C.F. is vol. of building standing									
0020	Steel	B-8	21500	.003	C.F.		.14	.13	.27	.36
0050	Concrete		15300	.004			.19	.19	.38	.50
0080	Masonry		20100	.003			.15	.14	.29	.38
0100	Mixture of types		20100	.003			.15	.14	.29	.38
0500	Small bldgs, or single bldgs, no salvage included, steel	B-3	14800	.003			.14	.15	.29	.39
0600	Concrete		11300	.004			.19	.20	.39	.51
0650	Masonry		14800	.003			.14	.15	.29	.39

22 11 13.48 Pipe, Fittings and Valves, Steel, Grooved-Joint		Crew	Daily Output	Labor-Hours	Unit	2018 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.	6.05	7		13.05	17.20
1050	1" diameter		63	.127		5.85	7.90		13.75	18.35
1060	1-1/4" diameter		58	.138		6.95	8.55		15.50	20.50
1070	1-1/2" diameter		51	.157		7.55	9.75		17.30	23
1080	2" diameter		40	.200		8.75	12.45		21.20	28.50
1090	2-1/2" diameter	Q-1	57	.281		11.45	15.70		27.15	36
1100	3" diameter		50	.320		13.85	17.90		31.75	42.50
1110	4" diameter		45	.356		24	19.90		43.90	56.50
1120	5" diameter		37	.432		43.50	24		67.50	84
1130	6" diameter	Q-2	42	.571		49	33		82	104
1140	8" diameter		37	.649		81	37.50		118.50	146
1150	10" diameter		31	.774		108	45		153	187
1160	12" diameter		27	.889		121	51.50		172.50	211
1170	14" diameter		20	1.200		128	69.50		197.50	246
1180	16" diameter		17	1.412		189	82		271	330
1190	18" diameter		14	1.714		194	99.50		293.50	365
1200	20" diameter		12	2		230	116		346	430
1210	24" diameter		10	2.400		258	139		397	495
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.	6.25	7		13.25	17.45
1850	1" diameter		63	.127		6.50	7.90		14.40	19.05
1860	1-1/4" diameter		58	.138		7.80	8.55		16.35	21.50
1870	1-1/2" diameter		51	.157		8.65	9.75		18.40	24
1880	2" diameter		40	.200		10	12.45		22.45	29.50
1890	2-1/2" diameter	Q-1	57	.281		12.95	15.70		28.65	38
1900	3" diameter		50	.320		15.75	17.90		33.65	44.50
1910	4" diameter		45	.356		26.50	19.90		46.40	59.50
1920	5" diameter		37	.432		31	24		55	71
1930	6" diameter	Q-2	42	.571		33	33		66	86.50
1940	8" diameter		37	.649		50.50	37.50		88	112
1950	10" diameter		31	.774		103	45		148	181
1960	12" diameter		27	.889		124	51.50		175.50	215
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.	77	13.10		90.10	104
4740	1" diameter		33	.242		59.50	15.05		74.55	88
4750	1-1/4" diameter		27	.296		59.50	18.40		77.90	93
4760	1-1/2" diameter		22	.364		59.50	22.50		82	99.50
4770	2" diameter		17	.471		59.50	29.50		89	110
4780	2-1/2" diameter	Q-1	27	.593		59.50	33		92.50	116

22 11 13.48 Pipe, Fittings and Valves, Steel, Grooved-Joint		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
4790	3" diameter	Q-1	22	.727	Ea.	81	40.50		121.50	151
4800	4" diameter		17	.941		123	52.50		175.50	216
4810	5" diameter		13	1.231		287	69		356	420
4820	6" diameter	Q-2	17	1.412		330	82		412	490
4830	8" diameter		14	1.714		725	99.50		824.50	950
4840	10" diameter		12	2		945	116		1,061	1,225
4850	12" diameter		10	2.400		1,225	139		1,364	1,550
4851	14" diameter		9	2.667		1,225	155		1,380	1,575
4852	16" diameter		8	3		1,375	174		1,549	1,775
4853	18" diameter	Q-3	10	3.200		1,725	189		1,914	2,175
4854	20" diameter		9	3.556		2,475	210		2,685	3,050
4855	24" diameter		8	4		3,775	237		4,012	4,500
4900	For galvanized tees, add					24%				
4939	Couplings									
4940	Flexible, standard, painted									
4950	3/4" diameter	1 Plum	100	.080	Ea.	21.50	4.97		26.47	31.50
4960	1" diameter		100	.080		21.50	4.97		26.47	31.50
4970	1-1/4" diameter		80	.100		28	6.20		34.20	40.50
4980	1-1/2" diameter		67	.119		30.50	7.40		37.90	44.50
4990	2" diameter		50	.160		33	9.95		42.95	51
5000	2-1/2" diameter	Q-1	80	.200		38	11.20		49.20	59
5010	3" diameter		67	.239		42	13.35		55.35	66.50
5020	3-1/2" diameter		57	.281		60.50	15.70		76.20	90
5030	4" diameter		50	.320		61	17.90		78.90	94
5040	5" diameter		40	.400		91.50	22.50		114	135
5050	6" diameter	Q-2	50	.480		108	28		136	161
5070	8" diameter		42	.571		175	33		208	243
5090	10" diameter		35	.686		286	40		326	375
5110	12" diameter		32	.750		325	43.50		368.50	420
5120	14" diameter		24	1		465	58		523	600
5130	16" diameter		20	1.200		610	69.50		679.50	775
5140	18" diameter		18	1.333		710	77.50		787.50	900
5150	20" diameter		16	1.500		1,125	87		1,212	1,350
5160	24" diameter		13	1.846		1,225	107		1,332	1,500
5200	For galvanized couplings, add					33%				
5750	Flange, w/groove gasket, black steel									
5754	See Line 22 11 13.47 0620 for gasket & bolt set									
5760	ANSI class 125 and 150, painted									
5780	2" pipe size	1 Plum	23	.348	Ea.	126	21.50		147.50	172
5790	2-1/2" pipe size	Q-1	37	.432		157	24		181	210
5800	3" pipe size		31	.516		169	29		198	230
5820	4" pipe size		23	.696		226	39		265	305
5830	5" pipe size		19	.842		262	47		309	360
5840	6" pipe size	Q-2	23	1.043		286	60.50		346.50	405
5850	8" pipe size		17	1.412		325	82		407	480
5860	10" pipe size		14	1.714		510	99.50		609.50	710
5870	12" pipe size		12	2		665	116		781	910
5880	14" pipe size		10	2.400		1,225	139		1,364	1,550
5890	16" pipe size		9	2.667		1,425	155		1,580	1,800
5900	18" pipe size		6	4		1,750	232		1,982	2,275
5910	20" pipe size		5	4.800		2,125	278		2,403	2,750
5920	24" pipe size		4.50	5.333		2,700	310		3,010	3,450
8000	Butterfly valve, 2 position handle, with standard trim									

32 31 Fences and Gates

32 31 26 – Wire Fences and Gates

32 31 26.10 Fences, Misc. Metal		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
4600	16' high	B-80	20	1.600	L.F.	79	71	30.50	180.50	229
4990	Security fence, prison grade, set in concrete, 10' high	↓	25	1.280	↓	61.50	57	24.50	143	181

32 31 26.20 Wire Fencing, General		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**WIRE FENCING, GENERAL**									
0015	Barbed wire, galvanized, domestic steel, hi-tensile 15-1/2 ga.				M.L.F.	130			130	142
0020	Standard, 12-3/4 ga.					146			146	160
0210	Barbless wire, 2-strand galvanized, 12-1/2 ga.				↓	146			146	160
0500	Helical razor ribbon, stainless steel, 18" diam. x 18" spacing				C.L.F.	174			174	191
0600	Hardware cloth galv., 1/4" mesh, 23 ga., 2' wide				C.S.F.	34.50			34.50	38
0700	3' wide					26.50			26.50	29
0900	1/2" mesh, 19 ga., 2' wide					36			36	39.50
1000	4' wide					45			45	49.50
1200	Chain link fabric, steel, 2" mesh, 6 ga., galvanized					61			61	67
1300	9 ga., galvanized					54			54	59.50
1350	Vinyl coated					30			30	33
1360	Aluminized					184			184	203
1400	2-1/4" mesh, 11-1/2 ga., galvanized					42.50			42.50	46.50
1600	1-3/4" mesh (tennis courts), 11-1/2 ga. (core), vinyl coated					48			48	53
1700	9 ga., galvanized				↓	85			85	93.50
2100	Welded wire fabric, galvanized, 1" x 2", 14 ga.	2 Carp	1600	.010	S.F.	.65	.51		1.16	1.49
2200	2" x 4", 12-1/2 ga.				C.S.F.	33			33	36

32 31 29 – Wood Fences and Gates

32 31 29.10 Fence, Wood		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**FENCE, WOOD**									
0011	Basket weave, 3/8" x 4" boards, 2" x 4"									
0020	stringers on spreaders, 4" x 4" posts									
0050	No. 1 cedar, 6' high	B-80C	160	.150	L.F.	26	6.20	1.22	33.42	39.50
0070	Treated pine, 6' high	"	150	.160	"	37	6.60	1.31	44.91	52
0200	Board fence, 1" x 4" boards, 2" x 4" rails, 4" x 4" post									
0220	Preservative treated, 2 rail, 3' high	B-80C	145	.166	L.F.	10.30	6.85	1.35	18.50	23
0240	4' high		135	.178		11.85	7.35	1.45	20.65	25.50
0260	3 rail, 5' high		130	.185		12.40	7.65	1.51	21.56	27
0300	6' high		125	.192		15.30	7.95	1.57	24.82	30.50
0320	No. 2 grade western cedar, 2 rail, 3' high		145	.166		12.35	6.85	1.35	20.55	25.50
0340	4' high		135	.178		11.75	7.35	1.45	20.55	25.50
0360	3 rail, 5' high		130	.185		13.85	7.65	1.51	23.01	28.50
0400	6' high		125	.192		14.75	7.95	1.57	24.27	30
0420	No. 1 grade cedar, 2 rail, 3' high		145	.166		13.30	6.85	1.35	21.50	26.50
0440	4' high		135	.178		14.70	7.35	1.45	23.50	29
0460	3 rail, 5' high		130	.185		17.40	7.65	1.51	26.56	32.50
0500	6' high		125	.192		21.50	7.95	1.57	31.02	37.50
0860	Open rail fence, split rails, 2 rail, 3' high, no. 1 cedar		160	.150		9.75	6.20	1.22	17.17	21.50
0870	No. 2 cedar		160	.150		8.15	6.20	1.22	15.57	19.70
0880	3 rail, 4' high, no. 1 cedar		150	.160		12.15	6.60	1.31	20.06	25
0890	No. 2 cedar		150	.160		8	6.60	1.31	15.91	20
0920	Rustic rails, 2 rail, 3' high, no. 1 cedar		160	.150		12.30	6.20	1.22	19.72	24.50
0930	No. 2 cedar		160	.150		11.15	6.20	1.22	18.57	23
0940	3 rail, 4' high		150	.160		11.80	6.60	1.31	19.71	24.50
0950	No. 2 cedar		150	.160		8.05	6.60	1.31	15.96	20.50
1240	Stockade fence, no. 1 cedar, 3-1/4" rails, 6' high		160	.150		13.15	6.20	1.22	20.57	25
1260	8' high		155	.155	↓	18.10	6.40	1.26	25.76	31
1270	Gate, 3'-6" wide	↓	9	2.667	Ea.	260	110	22	392	475

32 31 Fences and Gates

32 31 29 – Wood Fences and Gates

32 31 29.10 Fence, Wood		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
1300	No. 2 cedar, treated wood rails, 6' high	B-80C	160	.150	L.F.	13.45	6.20	1.22	20.87	25.50
1320	Gate, 3'-6" wide		8	3	Ea.	89.50	124	24.50	238	315
1360	Treated pine, treated rails, 6' high		160	.150	L.F.	13.95	6.20	1.22	21.37	26
1400	8' high		150	.160	"	19.80	6.60	1.31	27.71	33.50
1420	Gate, 3'-6" wide	↓	9	2.667	Ea.	100	110	22	232	300

32 31 29.20 Fence, Wood Rail		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**FENCE, WOOD RAIL**									
0012	Picket, No. 2 cedar, Gothic, 2 rail, 3' high	B-1	160	.150	L.F.	8.10	6.10		14.20	18.15
0050	Gate, 3'-6" wide	B-80C	9	2.667	Ea.	78	110	22	210	277
0400	3 rail, 4' high		150	.160	L.F.	9.10	6.60	1.31	17.01	21.50
0500	Gate, 3'-6" wide	↓	9	2.667	Ea.	95	110	22	227	295
5000	Fence rail, redwood, 2" x 4", merch. grade, 8'	B-1	2400	.010	L.F.	2.53	.41		2.94	3.40
6000	Fence post, select redwood, earth packed & treated, 4" x 4" x 6'		96	.250	Ea.	14	10.15		24.15	31
6010	4" x 4" x 8'		96	.250		19.25	10.15		29.40	36.50
6020	Set in concrete, 4" x 4" x 6'		50	.480		22	19.45		41.45	53.50
6030	4" x 4" x 8'		50	.480		23	19.45		42.45	55
6040	Wood post, 4' high, set in concrete, incl. concrete		50	.480		14.20	19.45		33.65	45
6050	Earth packed		96	.250		17.20	10.15		27.35	34.50
6060	6' high, set in concrete, incl. concrete		50	.480		17.70	19.45		37.15	49
6070	Earth packed	↓	96	.250	↓	12.10	10.15		22.25	29

32 32 Retaining Walls

32 32 13 – Cast-in-Place Concrete Retaining Walls

32 32 13.10 Retaining Walls, Cast Concrete		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**RETAINING WALLS, CAST CONCRETE**									
1800	Concrete gravity wall with vertical face including excavation & backfill									
1850	No reinforcing									
1900	6' high, level embankment	C-17C	36	2.306	L.F.	89	122	15.80	226.80	300
2000	33° slope embankment		32	2.594		103	137	17.80	257.80	345
2200	8' high, no surcharge		27	3.074		110	163	21	294	395
2300	33° slope embankment		24	3.458		133	183	23.50	339.50	450
2500	10' high, level embankment		19	4.368		157	231	30	418	560
2600	33° slope embankment	↓	18	4.611	↓	217	244	31.50	492.50	650
2800	Reinforced concrete cantilever, incl. excavation, backfill & reinf.									
2900	6' high, 33° slope embankment	C-17C	35	2.371	L.F.	80.50	125	16.25	221.75	298
3000	8' high, 33° slope embankment		29	2.862		93	151	19.65	263.65	355
3100	10' high, 33° slope embankment		20	4.150		121	219	28.50	368.50	500
3200	20' high, 500 lb./L.F. surcharge	↓	7.50	11.067	↓	360	585	76	1,021	1,375
3500	Concrete cribbing, incl. excavation and backfill									
3700	12' high, open face	B-13	210	.267	S.F.	40.50	11.65	2.81	54.96	65.50
3900	Closed face	"	210	.267	"	38	11.65	2.81	52.46	62.50
4100	Concrete filled slurry trench, see Section 31 56 23.20									

32 32 23 – Segmental Retaining Walls

32 32 23.13 Segmental Conc. Unit Masonry Retaining Walls		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**SEGMENTAL CONC. UNIT MASONRY RETAINING WALLS**									
7100	Segmental retaining wall system, incl. pins and void fill									
7120	base and backfill not included									
7140	Large unit, 8" high x 18" wide x 20" deep, 3 plane split	B-62	300	.080	S.F.	12.75	3.49	.58	16.82	20
7150	Straight split		300	.080		12.85	3.49	.58	16.92	20
7160	Medium, lt. wt., 8" high x 18" wide x 12" deep, 3 plane split	↓	400	.060	↓	6.30	2.62	.44	9.36	11.35

33 16 Water Utility Storage Tanks

33 16 23 – Ground-Level Steel Water Storage Tanks

33 16 23.13 Steel Water Storage Tanks		Crew	Daily Output	Labor-Hours	Unit	2018 Bare Costs Material	2018 Bare Costs Labor	2018 Bare Costs Equipment	2018 Bare Costs Total	Total Incl O&P
0010	**STEEL WATER STORAGE TANKS**									
0910	Steel, ground level, ht./diam. less than 1, not incl. fdn., 100,000 gallons				Ea.				202,000	244,500
1000	250,000 gallons								295,500	324,000
1200	500,000 gallons								417,000	458,500
1250	750,000 gallons								538,000	591,500
1300	1,000,000 gallons								558,000	725,500
1500	2,000,000 gallons								1,043,000	1,148,000
1600	4,000,000 gallons								2,121,000	2,333,000
1800	6,000,000 gallons								3,095,000	3,405,000
1850	8,000,000 gallons								4,068,000	4,475,000
1910	10,000,000 gallons								5,050,000	5,554,500
2100	Steel standpipes, ht./diam. more than 1,100' to overflow, no fdn.									
2200	500,000 gallons				Ea.				546,500	600,500
2400	750,000 gallons								722,500	794,500
2500	1,000,000 gallons								1,060,500	1,167,000
2700	1,500,000 gallons								1,749,000	1,923,000
2800	2,000,000 gallons								2,327,000	2,559,000

33 16 36 – Ground-Level Reinforced Concrete Water Storage Tanks

33 16 36.16 Prestressed Conc. Water Storage Tanks		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**PRESTRESSED CONC. WATER STORAGE TANKS**									
0020	Not including fdn., pipe or pumps, 250,000 gallons				Ea.				299,000	329,500
0100	500,000 gallons								[illegible]	[illegible]
0300	1,000,000 gallons									

33 14 13.25 Water Supply, Polyvinyl Chloride Pipe	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
8785 20" diameter	B-20A	9.14	3.501	Ea.	465	169		634	770
8790 24" diameter		7.53	4.250		540	206		746	905

33 14 13.35 Water Supply, HDPE	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010 WATER SUPPLY, HDPE									
0011 Butt fusion joints, SDR 21 40' lengths not including excavation or backfill									
0100 4" diameter	B-22A	400	.100	L.F.	2.50	4.60	1.71	8.81	11.65
0200 6" diameter		380	.105		5.65	4.84	1.80	12.29	15.60
0300 8" diameter		320	.125		8.85	5.75	2.14	16.74	21
0400 10" diameter		300	.133		11.50	6.15	2.28	19.93	24.50
0500 12" diameter		260	.154		13	7.10	2.63	22.73	28
0600 14" diameter	B-22B	220	.182		15.35	8.35	9.85	33.55	40.50
0700 16" diameter		180	.222		18.90	10.20	12.05	41.15	50
0800 18" diameter		140	.286		28	13.15	15.50	56.65	68
0900 24" diameter		100	.400		49.50	18.40	21.50	89.40	107
1000 Fittings									
1100 Elbows, 90 degrees									
1200 4" diameter	B-22A	32	1.250	Ea.	17.25	57.50	21.50	96.25	130
1300 6" diameter		28	1.429		44.50	65.50	24.50	134.50	176
1400 8" diameter		24	1.667		116	76.50	28.50	221	276
1500 10" diameter		18	2.222		252	102	38	392	475
1600 12" diameter		12	3.333		297	153	57	507	620
1700 14" diameter	B-22B	9	4.444		570	204	241	1,015	1,200
1800 16" diameter		6	6.667		830	305	360	1,495	1,775
1900 18" diameter		4	10		955	460	540	1,955	2,350
2000 24" diameter		3	13.333		1,700	615	720	3,035	3,600
2100 Tees									
2200 4" diameter	B-22A	30	1.333	Ea.	21.50	61.50	23	106	142
2300 6" diameter		26	1.538		51.50	71	26.50	149	194
2400 8" diameter		22	1.818		130	83.50	31	244.50	305
2500 10" diameter		15	2.667		172	123	45.50	340.50	425
2600 12" diameter		10	4		360	184	68.50	612.50	750
2700 14" diameter	B-22B	8	5		425	230	271	926	1,125
2800 16" diameter		6	6.667		500	305	360	1,165	1,400
2900 18" diameter		4	10		565	460	540	1,565	1,925
3000 24" diameter		2	20		920	920	1,075	2,915	3,600
4100 Caps									
4110 4" diameter	B-22A	34	1.176	Ea.	15	54	20	89	121
4120 6" diameter		30	1.333		30.50	61.50	23	115	153
4130 8" diameter		26	1.538		51	71	26.50	148.50	193
4150 10" diameter		20	2		161	92	34	287	355
4160 12" diameter		14	2.857		201	131	49	381	475

33 14 13.40 Water Supply, Black Steel Pipe	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010 WATER SUPPLY, BLACK STEEL PIPE									
0011 Not including excavation or backfill									
1000 Pipe, black steel, plain end, welded, 1/4" wall thk, 8" diam.	B-35A	208	.269	L.F.	31.50	13.10	8.70	53.30	64
1010 10" diameter		204	.275		40	13.35	8.85	62.20	74.50
1020 12" diameter		195	.287		47	14	9.25	70.25	83
1030 18" diameter		175	.320		73.50	15.60	10.30	99.40	116
1040 5/16" wall thickness, 12" diameter		195	.287		59.50	14	9.25	82.75	96.50
1050 18" diameter		175	.320		92	15.60	10.30	117.90	136
1060 36" diameter		28.96	1.934		173	94	62.50	329.50	400
1070 3/8" wall thickness, 18" diameter		43.20	1.296		108	63	42	213	261

33 14 13.40 Water Supply, Black Steel Pipe	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
1080 24" diameter	B-35A	36	1.556	L.F.	146	75.50	50	271.50	330
1090 30" diameter		30.40	1.842		179	89.50	59.50	328	400
1100 1/2" wall thickness, 36" diameter		26.08	2.147		279	105	69.50	453.50	540
1110 48" diameter		21.68	2.583		475	126	83.50	684.50	810
1135 7/16" wall thickness, 48" diameter		20.80	2.692		360	131	87	578	690
1140 5/8" wall thickness, 48" diameter		21.68	2.583		510	126	83.50	719.50	850

33 14 13.45 Water Supply, Copper Pipe	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010 WATER SUPPLY, COPPER PIPE									
0020 Not including excavation or backfill									
2000 Tubing, type K, 20' joints, 3/4" diameter	Q-1	400	.040	L.F.	6.75	2.24		8.99	10.80
2200 1" diameter		320	.050		9.40	2.80		12.20	14.55
3000 1-1/2" diameter		265	.060		14.30	3.38		17.68	21
3020 2" diameter		230	.070		22	3.89		25.89	30
3040 2-1/2" diameter		146	.110		34.50	6.15		40.65	47.50
3060 3" diameter		134	.119		47	6.70		53.70	62
4012 4" diameter		95	.168		79.50	9.40		88.90	102
4016 6" diameter	Q-2	80	.300		124	17.40		141.40	163
5000 Tubing, type L									
5108 2" diameter	Q-1	230	.070	L.F.	14.05	3.89		17.94	21.50
6010 3" diameter		134	.119		37	6.70		43.70	50.50
6012 4" diameter		95	.168		46.50	9.40		55.90	65
6016 6" diameter	Q-2	80	.300		108	17.40		125.40	145
7165 Fittings, brass, corporation stops, no lead, 3/4" diameter	1 Plum	19	.421	Ea.	74	26		100	121
7166 1" diameter		16	.500		97	31		128	154
7167 1-1/2" diameter		13	.615		207	38.50		245.50	286
7168 2" diameter		11	.727		325	45		370	430
7170 Curb stops, no lead, 3/4" diameter		19	.421		94	26		120	143
7171 1" diameter		16	.500		142	31		173	204
7172 1-1/2" diameter		13	.615		268	38.50		306.50	355
7173 2" diameter		11	.727		345	45		390	450
7180 Curb box, cast iron, 1/2" to 1" curb stops		12	.667		52	41.50		93.50	120
7200 1-1/4" to 2" curb stops		8	1		83.50	62		145.50	186
7220 Saddles, 3/4" & 1" diameter, add					71			71	78
7240 1-1/2" to 2" diameter, add					92.50			92.50	102
7250 For copper fittings, see Section 22 11 13.25									

33 14 13.90 Water Supply, Thrust Blocks	Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010 WATER SUPPLY, THRUST BLOCKS									
0015 Piping, not including excavation or backfill									
0110 Thrust block for 90 degree elbow, 4" diameter	C-30	41	.195	Ea.	19.35	7.80	3.93	31.08	37.50
0115 6" diameter		23	.348		33.50	13.85	7	54.35	65
0120 8" diameter		14	.571		51.50	23	11.50	86	104
0125 10" diameter		9	.889		74	35.50	17.90	127.40	155
0130 12" diameter		7	1.143		101	45.50	23	169.50	206
0135 14" diameter		5	1.600		135	64	32	231	282
0140 16" diameter		4	2		171	79.50	40.50	291	355
0145 18" diameter		3	2.667		210	106	53.50	369.50	450
0150 20" diameter		2.50	3.200		254	128	64.50	446.50	545
0155 24" diameter		2	4		365	159	80.50	604.50	730
0210 Thrust block for tee or deadend, 4" diameter		65	.123		13.30	4.90	2.48	20.68	25
0215 6" diameter		35	.229		23.50	9.10	4.60	37.20	45
0220 8" diameter		21	.381		36.50	15.20	7.65	59.35	72
0225 10" diameter		14	.571		53	23	11.50	87.50	106

33 71 16 – Electrical Utility Poles

33 71 16.23 Steel Electrical Utility Poles		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0880	85'	R-13	1.40	30	Ea.	7,200	1,700	168	9,068	10,600
0900	90'		1.25	33.600		9,425	1,900	188	11,513	13,400
0920	95'		1.15	36.522		11,800	2,050	205	14,055	16,300
0940	100'		1	42		14,400	2,375	235	17,010	19,700
0960	105'		.90	46.667		15,900	2,625	261	18,786	21,600
0980	Ladder clips					253			253	279
1000	Galvanized steel, round, tapered, w/one 6' arm, 20'	R-15A	9.20	5.217		1,050	266	30.50	1,346.50	1,575
1020	25'		7.65	6.275		1,125	320	37	1,482	1,775
1040	30'		6.55	7.328		1,250	375	43	1,668	1,975
1060	35'		5.75	8.348		1,350	425	49	1,824	2,175
1080	40'		5.15	9.320		1,425	475	55	1,955	2,350
1200	Two 6' arms, 20'		6.55	7.328		1,350	375	43	1,768	2,075
1220	25'		5.75	8.348		1,375	425	49	1,849	2,200
1240	30'		5.15	9.320		1,425	475	55	1,955	2,350
1260	35'		4.60	10.435		1,625	530	61.50	2,216.50	2,650
1280	40'		4.20	11.429		1,875	585	67.50	2,527.50	3,000
1400	One 12' truss arm, 25'		7.65	6.275		1,300	320	37	1,657	1,950
1420	30'		6.55	7.328		1,350	375	43	1,768	2,075
1440	35'		5.75	8.348		1,450	425	49	1,924	2,300
1460	40'		5.15	9.320		1,625	475	55	2,155	2,575
1480	45'		4.60	10.435		1,875	530	61.50	2,466.50	2,950
1600	Two 12' truss arms, 25'		5.75	8.348		1,525	425	49	1,999	2,400
1620	30'		5.15	9.320		1,575	475	55	2,105	2,525
1640	35'		4.60	10.435		1,700	530	61.50	2,291.50	2,750
1660	40'		4.20	11.429		1,875	585	67.50	2,527.50	3,025
1680	45'		3.85	12.468		2,125	635	73.50	2,833.50	3,350
3400	Galvanized steel, tapered, 10'		15.50	3.097		425	158	18.25	601.25	725
3420	12'		11.50	4.174		500	213	24.50	737.50	895
3440	14'		9.20	5.217		370	266	30.50	666.50	840
3460	16'		8.45	5.680		385	290	33.50	708.50	895
3480	18'		7.65	6.275		395	320	37	752	955
3500	20'		7.10	6.761		380	345	40	765	985
6000	Digging holes in earth, average	R-5	25.14	3.500			178	48	226	320
6010	In rock, average	"	4.51	19.512			990	269	1,259	1,800
6020	Formed plate pole structure									
6030	Material handling and spotting	R-7	2.40	20	Ea.		825	69	894	1,350
6040	Erect steel plate pole	R-5	1.95	45.128		10,400	2,300	620	13,320	15,500
6050	Guys, anchors and hardware for pole, in earth		7.04	12.500		630	635	172	1,437	1,850
6060	In rock		17.96	4.900		750	249	67.50	1,066.50	1,275
6070	Foundations for line poles									
6080	Excavation, in earth	R-5	135.38	.650	C.Y.		33	8.95	41.95	60
6090	In rock		20	4.400			224	60.50	284.50	400
6110	Concrete foundations		11	8		153	405	110	668	905

33 71 16.33 Wood Electrical Utility Poles		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**WOOD ELECTRICAL UTILITY POLES**									
0011	Excludes excavation, backfill and cast-in-place concrete									
1020	12" Ponderosa Pine Poles treated 0.40 ACQ, 16'	R-3	3.20	6.250	Ea.	875	360	40.50	1,275.50	1,550
5000	Wood, class 3 yellow pine, penta-treated, 25'	R-15A	8.60	5.581		278	285	33	596	770
5020	30'		7.70	6.234		320	320	36.50	676.50	870
5040	35'		5.80	8.276		400	420	48.50	868.50	1,125
5060	40'		5.30	9.057		475	460	53.50	988.50	1,275
5080	45'		4.70	10.213		515	520	60	1,095	1,425

33 71 16 – Electrical Utility Poles

33 71 16.33 Wood Electrical Utility Poles		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
5100	50'	R-15A	4.20	11.429	Ea.	635	585	67.50	1,287.50	1,650
5120	55'		3.80	12.632		745	645	74.50	1,464.50	1,875
5140	60'		3.50	13.714		995	700	81	1,776	2,250
5160	65'		3.20	15		1,300	765	88.50	2,153.50	2,675
5180	70'		3	16		1,825	815	94	2,734	3,325
5200	75'		2.80	17.143		2,350	875	101	3,326	4,000
6000	Wood, class 1 type C, CCA/ACA-treated, 25'		8.60	5.581		278	285	33	596	770
6020	30'		7.70	6.234		340	320	36.50	696.50	895
6040	35'		5.80	8.276		475	420	48.50	943.50	1,225
6060	40'		5.30	9.057		555	460	53.50	1,068.50	1,375
6080	45'		4.70	10.213		675	520	60	1,255	1,600
6100	50'		4.20	11.429		740	585	67.50	1,392.50	1,775
6120	55'		3.80	12.632		835	645	74.50	1,554.50	1,975
6200	Electric & tel sitework, 20' high, treated wd., see Section 26 56 13.10	R-3	3.10	6.452		189	375	42	606	815
6400	25' high		2.90	6.897		238	400	44.50	682.50	910
6600	30' high		2.60	7.692		340	445	50	835	1,100
6800	35' high		2.40	8.333		480	485	54	1,019	1,325
7000	40' high		2.30	8.696		640	505	56.50	1,201.50	1,525
7200	45' high		1.70	11.765		870	680	76	1,626	2,075
7400	Cross arms with hardware & insulators									
7600	4' long	1 Elec	2.50	3.200	Ea.	149	186		335	440
7800	5' long		2.40	3.333		165	194		359	470
8000	6' long		2.20	3.636		171	212		383	505
9000	Disposal of pole & hardware surplus material	R-7	20.87	2.300	Mile		95	7.95	102.95	154
9100	Disposal of crossarms & hardware surplus material	"	40	1.200	"		49.50	4.15	53.65	80.50

33 71 19 – Electrical Underground Ducts and Manholes

33 71 19.15 Underground Ducts and Manholes		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**UNDERGROUND DUCTS AND MANHOLES**									
0011	Not incl. excavation, backfill and concrete, in slab or duct bank									
1000	Direct burial									
1010	PVC, schedule 40, w/coupling, 1/2" diameter	1 Elec	340	.024	L.F.	.30	1.37		1.67	2.38
1020	3/4" diameter		290	.028		.40	1.61		2.01	2.84
1030	1" diameter		260	.031		.66	1.79		2.45	3.41
1040	1-1/2" diameter		210	.038		.97	2.22		3.19	4.38
1050	2" diameter		180	.044		1.26	2.59		3.85	5.25
1060	3" diameter	2 Elec	240	.067		2.26	3.88		6.14	8.30
1070	4" diameter		160	.100		3.09	5.80		8.89	12.10
1080	5" diameter		120	.133		4.61	7.75		12.36	16.65
1090	6" diameter		90	.178		6.05	10.35		16.40	22
1110	Elbows, 1/2" diameter	1 Elec	48	.167	Ea.	.62	9.70		10.32	15.20
1120	3/4" diameter		38	.211		.78	12.25		13.03	19.15
1130	1" diameter		32	.250		1.30	14.55		15.85	23.50
1140	1-1/2" diameter		21	.381		2.22	22		24.22	35.50
1150	2" diameter		16	.500		2.91	29		31.91	46.50
1160	3" diameter		12	.667		10.50	39		49.50	69.50
1170	4" diameter		9	.889		17.05	51.50		68.55	96.50
1180	5" diameter		8	1		26	58		84	116
1190	6" diameter		5	1.600		36	93		129	179
1210	Adapters, 1/2" diameter		52	.154		.21	8.95		9.16	13.65
1220	3/4" diameter		43	.186		.34	10.85		11.19	16.55
1230	1" diameter		39	.205		.48	11.95		12.43	18.40
1240	1-1/2" diameter		35	.229		.79	13.30		14.09	21

33 71 23 – Insulators and Fittings

33 71 23.16 Post Insulators		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010	**POST INSULATORS**									
7400	Insulators, pedestal type	R-11	112	.500	Ea.		27.50	5.90	33.40	48
7490	See also line 33 71 39.13 1000									

33 71 26 – Transmission and Distribution Equipment

33 71 26.13 Capacitor Banks		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**CAPACITOR BANKS**									
1300	Station capacitors									
1350	Synchronous, 13 to 26 kV	R-11	3.11	18.006	MVAR	7,375	995	213	8,583	9,850
1360	46 kV		3.33	16.817		9,425	930	199	10,554	12,000
1370	69 kV		3.81	14.698		9,275	815	174	10,264	11,600
1380	161 kV		6.51	8.602		8,650	475	102	9,227	10,400
1390	500 kV		10.37	5.400		7,525	299	64	7,888	8,800
1450	Static, 13 to 26 kV		3.11	18.006		6,250	995	213	7,458	8,600
1460	46 kV		3.01	18.605		7,900	1,025	220	9,145	10,500
1470	69 kV		3.81	14.698		7,675	815	174	8,664	9,875
1480	161 kV		6.51	8.602		7,125	475	102	7,702	8,675
1490	500 kV		10.37	5.400		6,500	299	64	6,863	7,675
1600	Voltage regulators, 13 to 26 kV		.75	74.667	Ea.	280,000	4,125	885	285,010	315,000

33 71 26.23 Current Transformers		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**CURRENT TRANSFORMERS**									
4050	Current transformers, 13 to 26 kV	R-11	14	4	Ea.	3,450	221	47.50	3,718.50	4,175
4060	46 kV		9.33	6.002		10,000	330	71	10,401	11,600
4070	69 kV		7	8		10,400	445	94.50	10,939.50	12,300
4080	161 kV		1.87	29.947		33,800	1,650	355	35,805	40,100

33 71 26.26 Potential Transformers		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**POTENTIAL TRANSFORMERS**									
4100	Potential transformers, 13 to 26 kV	R-11	11.20	5	Ea.	4,925	277	59	5,261	5,875
4110	46 kV		8	7		10,100	385	82.50	10,567.50	11,800
4120	69 kV		6.22	9.003		10,700	500	106	11,306	12,700
4130	161 kV		2.24	25		23,200	1,375	296	24,871	27,900
4140	500 kV		1.40	40		69,000	2,225	475	71,700	80,000

33 71 39 – High-Voltage Wiring

33 71 39.13 Overhead High-Voltage Wiring		Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**OVERHEAD HIGH-VOLTAGE WIRING**									
0100	Conductors, primary circuits									
0110	Material handling and spotting	R-5	9.78	8.998	W.Mile		455	124	579	825
0120	For river crossing, add		11	8			405	110	515	735
0150	Conductors, per wire, 210 to 636 kcmil		1.96	44.898		12,400	2,275	620	15,295	17,800
0160	795 to 954 kcmil		1.87	47.059		24,800	2,400	650	27,850	31,600
0170	1,000 to 1,600 kcmil		1.47	59.864		42,500	3,050	825	46,375	52,500
0180	Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
0200	For river crossing, add, 210 to 636 kcmil		1.24	70.968			3,600	980	4,580	6,525
0220	795 to 954 kcmil		1.09	80.734			4,100	1,125	5,225	7,425
0230	1,000 to 1,600 kcmil		.97	90.722			4,600	1,250	5,850	8,325
0240	Over 1,600 kcmil		.87	101			5,150	1,400	6,550	9,275
0300	Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
0400	Sagging	R-5	7.33	12.001	W.Mile		610	165	775	1,100
0500	Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
0510	161 kV		5.33	9.006			495	113	608	865
0520	345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800

33 71 23 – Insulators and Fittings

33 71 23.16 Post Insulators

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material (2018 Bare Costs)	Labor (2018 Bare Costs)	Equipment (2018 Bare Costs)	Total (2018 Bare Costs)	Total Incl O&P
0010	**POST INSULATORS**									
7400	Insulators, pedestal type	R-11	112	.500	Ea.		27.50	5.90	33.40	48
7490	See also line 33 71 39.13 1000									

33 71 26 – Transmission and Distribution Equipment

33 71 26.13 Capacitor Banks

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**CAPACITOR BANKS**									
1300	Station capacitors									
1350	Synchronous, 13 to 26 kV	R-11	3.11	18.006	MVAR	7,375	995	213	8,583	9,850
1360	46 kV		3.33	16.817		9,425	930	199	10,554	12,000
1370	69 kV		3.81	14.698		9,275	815	174	10,264	11,600
1380	161 kV		6.51	8.602		8,650	475	102	9,227	10,400
1390	500 kV		10.37	5.400		7,525	299	64	7,888	8,800
1450	Static, 13 to 26 kV		3.11	18.006		6,250	995	213	7,458	8,600
1460	46 kV		3.01	18.605		7,900	1,025	220	9,145	10,500
1470	69 kV		3.81	14.698		7,675	815	174	8,664	9,875
1480	161 kV		6.51	8.602		7,125	475	102	7,702	8,675
1490	500 kV		10.37	5.400		6,500	299	64	6,863	7,675
1600	Voltage regulators, 13 to 26 kV		.75	74.667	Ea.	280,000	4,125	885	285,010	315,000

33 71 26.23 Current Transformers

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**CURRENT TRANSFORMERS**									
4050	Current transformers, 13 to 26 kV	R-11	14	4	Ea.	3,450	221	47.50	3,718.50	4,175
4060	46 kV		9.33	6.002		10,000	330	71	10,401	11,600
4070	69 kV		7	8		10,400	445	94.50	10,939.50	12,300
4080	161 kV		1.87	29.947		33,800	1,650	355	35,805	40,100

33 71 26.26 Potential Transformers

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**POTENTIAL TRANSFORMERS**									
4100	Potential transformers, 13 to 26 kV	R-11	11.20	5	Ea.	4,925	277	59	5,261	5,875
4110	46 kV		8	7		10,100	385	82.50	10,567.50	11,800
4120	69 kV		6.22	9.003		10,700	500	106	11,306	12,700
4130	161 kV		2.24	25		23,200	1,375	296	24,871	27,900
4140	500 kV		1.40	40		69,000	2,225	475	71,700	80,000

33 71 39 – High-Voltage Wiring

33 71 39.13 Overhead High-Voltage Wiring

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P
0010	**OVERHEAD HIGH-VOLTAGE WIRING**									
0100	Conductors, primary circuits									
0110	Material handling and spotting	R-5	9.78	8.998	W.Mile		455	124	579	825
0120	For river crossing, add		11	8			405	110	515	735
0150	Conductors, per wire, 210 to 636 kcmil		1.96	44.898		12,400	2,275	620	15,295	17,800
0160	795 to 954 kcmil		1.87	47.059		24,800	2,400	650	27,850	31,600
0170	1,000 to 1,600 kcmil		1.47	59.864		42,500	3,050	825	46,375	52,500
0180	Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
0200	For river crossing, add, 210 to 636 kcmil		1.24	70.968			3,600	980	4,580	6,525
0220	795 to 954 kcmil		1.09	80.734			4,100	1,125	5,225	7,425
0230	1,000 to 1,600 kcmil		.97	90.722			4,600	1,250	5,850	8,325
0240	Over 1,600 kcmil		.87	101			5,150	1,400	6,550	9,275
0300	Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
0400	Sagging	R-5	7.33	12.001	W.Mile		610	165	775	1,100
0500	Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
0510	161 kV		5.33	9.006			495	113	608	865
0520	345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800

33 71 39.13 Overhead High-Voltage Wiring

Line	Description	Crew	Daily Output	Labor-Hours	Unit	Material (2018 Bare Costs)	Labor (2018 Bare Costs)	Equipment (2018 Bare Costs)	Total (2018 Bare Costs)	Total Incl O&P
0600	Make and install jumpers, per structure, 69 kV	R-8	3.20	15	Ea.	450	770	88	1,308	1,775
0620	161 kV		1.20	40		895	2,050	234	3,179	4,350
0640	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
0700	Spacers	R-10	68.57	.700		89.50	38.50	8.75	136.75	166
0720	For river crossings, add	"	60	.800			44	10	54	77
0800	Installing pulling line (500 kV only)	R-9	1.45	44.138	W.Mile	840	2,125	194	3,159	4,350
0810	Disposal of surplus material, high voltage conductors	R-7	6.96	6.897	Mile		285	24	309	460
0820	With trailer mounted reel stands	"	13.71	3.501	"		145	12.10	157.10	234
0900	Insulators and hardware, primary circuits									
0920	Material handling and spotting, 69 kV	R-7	480	.100	Ea.		4.13	.35	4.48	6.75
0930	161 kV		685.71	.070			2.89	.24	3.13	4.70
0950	345 to 500 kV		960	.050			2.06	.17	2.23	3.35
1000	Disk insulators, 69 kV	R-5	880	.100		91.50	5.10	1.38	97.98	109
1020	161 kV		977.78	.090		104	4.57	1.24	109.81	123
1040	345 to 500 kV		1100	.080		104	4.07	1.10	109.17	122
1060	See Section 33 71 23.16 for pin or pedestal insulator									
1100	Install disk insulator at river crossing, add									
1110	69 kV	R-5	586.67	.150	Ea.		7.60	2.07	9.67	13.75
1120	161 kV		880	.100			5.10	1.38	6.48	9.15
1140	345 to 500 kV		880	.100			5.10	1.38	6.48	9.15
1150	Disposal of surplus material, high voltage insulators	R-7	41.74	1.150	Mile		47.50	3.98	51.48	77
1300	Overhead ground wire installation									
1320	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1340	Overhead ground wire	R-5	1.76	50		3,300	2,550	690	6,540	8,200
1350	At river crossing, add		1.17	75.214			3,825	1,025	4,850	6,925
1360	Disposal of surplus material, grounding wire		41.74	2.108	Mile		107	29	136	194
1400	Installing conductors, underbuilt circuits									
1420	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1440	Conductors, per wire, 210 to 636 kcmil	R-5	1.96	44.898		12,400	2,275	620	15,295	17,800
1450	795 to 954 kcmil		1.87	47.059		24,800	2,400	650	27,850	31,600
1460	1,000 to 1,600 kcmil		1.47	59.864		42,500	3,050	825	46,375	52,500
1470	Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
1500	Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
1550	Sagging	R-5	8.80	10	W.Mile		510	138	648	915
1600	Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
1620	161 kV		5.33	9.006			495	113	608	865
1640	345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800
1700	Making and installing jumpers, per structure, 69 kV	R-8	5.87	8.177		450	420	48	918	1,175
1720	161 kV		.96	50		895	2,575	293	3,763	5,175
1740	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
1800	Spacers	R-10	96	.500		89.50	27.50	6.25	123.25	146
1810	Disposal of surplus material, conductors & hardware	R-7	6.96	6.897	Mile		285	24	309	460
2000	Insulators and hardware for underbuilt circuits									
2100	Material handling and spotting	R-7	1200	.040	Ea.		1.65	.14	1.79	2.68
2150	Disk insulators, 69 kV	R-8	600	.080		91.50	4.12	.47	96.09	107
2160	161 kV		686	.070		104	3.60	.41	108.01	121
2170	345 to 500 kV		800	.060		104	3.09	.35	107.44	120
2180	Disposal of surplus material, insulators & hardware	R-7	41.74	1.150	Mile		47.50	3.98	51.48	77
2300	Sectionalizing switches, 69 kV	R-5	1.26	69.841	Ea.	23,500	3,550	960	28,010	32,300
2310	161 kV		.80	110		26,600	5,600	1,525	33,725	39,400
2500	Protective devices		5.50	16		7,700	815	220	8,735	9,925
2600	Clearance poles, 8 poles per mile									
2650	In earth, 69 kV	R-5	1.16	75.862	Mile	6,325	3,850	1,050	11,225	13,900

33 71 39 – High-Voltage Wiring

33 71 39.13 Overhead High-Voltage Wiring		Crew	Daily Output	Labor-Hours	Unit	Material	2018 Bare Costs Labor	Equipment	Total	Total Incl O&P
0600	Make and install jumpers, per structure, 69 kV	R-8	3.20	15	Ea.	450	770	88	1,308	1,775
0620	161 kV		1.20	40		895	2,050	234	3,179	4,350
0640	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
0700	Spacers	R-10	68.57	.700		89.50	38.50	8.75	136.75	166
0720	For river crossings, add	"	60	.800			44	10	54	77
0800	Installing pulling line (500 kV only)	R-9	1.45	44.138	W.Mile	840	2,125	194	3,159	4,350
0810	Disposal of surplus material, high voltage conductors	R-7	6.96	6.897	Mile		285	24	309	460
0820	With trailer mounted reel stands	"	13.71	3.501	"		145	12.10	157.10	234
0900	Insulators and hardware, primary circuits									
0920	Material handling and spotting, 69 kV	R-7	480	.100	Ea.		4.13	.35	4.48	6.75
0930	161 kV		685.71	.070			2.89	.24	3.13	4.70
0950	345 to 500 kV		960	.050			2.06	.17	2.23	3.35
1000	Disk insulators, 69 kV	R-5	880	.100		91.50	5.10	1.38	97.98	109
1020	161 kV		977.78	.090		104	4.57	1.24	109.81	123
1040	345 to 500 kV		1100	.080		104	4.07	1.10	109.17	122
1060	See Section 33 71 23.16 for pin or pedestal insulator									
1100	Install disk insulator at river crossing, add									
1110	69 kV	R-5	586.67	.150	Ea.		7.60	2.07	9.67	13.75
1120	161 kV		880	.100			5.10	1.38	6.48	9.15
1140	345 to 500 kV		880	.100			5.10	1.38	6.48	9.15
1150	Disposal of surplus material, high voltage insulators	R-7	41.74	1.150	Mile		47.50	3.98	51.48	77
1300	Overhead ground wire installation									
1320	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1340	Overhead ground wire	R-5	1.76	50		3,300	2,550	690	6,540	8,200
1350	At river crossing, add		1.17	75.214			3,825	1,025	4,850	6,925
1360	Disposal of surplus material, grounding wire		41.74	2.108	Mile		107	29	136	194
1400	Installing conductors, underbuilt circuits									
1420	Material handling and spotting	R-7	5.65	8.496	W.Mile		350	29.50	379.50	570
1440	Conductors, per wire, 210 to 636 kcmil	R-5	1.96	44.898		12,400	2,275	620	15,295	17,800
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1470	Over 1,600 kcmil		1.35	65.185		59,500	3,325	900	63,725	71,500
1500	Joints and dead ends	R-8	6	8	Ea.	1,650	410	47	2,107	2,500
1550	Sagging	R-5	8.80	10	W.Mile		510	138	648	915
1600	Clipping, per structure, 69 kV	R-10	9.60	5	Ea.		274	62.50	336.50	480
1620	161 kV		5.33	9.006			495	113	608	865
1640	345 to 500 kV		2.53	18.972			1,050	237	1,287	1,800
1700	Making and installing jumpers, per structure, 69 kV	R-8	5.87	8.177		450	420	48	918	1,175
1720	161 kV		.96	50		895	2,575	293	3,763	5,175
1740	345 to 500 kV		.32	150		1,500	7,725	880	10,105	14,200
1800	Spacers	R-10	96	.500		89.50	27.50	6.25	123.25	146
1810	Disposal of surplus material, conductors & hardware	R-7	6.96	6.897	Mile		285	24	309	460

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

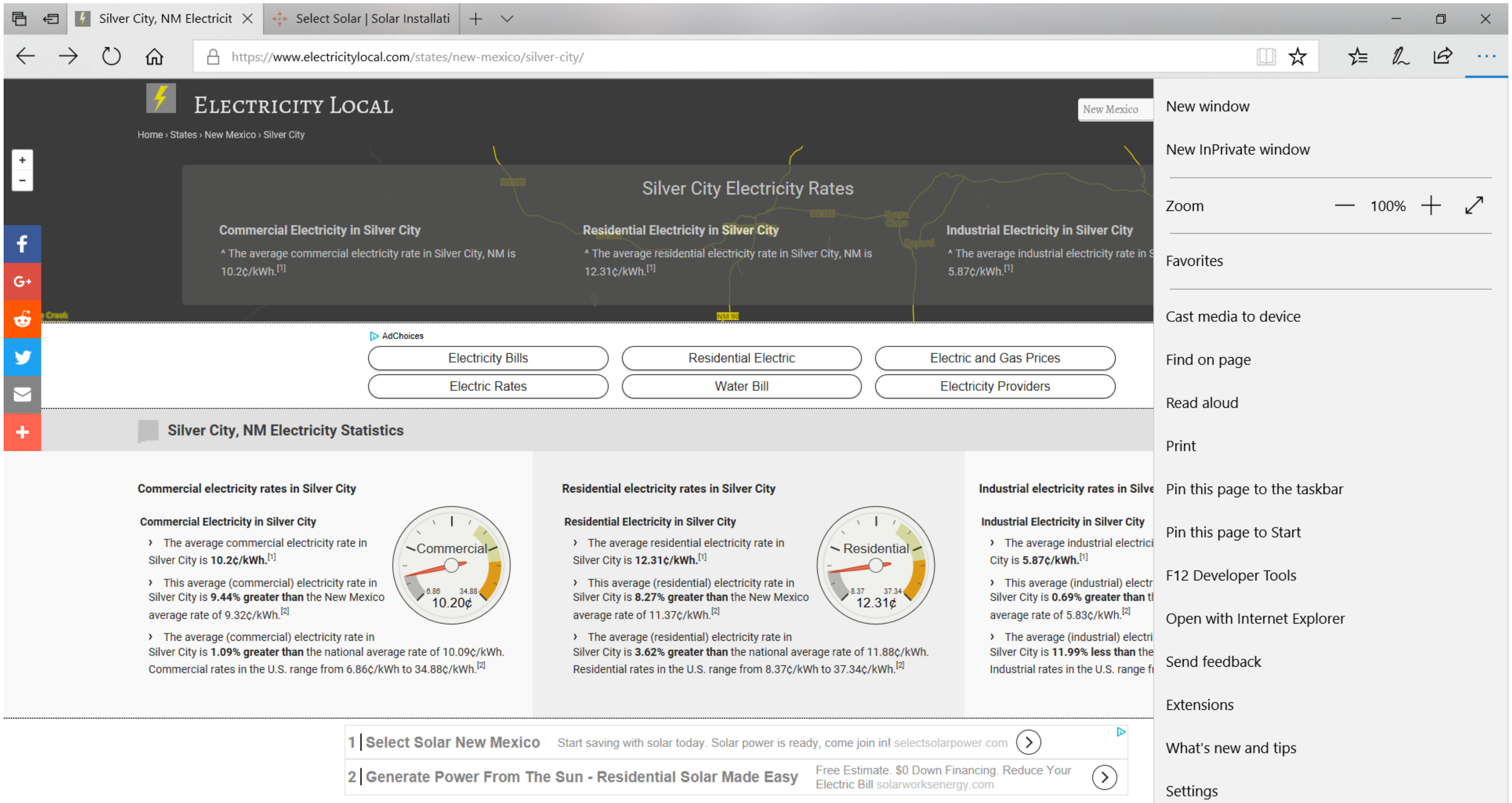
Schedule Name	Schedule Total
Water Samples	$280.00
Quote Sub Total:	$280.00
Discount:	0.00%
Misc Charges:	$0.00
Quote Total:	$280.00

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.



Silver City, NM Electricit
Select Solar | Solar Installati
https://www.electricitylocal.com/states/new-mexico/silver-city/
Electricity Local
Home › States › New Mexico › Silver City
New Mexico
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 S
5.87¢/kWh.[1]
AdChoices
Electricity Bills
Residential Electric
Electric and Gas Prices
Electric Rates
Water Bill
Electricity Providers
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]
› The average (commercial) electricity rate in Silver City is 1.09% greater than the national average rate of 10.09¢/kWh. Commercial rates in the U.S. range from 6.86¢/kWh to 34.88¢/kWh.[2]
Commercial
6.86
34.88
10.20¢
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]
› The average (residential) electricity rate in Silver City is 3.62% greater than the national average rate of 11.88¢/kWh. Residential rates in the U.S. range from 8.37¢/kWh to 37.34¢/kWh.[2]
Residential
8.37
37.34
12.31¢
Industrial electricity rates in Silve
Industrial Electricity in Silver City
› The average industrial electrici
City is 5.87¢/kWh.[1]
› This average (industrial) electr
Silver City is 0.69% greater than tl
average rate of 5.83¢/kWh.[2]
› The average (industrial) electri
Silver City is 11.99% less than the
Industrial rates in the U.S. range fi
1 | Select Solar New Mexico
Start saving with solar today. Solar power is ready, come join in! selectsolarpower.com
2 | Generate Power From The Sun - Residential Solar Made Easy
Free Estimate. $0 Down Financing. Reduce Your Electric Bill solarworksenergy.com
New window
New InPrivate window
Zoom
100%
Favorites
Cast media to device
Find on page
Read aloud
Print
Pin this page to the taskbar
Pin this page to Start
F12 Developer Tools
Open with Internet Explorer
Send feedback
Extensions
What's new and tips
Settings

Table 4 Existing and EOY 2019 PMLU Building Information

Description	Building Information					
	Dimensions				PMLU	
	L	W	H	Diameter	Previous CCP Designation	EOY 2019 Designation
Abandoned Building 1 (Shop #1)	51	28	12		Demolish	Removed [2]
Abandoned Building 2 (Shop#2)	60	48	20		Demolish	Removed [2]
Carpenter Shop	60	30	20		Industrial PMLU	Removed [2]
Chemical Lab	90	40	20		Industrial PMLU	Removed [2]
Concentrate Storage Tank			50	30	Demolish	Demolish
Explosives Storage	10	12	12		Demolish	Removed [2]
Garage	26	12	10		Demolish	Removed [2]
General Offices	118	38	20		Industrial PMLU	Removed [2]
Machine Shop	141	40	20		Industrial PMLU	Removed [2]
Magnetic Separator	15	20	14		Demolish	Demolish
MCC (Power Generation) Building	40	24	20		Industrial PMLU	Removed [2]
Mill Building #1 and Concentrator	160	140	70		Demolish	Demolish
Mill Building #2	197	140	70		Demolish	Demolish
Mine Change Room	152	50	20		Industrial PMLU	Removed [2]
No. 2 Mill Secondary Crusher Building	36	38	50		Demolish	Demolish
No. 2 Mill Stacker	820	20	15		Demolish	Demolish
No. 3 Headframe	30	50	100		Demolish	Removed [2]
No. 3 Hoist/Comp Building	150	45	28		Demolish	Removed [2]
No. 4 Headframe and Fan	50	13	42		Demolish	Removed [2]
No. 4 Hoist House and MCC	20	16	14		Demolish	Removed [2]
Oil Storage Building	37	26	16		Demolish	Removed [2]
Ore Bin (large)			90	30	Demolish	Demolish
Ore Bin (large)			90	30	Demolish	Demolish
Ore Bin (small)			70	30	Demolish	Demolish
Pioneer Crusher	35	25	40		Demolish	Removed [2]
Powder Magazine 1	40	20	20		Demolish	Removed [2]
Powder Magazine 2	40	20	20		Demolish	Removed [2]
Primary Crusher	70	50	60		Demolish	Demolish
Pump House (near Mill No. 2)	25	25	25		Demolish	Removed [2]
Pump House and Shed for Thickener	10	10	14		Demolish	Demolish
Safety (Engineering) Building	60	30	12		Industrial PMLU	Removed [2]
Scale House (Guard Shack)	10	10	10		Demolish	Demolish
Sewage Treatment Facility	25	40	12		Industrial PMLU	Removed[2]
Small Truck Shop	102	40	20		Industrial PMLU	Demolish
Stacker Hoist	28	23	18		Demolish	Demolish
Substation No. 2	66	50	30		Industrial PMLU	Demolish
Surge Tank			18	50	Industrial PMLU	Industrial PMLU
Thickener MCC	18	18	12		Demolish	Demolish
Thickener MCC	12	22	15		Demolish	Demolish
Thickener Tank (100-ft diam.)			14	100	Demolish	Demolish
Thickener Tank (60-ft diam.)			20	60	Demolish	Demolish
Warehouse	231	40	21		Industrial PMLU	Removed [2]
Water Tank (near stacker and stacker hoist)			120	40	Industrial PMLU	Industrial PMLU
Water Tank (on Hanover Mountain)			30	25	Demolish	Demolish (moved to new location)
Water Tank (on Hanover Mountain)			20	15	Demolish	Removed [2]
Water Tank (on Hanover Mountain)			50	35	Demolish	Demolish (moved to new location)

[1] Assume any new replacement building constructed prior to 2019 Full Build Out reclamation will have an Industrial PMLU

[2] Located within the estimated Hanover Mountain Mine (Hanover Mountain Deposit)/ Cobre Haul Road footprint. Removed Prior to EOY 2019.

Note: The following structures listed in GR002RE 01-1, Appendix D, have been removed: Unleaded Gasoline Above-ground Storage Tank, Underground Explosives Storage, Underground Fuel Farm, PCB Storage Building, Underground Mine Operations Office, and Ambulance Garage. Building dimensions have been updated; the No. 3 Headframe and No. 4 Headframe and Fan are listed as separate buildings.

Table 8 Earthwork Capital Costs

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital			
Tailing Ponds			
Magnetite Tailing Pond	$840,196	$237,776	**$1,077,972**
Main Tailings Impoundment	$2,313,012	$654,582	**$2,967,594**
Subtotal	**$3,153,208**	**$892,358**	**$4,045,566**
Waste Rock and Ore Piles			
SWRDF	$8,860,289	$2,507,462	**$11,367,751**
Hanover Mountain Deposit	$1,122,318	$317,616	**$1,439,934**
No. 3 Shaft Stockpile**	$56,522	$15,996	**$72,518**
Low Grade WRF	$323,121	$91,443	**$414,565**
Subtotal	**$10,362,250**	**$2,932,517**	**$13,294,767**
Continental Pit			
Subtotal	**$ 84,223**	**$ 23,835**	**$108,058**
Surface Impoundments			
Subtotal	**$97,518**	**$27,598**	**$125,116**
Historic Sites			
Pearson-Barnes Mine Area	**$163,263**	**$46,204**	**$209,467**
Other Disturbed Areas			
Haul and Exploration Roads	$75,291	$21,307	**$96,598**
Dist. Area Near SWRDF**	$17,895	$5,064	**$22,959**
Contingency Disturbance Area**	$632,427	$178,977	**$811,404**
Borrow Areas**	$47,750	$13,513	**$61,263**
Wells	$7,421	$2,100	**$9,521**
Subtotal	**$780,783**	**$220,962**	**$1,001,744**
Demolition			
Buildings	$1,389,430	$393,209	**$1,782,638**
Cover	$102,002	$28,867	**$130,869**
Rip & Revegetation	$1,068	$302	**$1,370**
Subtotal	**$1,492,500**	**$422,378**	**$1,914,878**
Total Capital Cost	**$16,133,746**	**$4,565,850**	**$20,699,596**
CHR Total Capital Cost*	**$433,176**	**$122,589**	**$555,764**
Total	**$16,566,922**	**$4,688,439**	**$21,255,360**

*Updated from the 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

**Added since 2014 CCP

Table 9 Earthwork O&M Costs

Total Earthwork O&M Cost[1]				
Period (years)	Erosion Control	Road Maintenance	Revegetation Maintenance	Total (Current Year $)
Overall Site				
0 to 19	$501,874	$460,107	$256,388	**$1,218,370**
20 to 39	$308,846	$296,843	$0	**$605,689**
40 to 99	$231,634	$445,265	$0	**$676,899**
Totals	**$1,042,355**	**$1,202,215**	**$256,388**	**$2,500,958**
CHR[2]				
0 to 11	$74,610	-	$17,384	**$91,994**
Totals	**$74,610**	**$0**	**$17,384**	**$91,994**

[1] Earthwork O&M costs include 23.3% indirect costs.

[2] Updated from the 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

Table 10 Water Management Costs

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement			
Ponds and Tanks	$520,595	$147,328	$667,923
Pumps	$659,426	$186,618	$846,044
Pipelines	$0	$0	$0
Electrical	$0	$0	$0
Subtotal	**$1,180,021**	**$333,946**	**$1,513,967**
Removal[1]			
Pumps	$149,324	$42,259	$191,583
Pipelines	$114,136	$32,301	$146,437
Electrical	$52,381	$14,824	$67,205
Subtotal	**$315,841**	**$89,384**	**$405,225**
Operations and Maintenance			
Ponds and Tanks	$225,298	$38,301	$263,599
Pumps	$113,383	$19,275	$132,658
Pipelines	$128,879	$21,909	$150,788
Electrical Infrastructure	$117,759	$20,019	$137,778
Materials			
Electricity and Fuel	$30,408	$5,169	$35,578
Environmental Sampling	$297,192	$50,523	$347,715
Subtotal	**$912,920**	**$155,196**	**$1,068,116**
Total Estimated Cost	**$2,408,782**	**$578,526**	**$2,987,308**

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

May 19, 2018

		Yr 1-10	Yr 11-100
	Escalation	Discount	Discount
	Rate	Rate	Rate
Earthwork	3.14%	7.27%	7.42%
Water Management	2.43%	7.27%	7.42%

Component	Current Cost	NPV
Earthwork	$23,848,312	$21,556,942
Water Management	$2,987,308	$2,380,830
Total	**$26,835,620**	**$23,937,772**

	Earthwork						Water Management	
Year	Earthwork[1] Current Cost	O&M Reveg Mnt[2] Current Cost	O&M[3] Current Cost	Haul Road O&M[4] Current Cost	Total Earthwork Current Cost	Earthwork NPV	Water Management[5] Current Cost	Water Management NPV
1	6,953,472	-	-	-	6,953,472	6,953,472	1,237,272	1,237,272
2	6,953,472		-	7,666	6,961,138	6,693,127	72,205	68,947
3	6,953,472	21,366	12,669	7,666	6,995,172	6,466,899	72,205	65,836
4	394,945	21,366	25,337	7,666	449,314	399,389	72,205	62,866
5	-	21,366	38,006	7,666	67,037	57,294	191,118	158,890
6	-	21,366	50,674	7,666	79,706	65,499	415,144	329,567
7	-	21,366	63,343	7,666	92,374	72,987	57,650	43,701
8	-	21,366	76,011	7,666	105,043	79,801	57,650	41,730
9	-	21,366	76,011	7,666	105,043	76,729	57,650	39,847
10	-	21,366	76,011	7,666	105,043	73,775	94,432	62,325
11	-	21,366	76,011	7,666	105,043	69,950	54,959	34,155
12	-	21,366	76,011	7,666	105,043	67,163	54,959	32,569
13	-	21,366	76,011	7,666	105,043	64,487	301,897	170,594
14	-	21,366	45,127	-	66,492	39,194	2,850	1,536
15	-	-	45,127	-	45,127	25,540	2,850	1,464
16	-	-	45,127	-	45,127	24,522	2,850	1,396
17	-	-	45,127	-	45,127	23,545	2,850	1,331
18	-	-	45,127	-	45,127	22,607	2,850	1,270
19	-	-	45,127	-	45,127	21,706	2,850	1,211
20	-	-	45,127	-	45,127	20,842	2,850	1,154
21	-	-	30,284	-	30,284	13,429	2,850	1,101
22	-	-	30,284	-	30,284	12,894	2,850	1,050
23	-	-	30,284	-	30,284	12,381	2,850	1,001

	Earthwork						Water Management	
Year	Earthwork[1] Current Cost	O&M Reveg Mnt[2] Current Cost	O&M[3] Current Cost	Haul Road O&M[4] Current Cost	Total Earthwork Current Cost	Earthwork NPV	Water Management[5] Current Cost	Water Management NPV
24	-	-	30,284	-	30,284	11,887	2,850	954
25	-	-	30,284	-	30,284	11,414	2,850	910
26	-	-	30,284	-	30,284	10,959	2,850	868
27	-	-	30,284	-	30,284	10,522	2,850	827
28	-	-	30,284	-	30,284	10,103	2,850	789
29	-	-	30,284	-	30,284	9,701	2,850	752
30	-	-	30,284	-	30,284	9,314	2,850	717
31	-	-	30,284	-	30,284	8,943	2,850	684
32	-	-	30,284	-	30,284	8,587	2,850	652
33	-	-	30,284	-	30,284	8,244	2,850	622
34	-	-	30,284	-	30,284	7,916	2,850	593
35	-	-	30,284	-	30,284	7,601	2,850	566
36	-	-	30,284	-	30,284	7,298	2,850	539
37	-	-	30,284	-	30,284	7,007	2,850	514
38	-	-	30,284	-	30,284	6,728	2,850	490
39	-	-	30,284	-	30,284	6,460	2,850	468
40	-	-	30,284	-	30,284	6,202	2,850	446
41	-	-	11,282	-	11,282	2,218	2,850	425
42	-	-	11,282	-	11,282	2,130	2,850	405
43	-	-	11,282	-	11,282	2,045	2,850	387
44	-	-	11,282	-	11,282	1,964	2,850	369
45	-	-	11,282	-	11,282	1,885	2,850	351
46	-	-	11,282	-	11,282	1,810	2,850	335
47	-	-	11,282	-	11,282	1,738	2,850	320
48	-	-	11,282	-	11,282	1,669	2,850	305
49	-	-	11,282	-	11,282	1,602	2,850	291
50	-	-	11,282	-	11,282	1,539	2,850	277
51	-	-	11,282	-	11,282	1,477	2,850	264
52	-	-	11,282	-	11,282	1,418	2,850	252
53	-	-	11,282	-	11,282	1,362	2,850	240
54	-	-	11,282	-	11,282	1,308	2,850	229

	Earthwork						Water Management	
Year	Earthwork[1] Current Cost	O&M Reveg Mnt[2] Current Cost	O&M[3] Current Cost	Haul Road O&M[4] Current Cost	Total Earthwork Current Cost	Earthwork NPV	Water Management[5] Current Cost	Water Management NPV
55	-	-	11,282	-	11,282	1,256	2,850	218
56	-	-	11,282	-	11,282	1,206	2,850	208
57	-	-	11,282	-	11,282	1,158	2,850	199
58	-	-	11,282	-	11,282	1,111	2,850	189
59	-	-	11,282	-	11,282	1,067	2,850	181
60	-	-	11,282	-	11,282	1,025	2,850	172
61	-	-	11,282	-	11,282	984	2,850	164
62	-	-	11,282	-	11,282	945	2,850	157
63	-	-	11,282	-	11,282	907	2,850	149
64	-	-	11,282	-	11,282	871	2,850	142
65	-	-	11,282	-	11,282	836	2,850	136
66	-	-	11,282	-	11,282	803	2,850	129
67	-	-	11,282	-	11,282	771	2,850	123
68	-	-	11,282	-	11,282	740	2,850	118
69	-	-	11,282	-	11,282	711	2,850	112
70	-	-	11,282	-	11,282	682	2,850	107
71	-	-	11,282	-	11,282	655	2,850	102
72	-	-	11,282	-	11,282	629	2,850	97
73	-	-	11,282	-	11,282	604	2,850	93
74	-	-	11,282	-	11,282	580	2,850	88
75	-	-	11,282	-	11,282	557	2,850	84
76	-	-	11,282	-	11,282	535	2,850	80
77	-	-	11,282	-	11,282	513	2,850	77
78	-	-	11,282	-	11,282	493	2,850	73
79	-	-	11,282	-	11,282	473	2,850	70
80	-	-	11,282	-	11,282	454	2,850	67
81	-	-	11,282	-	11,282	436	2,850	63
82	-	-	11,282	-	11,282	419	2,850	60
83	-	-	11,282	-	11,282	402	2,850	58
84	-	-	11,282	-	11,282	386	2,850	55
85	-	-	11,282	-	11,282	371	2,850	52
86	-	-	11,282	-	11,282	356	2,850	50

	Earthwork						Water Management	
Year	Earthwork[1] Current Cost	O&M Reveg Mnt[2] Current Cost	O&M[3] Current Cost	Haul Road O&M[4] Current Cost	Total Earthwork Current Cost	Earthwork NPV	Water Management[5] Current Cost	Water Management NPV
87	-	-	11,282	-	11,282	342	2,850	48
88	-	-	11,282	-	11,282	328	2,850	45
89	-	-	11,282	-	11,282	315	2,850	43
90	-	-	11,282	-	11,282	303	2,850	41
91	-	-	11,282	-	11,282	291	2,850	39
92	-	-	11,282	-	11,282	279	2,850	38
93	-	-	11,282	-	11,282	268	2,850	36
94	-	-	11,282	-	11,282	257	2,850	34
95	-	-	11,282	-	11,282	247	2,850	33
96	-	-	11,282	-	11,282	237	2,850	31
97	-	-	11,282	-	11,282	228	2,850	30
98	-	-	11,282	-	11,282	219	2,850	28
99	-	-	11,282	-	11,282	210	2,850	27
100	-	-	11,282	-	11,282	201	2,850	26
Total	21,255,360	256,388	2,244,570	91,994	23,848,312	21,556,942	2,987,308	2,380,830

Notes:

1. Includes all Earthwork Direct and Indirect costs - compare to total of Table 8 from CCP. Vegetation Costs are started in year 2 and distributed equally at $394,945 through year 4 (which is the total cost of primary revegetation for all facilities - totalling $1,184,835).

2. Includes all revegetation maintenance costs for the Continental Mine proper as shown in Table 9 - excludes CHR Reveg Mnt costs. Distributed in years 3 through 14

3. Copied from column "N" of tab "20 O&M" from work book titled "Cobre_OM_2018_NOBS_20180517" - cost estimator provided cash flow. Note that the sum of this column and the previous column - "O&M Reveg Mnt" = the Overall Site O&M costs shown in Table 9 of the Revised CCP.

4. Cobre/Chino connecting haul road O&M from Table 9 distributed over 12 years.

5. Cash flow for all water management costs (capital and O&M combined), cash flow copied from tab "3 WM cash flow" in work book titled "Cobre_WM_20180517"
Note that the sum of this column = total water management costs shown in Table 10 of the Revised CCP.

EARTH WORK RECLAMATION ESCALATION RATE -- GEOMETRIC MEAN METHOD

Current Calculation	2017	**COBRE**	
Category	Rate	% of Project	% of Escalation Rate
Earthwork Labor	2.70%	16%	0.42%
#2 Diesel Fuel	4.43%	17%	0.75%
Machinery & Equipment	2.92%	67%	1.97%
Earth Work Reclamation Escalation Rate:			**3.14%**

http://data.bls.gov/cgi-bin/srgate

Employment, Hours, and Earnings from the Current Employment Statistics survey (National)

Original Data Value

Series Id: CEU2023700003

Not Seasonally Adjusted

Series Title: Average hourly earnings of all employees, heavy and civil engineering construction

Super Sector: Construction

Industry: Heavy and civil engineering construction

NAICS Code: 237

Data Type: AVERAGE HOURLY EARNINGS OF ALL EMPLOYEES

Years: 2006 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
2006			21.99	22.35	22.48	22.83	22.67	22.79	23.09	23.23	23.01	23.03	22.75	N/A	N/A
2007	22.55	22.36	22.35	22.75	22.96	23.18	23.54	23.46	23.75	23.56	23.59	23.89	23.16	1.82%	1.02
2008	23.62	23.42	23.54	23.61	23.90	23.75	24.02	24.36	24.37	24.43	24.42	24.80	24.02	3.71%	1.04
2009	24.51	24.52	24.65	24.52	24.68	24.63	24.69	24.88	24.98	25.47	25.37	25.36	24.86	3.48%	1.03
2010	25.51	25.63	25.20	25.04	25.23	25.21	25.43	25.57	25.63	25.90	25.72	25.76	25.49	2.54%	1.03
2011	25.98	26.12	25.84	25.76	25.86	26.02	26.20	26.37	26.37	26.36	26.26	26.28	26.12	2.48%	1.02
2012	26.06	26.41	26.51	26.15	26.23	26.38	26.70	26.45	26.70	26.61	26.62	26.85	26.47	1.36%	1.01
2013	26.62	26.85	26.38	26.44	26.53	26.56	26.77	26.88	27.11	27.03	26.85	27.31	26.78	1.15%	1.01
2014	27.04	27.57	27.15	27.23	27.11	27.40	27.52	27.57	28.03	28.19	28.12	28.16	27.59	3.04%	1.03
2015	28.43	28.24	28.66	28.72	28.54	28.38	28.59	28.92	28.58	29.08	28.96	29.05	28.68	3.94%	1.04
2016	28.79	28.84	29.28	29.41	29.36	29.38	29.49	29.55	29.75	30.08	29.57	29.79	29.44	2.66%	1.03
2017	29.93	29.71	30.29	29.95	30.26	30.46	30.64	30.71	31.27	30.87	30.77	30.87	30.48	3.52%	1.04
Arithmetic mean:														2.70%	2.70%
Geometric mean:														N/A	**2.70%**

P : Preliminary. All indexes are subject to revision four months after original publication.

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPS057303
Seasonally Adjusted
Group: Fuels and related products and power
Item: No. 2 diesel fuel
Base Date: 198200
Years: 1985 to 2017

Data:*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
1985						80.5	78.7	78.1	79.4	80.1	82.1	84.7	80.5	N/A	N/A
1986	79.7	63.7	49.9	48.9	45.1	44.0	37.4	40.0	46.0	41.5	41.5	43.8	48.5	N/A	N/A
1987	48.1	52.9	49.9	50.7	52.8	56.1	59.9	63.6	59.3	58.7	59.1	55.0	55.5	0.15	1.15
1988	52.1	52.1	51.4	53.6	55.1	53.0	50.8	49.8	47.6	40.4	44.1	47.5	49.8	-0.10	0.90
1989	52.4	55.8	58.9	63.0	58.2	55.6	56.1	56.2	59.9	61.8	61.5	66.5	58.8	0.18	1.18
1990	85.1	61.2	62.5	62.6	60.0	56.7	55.2	75.1	86.8	95.9	91.1	88.8	73.4	0.25	1.25
1991	82.5	77.2	63.3	61.3	61.6	61.3	62.6	64.4	64.3	61.4	65.2	62.0	65.6	-0.11	0.89
1992	55.5	59.0	57.0	59.2	62.8	68.5	68.0	65.0	63.9	64.1	60.5	59.6	61.9	-0.06	0.94
1993	61.9	62.8	65.5	64.5	64.3	63.3	59.9	54.6	58.6	62.1	59.1	50.6	60.6	-0.02	0.98
1994	52.6	58.8	58.6	55.1	54.0	54.9	58.2	58.5	56.1	55.3	56.1	54.3	56.0	-0.08	0.92
1995	55.3	54.7	57.4	58.9	59.2	58.1	55.3	56.3	56.6	55.3	56.5	59.9	57.0	0.02	1.02
1996	63.8	61.0	64.8	75.9	74.6	67.2	68.4	67.3	71.4	75.8	72.4	76.1	69.9	0.23	1.23
1997	74.4	74.8	70.0	66.3	62.7	63.6	60.4	63.1	58.4	60.5	61.5	58.9	64.6	-0.08	0.92
1998	54.8	53.4	50.2	51.0	49.9	47.7	46.3	44.7	44.6	44.1	43.1	39.4	47.4	-0.27	0.73
1999	41.2	38.6	46.3	54.5	53.2	55.6	61.8	66.9	63.4	63.1	66.8	73.8	57.1	0.20	1.20
2000	80.3	89.7	92.5	84.0	82.3	87.5	90.8	90.5	104.6	102.1	105.4	107.3	93.1	0.63	1.63
2001	103.4	97.7	85.1	88.7	92.5	91.5	81.9	80.3	83.6	69.8	70.0	58.9	83.6	-0.10	0.90
2002	61.0	63.6	71.2	75.1	75.4	74.8	78.3	78.4	85.9	90.4	85.1	92.7	77.7	-0.07	0.93
2003	106.4	133.6	129.1	99.9	86.8	89.5	93.5	96.3	84.2	95.3	93.3	103.8	101.0	0.30	1.30
2004	117.1	113.1	109.3	116.0	117.3	112.8	122.8	132.7	133.1	157.2	160.2	144.7	128.0	0.27	1.27
2005	153.5	162.4	177.7	169.1	168.2	186.3	188.3	195.7	201.3	246.6	204.5	205.0	188.2	0.47	1.47
2006	213.8	215.2	208.6	224.3	234.9	240.2	233.5	243.1	194.4	189.7	194.9	209.7	216.9	0.15	1.15
2007	196.9	212.7	220.5	228.2	221.0	221.8	243.5	222.3	239.9	246.6	285.0	287.1	235.5	0.09	1.09
2008	305.0	314.3	343.4	341.9	382.5	402.9	417.3	340.6	346.8	286.1	224.3	175.9	323.4	0.37	1.37
2009	172.0	158.9	135.7	156.7	161.1	187.1	175.3	198.0	194.0	204.0	214.4	214.1	180.9	-0.44	0.56
2010	245.4	216.2	217.7	222.2	228.9	222.5	228.0	226.1	230.0	244.7	251.0	268.3	233.4	0.29	1.29
2011	286.3	298.3	313.3	318.8	322.3	337.0	341.5	301.2	315.6	310.6	329.8	319.9	316.2	0.35	1.35
2012	343.6	345.1	348.5	331.7	319.7	292.2	298.5	316.9	326.7	346.9	317.8	328.6	326.4	0.03	1.03
2013	335.0	351.9	323.2	318.6	301.7	304.5	311.0	312.5	312.4	311.2	307.9	324.4	317.9	-0.03	0.97
2014	324.0	330.9	320.3	319.0	310.3	308.5	307.2	300.3	287.9	277.1	273.1	237.0	299.6	-0.06	0.94
2015	191.8	196.8	194.5	184.0	198.6	198.5	193.6	185.2	161.3	169.6	167.9	134.8	181.4	-0.39	0.61
2016	125.2	116.5	120.2	123.7	141.6	155.2	157.3	146.6	155.3	156.1	157.5	163.8	143.3	-0.21	0.79
2017	169.2	168.0	162.5	163.0	170.2	171.3	179.2	184.9	194.5	208.7	224.4	230.9	185.6	0.30	1.30
Arithmetic mean:														7.32%	7.32%
Geometric mean:														N/A	**4.43%**

P : Preliminary. All indexes are subject to revision four months after original publication.
* : Data is regularly evaluated per revised seasonal factor every year

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPU112D
Not Seasonally Adjusted
Group: Machinery and equipment
Item: Off-highway, equipment, ex. parts
Base Date: 199912
Years: 2000 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
1982	97.8	98.2	98.8	99.4	100.1	100.5	100.3	100.6	100.9	100.8	101.2	101.4	100	N/A	N/A
1983	101.2	101.2	101.6	101.4	101.8	102	102.6	102.8	103	102.9	103.1	103.1	102.2	2.22%	1.02
1984	102.9	103	103.1	103.2	103.1	103.4	103.5	103.6	103.7	103.7	103.8	103.9	103.4	1.16%	1.01
1985	104.3	104.4	104.4	104.5	104.4	104.3	104.2	104.3	104.3	104.5	104.2	104.4	104.4	0.91%	1.01
1986	104.3	104.4	104.6	104.8	104.8	104.4	104.3	104.3	104.4	104.6	106.5	106.7	104.8	0.47%	1.00
1987	105.6	105.8	105.9	106	107.5	107.1	106.8	106.8	107.5	107.6	107.9	108.1	106.9	1.95%	1.02
1988	108.8	110.2	109.9	110.4	110.7	110.2	112.8	112.9	113.4	113.8	114.1	114.6	111.8	4.62%	1.05
1989	116.7	116.4	117.9	118.5	119.3	122.7	121.1	121.6	121.9	122.3	122.5	122.8	120.3	7.59%	1.08
1994	134.9	134.8	134.9	135.3	135.5	135.7	136	136.3	136.4	136.8	137.1	137.2	135.9	12.97%	1.13
1995	137.7	138.5	138.4	138.4	138.6	138.8	139	139.3	139.5	139.8	140.1	140.9	139.1	2.34%	1.02
1996	140.4	141.8	141.7	141.7	141.8	143.1	143.2	143.5	143.8	144.1	144.4	144.7	142.9	2.71%	1.03
1997	144.7	144.8	144.9	146.1	146.2	146.1	146.3	146.6	146.9	147.2	147.5	147.8	146.3	2.39%	1.02
1998	148.7	148.7	149.4	149.1	149.4	149.7	149.9	150.3	150.6	150.9	151.1	151.7	150.0	2.53%	1.03
1999	150.1	151.3	151.2	152.3	152.6	152.9	153.1	153.4	153.7	154	154.3	154.6	152.8	1.89%	1.02
1999	Change to new Series per note below											100	100		
2000	101.2	101.3	101.3	101.4	101.4	101.4	101.4	101.4	101.4	101.4	101.4	101.4	101.4	1.37%	1.01
2001	101.6	101.6	101.6	101.7	101.7	101.7	101.7	101.7	101.7	102.2	102.3	102.4	101.8	0.45%	1.00
2002	102.9	102.9	102.9	102.9	102.9	102.9	102.9	103.1	103.1	103.1	103.3	103.3	103.0	1.17%	1.01
2003	104.2	104.2	104	104	104.1	104.1	104.1	104.1	104.1	104.1	104.5	104.6	104.2	1.12%	1.01
2004	105.4	105.7	105.8	106.7	106.8	107	108.7	108.8	108.8	108.1	108.1	107.9	107.3	3.02%	1.03
2005	109.9	109.7	109.7	109.7	111.6	113.1	113.1	113.1	113.1	113.5	113.7	114	112.0	4.38%	1.04
2006	115.9	116.1	116.2	116.2	115.9	116	116	116	116.4	116.7	116.7	116.6	116.2	3.76%	1.04
2007	117.7	117.7	117.4	117.5	117.5	117.5	117.5	117.6	117	117.9	118.2	118.4	117.7	1.23%	1.01
2008	118.3	119.7	119.9	121.6	121.6	122	122.3	122.7	122.8	122.6	123.7	124.9	121.8	3.56%	1.04
2009	124.6	125.5	126.5	127.6	128.6	129.7	129.9	129.2	127.9	127.1	128.3	131.1	128.0	5.05%	1.05
2010	129.1	129.6	130	128.5	128.8	129.1	129.9	130.1	133.7	130.1	129.2	131.5	130.0	1.54%	1.02
2011	131.1	130.8	132.2	132	132.8	134.3	135.5	137.5	137.4	139	138.7	137.2	134.9	3.78%	1.04
2012	143.9	147.6	145.7	146.9	147.7	146	146.1	149.4	145.6	149.3	148.4	150.6	147.3	9.19%	1.09
2013	151.8	151.8	149.1	150.8	151.4	153	152.8	152.8	152.8	153	153.1	153.1	152.1	3.30%	1.03
2014	155.6	155.6	155.6	155.1	155.1	155.1	153.3	153.3	153.3	153.7	154.8	154.8	154.6	1.63%	1.02
2015	157.3	157.3	157.3	157	157	157	157.2	157.2	157.2	157.3	157.3	157.4	157.2	1.68%	1.02
2016	159.8	160.1	159.3	159	159	159	159.1	159.1	159.1	159.1	159.1	159.1	159.2	1.29%	1.01
2017	160.1	160.1	160.1	159.9	160	160	159.5	159.5	159.5	159.8	160	160	159.9	0.40%	1.00
Arithmetic mean:														2.96%	2.96%
Geometric mean:														N/A	**2.92%**

P : Preliminary. All indexes are subject to revision four months after original publication.
* : WPS1129 was discontinued on 1999. WPU112D is the closest report to the old WPS1129 report.

WATER MANAGEMENT ESCALATION RATE -- GEOMETRIC MEAN METHOD

Current Calculation	2017	**COBRE**	
Category	Rate	% of Project	% of Escalation Rate
Ponds and Tanks	2.10%	29%	0.61%
Industrial Pumps	4.45%	8%	0.34%
Pipelines	0.43%	3%	0.01%
Electrical Infrastructure:	2.32%	2%	0.04%
Machinery & Equipment	2.92%	3%	0.08%
#2 Diesel Fuel	4.43%	1%	0.04%
Electricity	3.28%	1%	0.04%
Water Management Labor	2.33%	51%	1.18%
Earthwork Labor	2.70%	3%	0.07%
		100.0%	2.43%

Water Management Reclamation Escalation Rate: **2.43%**

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPU10720104
Not Seasonally Adjusted
Series Title: PPI Commodity data for Metals and metal products-Storage and other non-pressure tanks
Group: Metals and metal products
Item: Storage and other non-pressure tanks
Base Date: 199412
Years: 1994 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
1994												100.0	100.0	N/A	N/A
1995	101.2	101.2	101.2	104.2	104.7	104.7	104.7	105.1	105.1	105.5	105.5	105.5	104.1	4.05%	1.04
1996	105.5	105.5	105.8	106.2	106.2	106.2	106.2	106.2	106.6	106.7	106.7	106.6	106.2	2.07%	1.02
1997	106.6	106.6	106.6	107.2	107.2	107.6	107.6	108.6	116.0	112.5	113.6	109.0	109.1	2.72%	1.03
1998	109.5	109.5	110.5	107.3	107.5	110.7	110.8	107.9	115.7	115.7	115.2	112.4	111.1	1.80%	1.02
1999	114.7	113.8	113.8	113.8	115.6	118.0	115.7	115.7	115.7	115.3	116.9	116.9	115.5	3.99%	1.04
2000	116.0	116.1	117.5	116.7	118.4	118.3	118.3	116.6	116.6	116.6	116.6	116.6	117.0	1.33%	1.01
2001	116.6	116.6	116.6	114.3	115.7	115.7	115.9	115.9	115.9	115.9	115.9	115.9	115.9	-0.95%	0.99
2002	115.8	114.7	113.8	113.8	117.5	117.3	115.0	115.6	118.9	120.1	120.1	116.5	116.6	0.59%	1.01
2003	116.5	116.4	118.0	118.6	117.3	115.6	115.5	115.8	116.0	116.0	116.8	116.2	116.6	-0.03%	1.00
2004	117.2	117.7	121.7	122.2	123.9	127.2	129.0	132.5	137.8	148.3	151.7	150.5	131.6	12.94%	1.13
2005	152.8	153.0	153.0	151.9	150.1	150.0	150.0	152.1	153.1	153.3	152.8	155.5	152.3	15.69%	1.16
2006	155.5	156.2	156.2	156.9	156.9	155.2	155.2	153.8	153.8	152.5	153.6	159.9	155.5	2.08%	1.02
2007	159.9	162.4	162.4	163.2	163.8	163.6	163.0	161.5	161.5	162.1	162.1	160.2	162.1	4.29%	1.04
2008	160.8	162.9	164.9	166.3	167.6	163.1	168.3	173.2	173.2	174.9	174.9	172.7	168.6	3.96%	1.04
2009	173.5	173.9	173.9	167.0		169.9	169.9	169.0	169.0	171.3	170.1	168.8	170.6	1.19%	1.01
2010	168.8	166.5	166.5	168.4	168.4	167.5	167.5	164.8	164.8	168.2	168.2	166.8	167.2	-1.98%	0.98
2011	166.8	162.0	162.0	155.5	155.5	155.5	156.9	156.6	156.7	158.1	160.3	160.7	158.9	-4.97%	0.95
2012	159.7	159.7	161.7	161.7	161.8	161.8	162.8	161.8	160.5	160.2	160.0	160.5	161.0	1.34%	1.01
2013	159.5	158.6	159.0	159.1	159.1	159.1	158.6	158.6	158.6	159.2	159.2	159.5	159.0	-1.25%	0.99
2014	159.6	160.3	159.7	159.7	159.7	160.0	160.0	160.1	160.3	161.1	161.7	161.7	160.3	0.83%	1.01
2015	161.8	161.4	157.3	157.3	157.3	155.4	155.4	154.6	154.4	153.3	153.3	153.3	156.2	-2.55%	0.97
2016	153.1	152.4	153.0	153.0	153.9	155.6	155.6	155.6	155.6	155.6	156.4	156.7	154.7	-0.98%	0.99
2017	158.0	158.3	159.6	160.3	160.6	160.8	160.8	163.2	163.2	163.2	163.2	165.6	161.4	4.33%	1.04
Arithmetic mean:														2.20%	2.20%
Geometric mean:														N/A	**2.10%**

P : Preliminary. All indexes are subject to revision four months after original publication.

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPU114102
Not Seasonally Adjusted
Group: Machinery and equipment
Item: Industrial pumps, except hydraulic fluid power pumps
Base Date: 198200
Years: 1971 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
1971	33.1	33.2	33.4	33.5	33.7	33.3	33.3	33.6	33.6	33.6	33.6	33.6	33.5	N/A	N/A
1972	33.7	34.2	34.3	34.3	33.8	34.5	34.6	34.6	34.6	34.6	34.7	34.7	34.4	2.69%	1.03
1973	34.7	35	35.1	35.3	35.3	36.2	36.1	36	36.2	36.7	37	37.2	35.9	4.36%	1.04
1974	37.4	37.6	38.9	40.2	42.3	44.7	46.9	47.6	48	49.3	51.3	51.6	44.6	24.23%	1.24
1975	52.3	53	53	52.7	52.8	52.8	53.3	53.4	53.7	53.8	54.1	54	53.2	19.28%	1.19
1976	54.2	55.1	55.5	55.7	55.4	55.5	55.6	56	56.5	56.6	56.5	57.5	55.8	4.89%	1.05
1977	58.2	58.1	58.3	58.3	58.9	59.5	60.3	60.2	60.7	61	61.5	61.6	59.7	6.99%	1.07
1978	61.9	62.3	62.5	63.6	63.8	64.6	64.9	65	65.4	65.6	66.9	67.1	64.5	8.04%	1.08
1979	67.3	67.3	68.1	68.6	69.7	69.9	70.1	70.8	71	71.8	72.3	75.7	70.2	8.84%	1.09
1980	76.9	77.6	79	80.4	81.1	81.4	82.3	82.8	83.3	85	87	88.5	82.1	16.95%	1.17
1981	89.2	90.5	91	91.2	93.6	94	95.6	96.3	95.8	96.5	97.3	97.7	94.1	14.62%	1.15
1982	98.9	99.4	99.8	100.4	100.5	100	100	100	100.2	100.1	100.4	100.5	100	6.27%	1.06
1983	101.1	101	100.2	100.2	100.2	100.2	100.3	99.2	99.3	98.7	98.8	98.9	99.8	-0.20%	1.00
1984	99	99.7	100	100.3	99.5	99.9	100	100.1	101	101.6	102.5	101.6	100.4	0.60%	1.01
1985	101.8	102.4	102.8	102	101.9	102.1	102.2	102.4	102.3	102.8	103.1	101.8	102.3	1.89%	1.02
1986	102.2	103.7	103.8	103.8	102.8	102.8	102.8	102.9	103.5	103.5	103.6	103.7	103.3	0.98%	1.01
1987	104.3	104.3	104.5	104.5	105.1	105	105	105.2	105.3	105.6	106.2	106.9	105.2	1.84%	1.02
1988	106.9	107.1	107.4	108.8	109.2	110.9	110.9	111.4	111.9	112.2	114	114.5	110.4	4.94%	1.05
1989	115.3	115.4	116.8	118.5	118.6	118.8	118.7	118.9	119.9	120	120.3	120.4	118.5	7.34%	1.07
1990	121	121.8	122.1	121.1	123.4	123.7	124	124.6	124.9	125.8	125.9	126.3	123.7	4.39%	1.04
1991	127.6	128.4	128.5	129.4	130.1	130.3	130.1	130.4	130.5	130.5	130.5	131.1	129.8	4.93%	1.05
1992	132.4	133.1	134	134.3	134.5	134.5	134.8	136.1	136.2	136.2	136.3	136.3	134.9	3.93%	1.04
1993	138	138.7	139.2	139.5	139.5	139.4	139.4	139.5	139.6	139.8	140	140	139.4	3.34%	1.03
1994	140.9	141.2	141.9	142.1	142.2	142.2	142.2	142.4	142.6	143	143	143.6	142.3	2.08%	1.02
1995	145.5	145.4	146.6	146.7	146.7	146.7	146.6	146.8	146.9	147	147.8	148.2	146.7	3.09%	1.03
1996	149.2	149	149.8	149.9	150.1	150	150.1	150.6	150.7	150.8	151	151.2	150.2	2.39%	1.02
1997	152.5	152.7	153.5	153.8	155.3	155.2	155.1	155.3	156	156.5	156.5	156.7	154.9	3.13%	1.03
1998	158.7	158.8	158.8	159	159	159	159.4	159.5	159.5	159.7	160.4	159.8	159.3	2.84%	1.03
1999	161	160.4	161.2	161.3	160.4	161.1	161.8	161.4	161.3	163.2	161.6	162	161.4	1.32%	1.01
2000	161.9	162.4	164.2	163.6	164.8	163.3	163.7	164	164.7	163.8	164.9	164.6	163.8	1.49%	1.01
2001	165.4	164.8	165.5	165.5	166.2	165.7	170.5	170.5	170.9	171	171.4	171.4	168.2	2.69%	1.03
2002	171.9	172.3	172.1	172.7	172.4	172.3	172.4	172.1	172.9	172.7	172.7	172.2	172.4	2.50%	1.02
2003	173.4	173.3	174	174.6	174	174	174.5	174.3	174.3	174.9	175	174.4	174.2	1.04%	1.01
2004	176.3	176	176.6	177.7	178.8	178.7	179.6	180.5	180.9	181.5	182.3	182	179.2	2.89%	1.03
2005	185.2	185.5	187.5	188.7	188.7	188.5	188.5	188.3	189.7	189.8	190.1	190.8	188.4	5.13%	1.05
2006	191.9	193.4	194.7	195	196.4	197	197.7	198	198	198.2	200.3	201.2	196.8	4.44%	1.04
2007	202.5	205.1	206.9	208.6	209.6	209.6	209.9	210.4	210.4	212.2	212.4	211.8	209.1	6.25%	1.06
2008	214.4	215	216.9	216.7	219	220.6	221.6	221.8	224	224.7	224.2	224.1	220.3	5.32%	1.05
2009	226.3	225.6	226.3	226.3	226.4	226.9	226.6	226.4	226.4	226.1	226.1	227.4	226.4	2.79%	1.03
2010	227.9	228.1	228.3	227.4	227.7	227.5	227.9	228.2	228.3	228.2	228.6	228.6	228.1	0.73%	1.01
2011	225.4	226.8	227.4	228.1	228.5	228.1	229.1	229.3	229.4	229.7	229.7	229.7	228.4	0.16%	1.00
2012	230.1	232.7	233.4	233.8	233.9	234.3	234.2	234.2	234.2	234.3	229.2	229.2	232.8	1.91%	1.02
2013	229.2	229.4	230.8	231.2	231.1	231.4	231.5	232.3	232.4	232.3	232.8	232.8	231.4	-0.58%	0.99
2014	235.2	235.8	235.8	236	235.9	235.8	235.9	235.9	235.9	236.3	236.7	236.8	236.0	1.97%	1.02
2015	239.3	239.6	239.7	240.4	240.3	240.3	240.5	240.5	240.5	240.5	240.5	241.7	240.3	1.83%	1.02
2016	244.3	244.6	244.3	244.3	243.2	243.2	243.1	243.1	243.1	243.1	243.1	244.1	243.6	1.38%	1.01
2017	244.5	246.7	247.9	247.9	247.9	247.9	247.9	247.9	247.9	249.5	251.6	250.8	248.2	1.88%	1.02
Arithmetic mean:														4.56%	4.56%
Geometric mean:														N/A	**4.45%**

P : Preliminary. All indexes are subject to revision four months after original publication.

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPU072106035

Not Seasonally Adjusted

Group: Rubber and plastic products
Item: Plastics industrial and mining pipe (Incl. chemical processing, food processing)
Base Date: 201112
Years: 2011 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
2011	0	0	0	0	0	0	0	0	0	0	0	100	100		
2012	99	103.5	106	106.8	107.2	109	104.6	102.7	106.4	106.7	107.1	106	105.417	5.42%	1.05
2013	106.2	106.6	108.1	109.1	106.2	106.3	106.2	106.6	106.1	105.7	103.3	103.6	106.167	0.71%	1.01
2014	103.2	107.9	112.6	112.4	106	104.6	105.2	107.9	107.1	108.1	107.7	106.1	107.4	1.16%	1.01
2015	105.6	105.7	105	104.9	105.2	104.6	104.7	104.3	103	102.4	102.4	105.3	104.425	-2.77%	0.97
2016	99.7	100	98.4	98.9	100	101.7	101.3	101.6	100.3	102.2	101.4	100.3	100.483	-3.77%	0.96
2017	100.7	100.8	102.3	103.4	105.2	104.4	104.2	104.4	99.2	102.9	102.4	101.2	102.592	2.10%	1.02
Arithmetic mean:														0.47%	0.47%
Geometric mean:														N/A	**0.43%**

P : Preliminary. All indexes are subject to revision four months after original publication.

http://data.bls.gov/cgi-bin/srgate

PPI Commodity Data

Series Id: WPU117
Not Seasonally Adjusted
Series Title: PPI Commodity data for Machinery and equipment-Electrical machinery and equipment
Group: Machinery and equipment
Item: Electrical machinery and equipment
Base Date: 198200
Years: 1940 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
1940	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5	N/A	N/A
1941	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.6	19.7	19.7	19.8	19.8	19.6	0.47%	1.00
1942	19.8	19.8	19.7	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.5	19.5	19.6	0.17%	1.00
1943	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.4	19.4	19.4	19.4	19.4	19.5	-0.85%	0.99
1944	19.4	19.4	19.4	19.4	19.4	19.1	19.0	19.0	19.0	19.0	19.0	19.0	19.2	-1.46%	0.99
1945	19.0	19.0	19.0	19.0	19.2	19.3	19.3	19.3	19.3	19.4	19.5	19.5	19.2	0.30%	1.00
1946	19.6	19.6	19.6	20.5	21.9	22.3	22.5	22.6	22.8	23.3	24.4	25.3	22.0	14.56%	1.15
1947	25.5	25.6	25.7	26.0	27.3	27.5	27.4	27.5	27.6	27.5	27.5	27.6	26.9	22.05%	1.22
1948	27.4	27.3	27.3	27.3	27.2	27.3	27.9	28.8	29.1	29.2	29.4	29.5	28.1	4.65%	1.05
1949	29.7	29.8	29.8	29.2	28.8	28.5	28.4	28.4	28.4	28.4	28.4	28.4	28.9	2.52%	1.03
1950	28.2	28.0	28.1	28.1	28.1	28.5	29.1	30.4	30.9	31.9	32.0	33.5	29.7	3.06%	1.03
1951	34.0	34.0	34.0	34.0	34.0	34.0	34.2	34.1	34.1	34.0	34.1	34.0	34.0	14.49%	1.14
1952	33.9	34.0	33.9	33.8	33.8	33.5	33.5	33.5	33.4	33.3	33.4	33.4	33.6	-1.25%	0.99
1953	33.4	33.4	33.5	33.9	34.2	34.7	34.9	35.1	35.2	35.3	35.4	35.4	34.5	2.73%	1.03
1954	35.4	35.4	35.4	35.3	35.2	35.2	35.2	35.1	35.1	35.0	35.4	35.4	35.3	2.10%	1.02
1955	35.4	35.4	35.3	35.3	35.3	35.3	35.4	35.7	36.5	36.5	36.7	36.9	35.8	1.56%	1.02
1956	37.0	37.2	37.3	37.9	38.3	38.4	38.4	38.6	39.6	40.0	40.6	40.6	38.7	7.96%	1.08
1957	40.8	41.1	41.2	41.3	41.4	41.4	41.8	41.8	42.2	42.1	42.2	42.2	41.6	7.67%	1.08
1958	42.2	42.2	42.2	42.4	42.5	42.6	42.6	42.7	42.7	42.7	42.5	42.5	42.5	2.06%	1.02
1959	42.5	42.5	42.7	42.7	43.0	43.0	43.5	43.4	43.5	43.6	43.6	43.4	43.1	1.49%	1.01
1960	43.5	43.5	43.5	43.3	42.8	42.8	42.9	42.8	42.7	42.6	42.6	42.6	43.0	-0.35%	1.00
1961	42.9	42.9	42.9	42.4	42.4	42.4	42.4	42.0	42.0	42.2	42.2	42.1	42.4	-1.32%	0.99
1962	41.9	41.9	41.9	41.8	41.8	41.8	41.6	41.6	41.8	41.8	41.6	41.6	41.8	-1.51%	0.98
1963	41.5	41.5	41.1	41.2	41.4	41.5	41.2	41.2	41.2	41.3	41.4	41.5	41.3	-1.02%	0.99
1964	41.0	41.1	41.2	41.5	41.5	40.9	40.9	41.0	40.9	40.9	40.9	40.9	41.1	-0.67%	0.99
1965	41.0	41.1	41.1	41.2	41.2	41.1	41.2	41.0	41.0	41.0	40.9	41.0	41.1	0.02%	1.00
1966	41.2	41.5	41.7	41.8	42.0	41.9	42.0	42.0	42.1	42.2	42.7	43.1	42.0	2.31%	1.02
1967	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.1	43.1	43.0	43.1	43.4	43.2	2.76%	1.03
1968	43.5	43.6	43.6	43.6	43.7	43.7	43.7	43.7	43.9	43.9	44.0	43.9	43.7	1.29%	1.01
1969	43.9	44.2	44.2	44.2	44.3	44.4	44.4	44.4	44.7	44.8	45.0	45.1	44.5	1.68%	1.02
1970	45.3	45.2	45.4	45.5	45.6	45.9	46.1	46.2	46.4	46.4	46.6	46.7	45.9	3.32%	1.03
1971	46.9	47.1	47.2	47.1	47.1	47.1	47.2	47.3	47.2	47.2	47.1	47.1	47.1	2.59%	1.03
1972	47.3	47.5	47.6	47.6	47.7	47.8	47.8	47.8	47.7	47.7	47.8	47.8	47.7	1.15%	1.01
1973	47.9	47.9	48.1	48.2	48.5	48.7	48.7	48.7	48.7	48.8	48.9	49.2	48.5	1.78%	1.02
1974	49.7	50.0	50.5	51.2	52.1	53.3	54.5	55.5	56.3	57.2	58.5	59.0	54.0	11.25%	1.11
1975	59.6	59.9	60.1	60.2	60.5	60.6	60.8	60.9	61.2	61.5	61.8	61.8	60.7	12.52%	1.13
1976	62.3	62.5	62.6	62.7	62.8	63.1	63.2	63.3	64.0	64.4	64.6	64.8	63.4	4.31%	1.04
1977	65.1	65.4	65.6	65.7	66.0	66.1	66.5	66.7	67.2	67.9	68.2	68.2	66.6	5.04%	1.05
1978	69.1	69.4	69.9	70.3	70.6	71.1	71.4	71.6	71.9	72.3	73.2	73.6	71.2	6.99%	1.07
1979	73.9	74.6	75.1	75.6	76.2	76.7	77.7	78.2	78.8	79.6	79.8	80.6	77.2	8.47%	1.08
1980	82.3	83.9	84.9	85.9	86.3	87.1	88.0	88.5	89.0	89.4	89.6	90.2	87.1	12.76%	1.13
1981	91.5	92.3	93.3	93.9	93.9	94.7	95.5	96.2	96.8	97.3	97.6	98.0	95.1	9.18%	1.09
1982	98.8	99.1	99.5	100.0	99.9	100.0	100.0	100.1	100.1	100.5	100.9	101.2	100.0	5.18%	1.05
1983	101.6	102.4	102.6	102.9	103.0	103.1	104.4	104.4	104.9	104.8	104.9	105.3	103.7	3.68%	1.04
1984	105.7	106.1	106.5	107.0	107.1	107.6	107.7	107.7	107.9	108.3	108.6	108.7	107.4	3.58%	1.04
1985	109.3	109.6	109.6	109.3	109.5	109.4	109.6	109.7	109.8	109.9	109.8	110.0	109.6	2.06%	1.02
1986	110.3	110.6	110.8	111.0	111.0	110.9	111.5	111.5	111.7	111.7	111.8	111.9	111.2	1.46%	1.01
1987	112.3	112.4	112.3	112.2	112.3	112.2	112.7	112.9	112.7	113.1	113.2	113.4	112.6	1.27%	1.01
1988	113.7	114.1	113.7	113.8	114.4	114.2	114.4	114.7	114.8	115.1	115.2	115.4	114.5	1.61%	1.02
1989	116.2	116.6	116.7	116.8	117.0	117.5	117.9	118.0	117.9	118.4	118.3	118.4	117.5	2.64%	1.03
1990	118.9	118.6	118.9	119.0	119.0	119.2	119.5	119.4	119.5	119.6	119.8	119.9	119.3	1.53%	1.02
1991	120.5	120.6	120.7	120.9	120.7	120.8	120.9	120.9	120.8	120.8	120.9	120.9	120.8	1.26%	1.01
1992	120.9	121.2	121.4	121.2	121.3	121.2	121.2	121.2	121.2	121.4	121.6	121.7	121.3	0.42%	1.00
1993	122.0	122.2	122.2	122.6	122.4	122.4	122.4	122.5	122.6	122.7	122.8	122.7	122.5	0.96%	1.01
1994	123.1	123.2	123.3	123.6	123.7	123.7	123.8	123.5	123.4	123.2	123.4	123.4	123.4	0.80%	1.01
1995	123.9	124.2	124.1	124.2	124.2	124.1	124.0	124.0	124.2	124.8	124.9	124.3	124.2	0.65%	1.01
1996	124.6	124.6	124.1	123.6	123.2	122.9	123.1	123.2	123.2	122.9	122.9	123.2	123.5	-0.63%	0.99
1997	123.0	122.9	122.7	122.6	122.4	122.4	122.6	122.1	122.0	121.6	121.8	121.8	122.3	-0.92%	0.99
1998	121.8	121.6	121.5	121.2	121.1	121.1	120.8	120.7	120.6	120.6	120.6	120.4	121.0	-1.08%	0.99
1999	120.6	120.6	120.5	120.3	119.8	119.6	119.5	119.4	119.2	119.3	119.3	119.3	119.8	-1.01%	0.99
2000	119.0	118.8	118.6	118.7	118.8	118.8	119.0	118.9	118.9	118.7	118.6	118.1	118.7	-0.87%	0.99
2001	118.2	118.0	118.1	117.8	117.7	117.4	117.1	116.9	116.8	116.7	116.7	116.7	117.3	-1.18%	0.99
2002	116.9	116.9	117.1	116.6	116.4	116.4	116.0	116.1	116.1	115.8	115.8	115.4	116.3	-0.89%	0.99
2003	115.3	115.0	115.1	115.2	115.2	114.9	114.6	114.4	114.4	114.2	114.2	114.0	114.7	-1.36%	0.99
2004	113.5	113.3	113.4	113.7	113.7	113.7	113.2	113.3	113.3	113.3	113.3	113.3	113.4	-1.13%	0.99
2005	113.4	113.4	113.3	113.3	113.1	113.0	113.1	113.2	112.9	113.0	112.6	112.3	113.1	-0.32%	1.00
2006	112.2	112.3	114.0	114.7	114.8	115.0	115.3	116.0	116.4	116.1	116.0	115.9	114.9	1.63%	1.02
2007	116.0	114.5	114.0	114.1	113.7	114.0	113.4	113.1	113.0	112.9	112.8	112.6	113.7	-1.06%	0.99
2008	112.7	113.2	113.2	113.2	113.5	113.7	113.7	113.7	113.8	114.0	113.6	113.3	113.5	-0.18%	1.00
2009	113.3	113.3	113.5	113.4	113.4	113.3	113.4	113.5	113.5	113.6	113.6	113.4	113.4	-0.03%	1.00
2010	113.4	113.5	113.6	113.4	113.5	113.4	113.4	113.2	113.0	112.9	112.6	112.7	113.2	-0.19%	1.00
2011	112.9	113.2	113.3	113.3	113.3	113.3	113.3	113.3	113.1	113.2	113.1	113.1	113.2	-0.01%	1.00
2012	113.4	113.5	113.5	113.5	113.7	113.5	113.4	113.3	113.1	113.1	113.0	112.8	113.3	0.10%	1.00
2013	113.4	113.4	113.4	113.6	113.8	113.8	113.9	113.9	113.8	113.9	113.8	113.9	113.7	0.35%	1.00
2014	113.8	113.8	113.7	113.6	113.6	113.6	113.7	113.7	113.8	113.8	113.8	113.8	113.7	0.01%	1.00
2015	114.1	114.1	114.1	114.0	114.1	113.9	113.9	113.7	113.6	113.5	113.5	113.5	113.8	0.10%	1.00
2016	113.3	113.2	113.3	113.2	113.2	113.1	113.2	113.1	113.0	112.8	112.7	112.7	113.1	-0.67%	0.99
2017	113.7	113.7	113.7	114.0	113.9	114.0	113.6	113.6	113.4	113.4	113.5	113.5	113.7	0.53%	1.01
Arithmetic mean:														2.40%	2.40%
Geometric mean:														N/A	**2.32%**

P : Preliminary. All indexes are subject to revision four months after original publication.

http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html

Retail Prices of Electricity Sold by Electric Utilities

Source: US Energy Information Administration

Electricity Industrial Sector Nominal Price

Year	Price per KWH	% Change	Convert to Positive
1960	110	N/A	N/A
1961	110	0.0%	1.00
1962	110	0.0%	1.00
1963	100	-9.1%	0.91
1964	100	0.0%	1.00
1965	100	0.0%	1.00
1966	100	0.0%	1.00
1967	100	0.0%	1.00
1968	100	0.0%	1.00
1969	100	0.0%	1.00
1970	100	0.0%	1.00
1971	110	10.0%	1.10
1972	120	9.1%	1.09
1973	130	8.3%	1.08
1974	170	30.8%	1.31
1975	210	23.5%	1.24
1976	220	4.8%	1.05
1977	250	13.6%	1.14
1978	280	12.0%	1.12
1979	310	10.7%	1.11
1980	370	19.4%	1.19
1981	430	16.2%	1.16
1982	500	16.3%	1.16
1983	500	0.0%	1.00
1984	483	-3.4%	0.97
1985	497	2.9%	1.03
1986	493	-0.8%	0.99
1987	477	-3.2%	0.97
1988	470	-1.5%	0.99
1989	472	0.4%	1.00
1990	474	0.4%	1.00
1991	483	1.9%	1.02
1992	483	0.0%	1.00
1993	485	0.4%	1.00
1994	477	-1.6%	0.98
1995	466	-2.3%	0.98
1996	460	-1.3%	0.99
1997	453	-1.5%	0.98
1998	448	-1.1%	0.99
1999	443	-1.1%	0.99
2000	464	4.7%	1.05
2001	505	8.8%	1.09
2002	488	-3.4%	0.97
2003	511	4.7%	1.05
2004	525	2.7%	1.03
2005	573	9.1%	1.09
2006	616	7.5%	1.08
2007	639	3.7%	1.04
2008	696	8.9%	1.09
2009	683	-1.9%	0.98
2010	677	-0.9%	0.99
2011	682	0.7%	1.01
2012	667	-2.2%	0.98
2013	689	3.3%	1.03
2014	710	3.0%	1.03
2015	691	-2.7%	0.97
2016	676	-2.2%	0.98
2017	691	2.2%	1.02
Arithmetic Mean:		3.51%	3.51%
Geometric Mean:		N/A	**3.28%**

http://data.bls.gov/cgi-bin/srgate

Employment, Hours, and Earnings from the Current Employment Statistics survey (National)

Original Data Value

Series Id: CEU2023700003
Not Seasonally Adjusted
Series Average hourly earnings of all employees, specialty trade
Super Construction
Industry: Specialty trade contractors
NAICS 238
Data Type: AVERAGE HOURLY EARNINGS OF ALL EMPLOYEES
Years: 2006 to 2017

Data:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% Change	Convert to Positive
2006			21.34	21.28	21.27	21.37	21.54	21.56	21.70	21.81	21.85	22.20	21.59	N/A	N/A
2007	22.01	22.16	22.18	22.22	22.39	22.37	22.50	22.59	22.80	22.80	22.94	23.30	22.52	4.31%	1.04
2008	23.13	23.21	23.23	23.29	23.37	23.38	23.57	23.84	23.95	24.05	24.23	24.51	23.65	5.00%	1.05
2009	24.36	24.25	24.40	24.31	24.25	24.15	24.25	24.38	24.42	24.57	24.54	24.70	24.38	3.11%	1.03
2010	24.63	24.68	24.70	24.57	24.52	24.39	24.52	24.65	24.68	24.89	24.91	25.16	24.69	1.27%	1.01
2011	25.07	25.01	24.93	24.90	24.78	24.64	24.76	24.97	24.98	25.04	24.97	25.28	24.94	1.02%	1.01
2012	25.16	25.18	25.19	25.14	25.05	24.94	25.07	25.19	25.40	25.41	25.43	25.67	25.24	1.17%	1.01
2013	25.58	25.56	25.52	25.42	25.34	25.36	25.46	25.50	25.51	25.54	25.58	25.89	25.52	1.13%	1.01
2014	25.80	25.97	25.80	25.85	25.80	25.73	25.78	25.94	26.07	26.06	26.05	26.18	25.92	1.56%	1.02
2015	26.22	26.09	26.31	26.27	26.31	26.26	26.40	26.49	26.42	26.58	26.66	26.87	26.41	1.88%	1.02
2016	26.77	26.72	27.00	26.95	27.03	27.08	27.17	27.24	27.34	27.39	27.38	27.56	27.14	2.76%	1.03
2017	27.48	27.51	27.56	27.49	27.57	27.72	27.85	27.96	28.10	28.02	28.03	28.36	27.80	2.46%	1.02
Arithmetic mean:														2.33%	2.33%
Geometric mean:														N/A	**2.33%**

P : Preliminary. All indexes are subject to revision four months after original publication.

Full Name	Value Date	YTD Total Return	Percent Change	Convert to Positive
U.S. Government/Credit	12/31/1973	2.298562	0.02298562	1.02298562
U.S. Government/Credit	12/31/1974	0.173907	0.00173907	1.00173907
U.S. Government/Credit	12/31/1975	12.291278	0.12291278	1.12291278
U.S. Government/Credit	12/31/1976	15.584238	0.15584238	1.15584238
U.S. Government/Credit	12/30/1977	2.994655	0.02994655	1.02994655
U.S. Government/Credit	12/29/1978	1.167421	0.01167421	1.01167421
U.S. Government/Credit	12/31/1979	2.279569	0.02279569	1.02279569
U.S. Government/Credit	12/31/1980	3.04756	0.0304756	1.0304756
U.S. Government/Credit	12/31/1981	7.286263	0.07286263	1.07286263
U.S. Government/Credit	12/31/1982	31.097855	0.31097855	1.31097855
U.S. Government/Credit	12/30/1983	7.987689	0.07987689	1.07987689
U.S. Government/Credit	12/31/1984	15.00544	0.1500544	1.1500544
U.S. Government/Credit	12/31/1985	21.325217	0.21325217	1.21325217
U.S. Government/Credit	12/31/1986	15.599849	0.15599849	1.15599849
U.S. Government/Credit	12/31/1987	2.303383	0.02303383	1.02303383
U.S. Government/Credit	12/30/1988	7.587892	0.07587892	1.07587892
U.S. Government/Credit	12/29/1989	14.228355	0.14228355	1.14228355
U.S. Government/Credit	12/31/1990	8.292586	0.08292586	1.08292586
U.S. Government/Credit	12/31/1991	16.125458	0.16125458	1.16125458
U.S. Government/Credit	12/31/1992	7.584939	0.07584939	1.07584939
U.S. Government/Credit	12/31/1993	11.03181	0.1103181	1.1103181
U.S. Government/Credit	12/30/1994	-3.509601	-0.03509601	0.96490399
U.S. Government/Credit	12/29/1995	19.242709	0.19242709	1.19242709
U.S. Government/Credit	12/31/1996	2.90357	0.0290357	1.0290357
U.S. Government/Credit	12/31/1997	9.757223	0.09757223	1.09757223
U.S. Government/Credit	12/31/1998	9.472479	0.09472479	1.09472479
U.S. Government/Credit	12/31/1999	-2.147122	-0.02147122	0.97852878
U.S. Government/Credit	12/29/2000	11.851169	0.11851169	1.11851169
U.S. Government/Credit	12/31/2001	8.502578	0.08502578	1.08502578
U.S. Government/Credit	12/31/2002	11.035881	0.11035881	1.11035881
U.S. Government/Credit	12/31/2003	4.668455	0.04668455	1.04668455
U.S. Government/Credit	12/31/2004	4.193423	0.04193423	1.04193423
U.S. Government/Credit	12/30/2005	2.369024	0.02369024	1.02369024
U.S. Government/Credit	12/29/2006	3.778366	0.03778366	1.03778366
U.S. Government/Credit	12/31/2007	7.226425	0.07226425	1.07226425
U.S. Government/Credit	12/31/2008	5.704	0.05704	1.05704
U.S. Government/Credit	12/31/2009	4.521	0.04521	1.04521
U.S. Government/Credit	12/31/2010	6.593	0.06593	1.06593
U.S. Government/Credit	12/30/2011	8.737	0.08737	1.08737
U.S. Government/Credit	12/31/2012	4.816	0.04816	1.04816
U.S. Government/Credit	12/31/2013	-2.352	-0.02352	0.97648
U.S. Government/Credit	12/31/2014	6.01	0.0601	1.0601
U.S. Government/Credit	12/31/2015	0.147220363	0.001472204	1.001472204
U.S. Government/Credit	12/31/2016	3.05	0.0305	1.0305
U.S. Government/Credit	12/31/2017	4.00	0.04	1.04
		Geometric mean:		7.27%

Full Name	Value Date	YTD Total Return	Percent Change	Convert to Positive
U.S. Aggregate	12/31/1976	15.595498	0.15595498	1.15595498
U.S. Aggregate	12/30/1977	3.02538	0.0302538	1.0302538
U.S. Aggregate	12/29/1978	1.398805	0.01398805	1.01398805
U.S. Aggregate	12/31/1979	1.924445	0.01924445	1.01924445
U.S. Aggregate	12/31/1980	2.707597	0.02707597	1.02707597
U.S. Aggregate	12/31/1981	6.261099	0.06261099	1.06261099
U.S. Aggregate	12/31/1982	32.635016	0.32635016	1.32635016
U.S. Aggregate	12/30/1983	8.373009	0.08373009	1.08373009
U.S. Aggregate	12/31/1984	15.153796	0.15153796	1.15153796
U.S. Aggregate	12/31/1985	22.125676	0.22125676	1.22125676
U.S. Aggregate	12/31/1986	15.24882	0.1524882	1.1524882
U.S. Aggregate	12/31/1987	2.756946	0.02756946	1.02756946
U.S. Aggregate	12/30/1988	7.878508	0.07878508	1.07878508
U.S. Aggregate	12/29/1989	14.529286	0.14529286	1.14529286
U.S. Aggregate	12/31/1990	8.945261	0.08945261	1.08945261
U.S. Aggregate	12/31/1991	16.000538	0.16000538	1.16000538
U.S. Aggregate	12/31/1992	7.402604	0.07402604	1.07402604
U.S. Aggregate	12/31/1993	9.749142	0.09749142	1.09749142
U.S. Aggregate	12/30/1994	-2.916151	-0.02916151	0.97083849
U.S. Aggregate	12/29/1995	18.473766	0.18473766	1.18473766
U.S. Aggregate	12/31/1996	3.630583	0.03630583	1.03630583
U.S. Aggregate	12/31/1997	9.653966	0.09653966	1.09653966
U.S. Aggregate	12/31/1998	8.686512	0.08686512	1.08686512
U.S. Aggregate	12/31/1999	-0.821319	-0.00821319	0.99178681
U.S. Aggregate	12/29/2000	11.626067	0.11626067	1.11626067
U.S. Aggregate	12/31/2001	8.443473	0.08443473	1.08443473
U.S. Aggregate	12/31/2002	10.25503	0.1025503	1.1025503
U.S. Aggregate	12/31/2003	4.104447	0.04104447	1.04104447
U.S. Aggregate	12/31/2004	4.338787	0.04338787	1.04338787
U.S. Aggregate	12/30/2005	2.428532	0.02428532	1.02428532
U.S. Aggregate	12/29/2006	4.333766	0.04333766	1.04333766
U.S. Aggregate	12/31/2007	6.966623	0.06966623	1.06966623
U.S. Aggregate	12/31/2008	5.24	0.0524	1.0524
U.S. Aggregate	12/31/2009	4.521	0.04521	1.04521
U.S. Aggregate	12/31/2010	6.542	0.06542	1.06542
U.S. Aggregate	12/30/2011	7.842	0.07842	1.07842
U.S. Aggregate	12/31/2012	4.215	0.04215	1.04215
U.S. Aggregate	12/31/2013	-2.024	-0.02024	0.97976
U.S. Aggregate	12/31/2014	5.97	0.0597	1.0597
U.S. Aggregate	12/31/2015	0.549954938	0.005499549	1.005499549
U.S. Aggregate	12/31/2016	2.65	0.0265	1.0265
U.S. Aggregate	12/31/2017	3.54	0.0354	1.0354

Geometric mean:	7.42%