Earthwork Cost Estimate
Summary Report

Prepared for

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Chino Mines Company
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1.0 INTRODUCTION

The New Mexico Environmental Department, Groundwater Bureau (NMED) and the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD) regulations require that financial assurance (FA) be posted for portions of a copper mining facility that would be reclaimed at closure in order for operating permits to be issued (New Mexico Administrative Code NMAC 20.6.7.29 and NMAC 19.10.12, respectively). This report describes the base assumptions and approach used to determine the FA earthwork reclamation cost estimate (RCE) for Freeport-McMoRan Chino Mines Company (Chino).

Telesto Solutions Inc. (Telesto) presents this earthwork RCE for Chino as part of the 2018 Chino Mine Closure/Closeout Plan (CCP) and the 2017 9 Waste Rock Stockpile Closure/Closeout Plan (9 WRS CCP) (Golder Associates, 2018; Golder Associates, 2017), with specific information obtained from the Earthworks and Ancillary Facilities Financial Assurance Cost Estimate Process Summary (Telesto Solutions, Inc., 2017), also referred to as the Scope of Work (SOW). Updated quantity takeoffs recently prepared by Golder under the CCP are also included. Operations and maintenance (O&M) costs are also included in this RCE.

1.1 Reclamation Overview

This earthwork RCE is based on the configuration of facilities during the most expensive reclamation year as described in the CCP. This represents the year with the greatest volume of regrading and cover (Golder Associates, 2018). This RCE excludes the North Lampbright and 3A stockpiles because of coverage by other RCEs. The O&M cost estimate is based on revegetation maintenance continuing for 12 years starting the year reclamation is completed and erosion control, road maintenance, and groundwater monitoring continuing for 100 years (Golder Associates, 2018).

Locations of mine facilities are shown in Figures 1 through 5 (from the 2018 Chino CCP and 2017 9 WRS CCP (Golder Associates, 2018; Golder Associates, 2017)). Table 1 presents a summary of the mine facilities and reclamation activities to be performed at each location. The planned reclamation activities are also shown in matrix charts that present reclamation locations and corresponding earthwork reclamation operations for North Mine Area (NMA) stockpiles, other sites in the NMA, and sites in the South Mine Area (SMA) at Chino in Table 2, Table 3, and Table 4, respectively.

1.2 Report Layout

This earthwork RCE report consists of the following sections:

- **Section 1.0** provides an introduction and overview of the RCE prepared for Chino.
- **Section 2.0** presents the data and assumptions used for estimating earthwork processes and equipment costs, indirect and O&M costs, and quotes and unit costs.
- **Section 3.0** presents the calculation steps followed to complete the earthwork RCE.
- **Section 4.0** presents the results including a summary by location for direct, indirect costs, capital, and O&M costs.
- **Section 5.0** lists the references cited in this report.

The following appendices provide supporting information, calculations, and results of the RCE:

- **Appendix A** presents the updated reclamation design drawings (Golder Associates, 2018; Golder Associates, 2017) along with quantities/takeoffs.
- **Appendix B** presents supporting data for the cost estimation, including labor rates, equipment data, direct quotes, and information for well abandonment costs and fuel costs.
- **Appendix C** presents the letter and table documenting the FA Work Group agreement for indirect costs used in the RCE.
- **Appendix D** presents the calculations and key equations used in the RCE spreadsheet.

- **Appendix E** presents the reclamation cost spreadsheet in hard copy and in electronic formats; the spreadsheet file is named 20190315_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx.
- **Appendix F** provides Facility Characteristics Forms and RCE costs for each location.

2.0 DATA AND ASSUMPTIONS

The reclamation design used as the basis for the earthwork RCE is presented in the 2018 CCP and 2017 9 WRS CCP drawings and updated information which are provided in Appendix A (Golder Associates, 2018; Golder Associates, 2017). Data and assumptions used throughout the cost estimate calculations are identified for earthwork processes and equipment, quotes and unit costs, indirect costs, and O&M. A brief summary of changes in data and assumptions, relative to the 2018 CCP (Golder Associates, 2018), 2017 9 WRS CCP (Golder Associates, 2017), and Process Summary (Telesto Solutions, Inc., 2017), is also provided.

Appendix B provides detailed information utilized to develop the earthwork RCE, which incorporates updates from the information presented in the 2018 CCP (Golder Associates, 2018). The sub-appendices in Appendix B are organized as follows:

- **Appendix B.1** tabulates the 2019 labor rates from the New Mexico Department of Labor (NMDOL).
- **Appendix B.2** contains copies of the EquipmentWatch (Penton Media, 2019) sheets from which equipment unit rates were obtained.
- **Appendix B.3** provides the curve fits used in the production sheets for dozers and haul trucks.
- **Appendix B.4** contains copies of the pertinent information from RSMeans (R.S. Means, 2019) and pages from several editions of the Caterpillar Performance Handbook (CPH).
- **Appendix B.5** provides direct quotes used in the cost estimates.
- **Appendix B.6** provides data and calculations used to prepare the fuel cost.

2.1 Earthwork Processes and Equipment

Data and assumptions used in the RCE for earthwork processes and equipment include the following:

- **Dozer Push Distances:** Dozer push distances represent the distance from the centroid of the cut block to the centroid of the fill block.
- **Cover Placement**: Trucks and hydraulic shovels with dozer assist perform all cover loading and distribution. The economic optimum number of trucks per hydraulic shovel is 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. Each haul route uses a maximum of three segments.
- **Borrow Areas:** Throughout the reclamation effort, cover materials are taken from the nearest source until no longer needed or used entirely. After use as a cover material source, borrow areas will be ripped and seeded.
- **Dust Suppression and Road Maintenance:** A water truck and a motor grader are included as part of the fleet during reclamation (Table 5). The water truck and grader task time is equal to hydraulic shovel task time.
- **Labor Rates:** All labor rates are developed based on the NMDOL Type H (Heavy Engineering) labor rates effective January 1, 2019 (NMDOL, 2019). These rates include the base, fringe benefit, and apprenticeship contribution rates (Table 6).
- **Equipment Rates:** Table 6 summarizes the rates for earth-moving equipment, commonly available to a contractor, which are used in the estimate. The equipment unit operating costs are taken from EquipmentWatch (Penton Media, 2019) Custom Cost Evaluator. The equipment costs for the heavy construction equipment to be utilized in completing the CCP earthwork can be found in Appendix B.2.
- **Hourly Adjustment:** The RCE is based on 50 minutes of work per hour. Cost information presented in EquipmentWatch is also based on 50 minutes of work per hour. Because the hourly adjustment is made in the RCE calculations, an hourly adjustment to a 60-minute work hour is applied to the EquipmentWatch source data with a multiplication factor of 60/50.
- **Revegetation and Scarification:** Scarifying the final surface takes place at the same time as revegetation.

- **Equipment Production Factors:** Table 5 summarizes equipment production factors from the CPH Editions 29, 35, 41, 44, 47, and 48 (Caterpillar, Inc., 1998; Caterpillar, Inc., 2004; Caterpillar, Inc., 2011; Caterpillar, Inc., 2014; Caterpillar, Inc., 2017; Caterpillar, Inc., 2018), and EquipmentWatch (Penton Media, 2019) information for each type of equipment presented in Table 6. Productivity curves are also developed from the Caterpillar references as described in Appendix B.3.
- **Miscellaneous Unit Costs:** Other miscellaneous unit costs shown in Table 7 were taken from several sources. Supporting documentation from direct quotes is included in Appendix B.5.

2.2 Indirect and O&M Costs

The RCE handles indirect and O&M costs as follows:

- **Capital Indirect Costs**: Total indirect costs of 30% are applied to the capital direct costs based on discussions involving the FA Work Group completed in December 2018 (see Appendix C). The FA Work Group involved representatives of Freeport-McMoRan New Mexico Operations (FNMO), MMD, NMED, and Gila Resources Information Project (GRIP). The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost. Appendix C presents the letter and table documenting the FA Work Group agreement for FNMO's RCEs to use 30% to calculate indirect costs.
- **Operations and Maintenance Indirect Costs**: Total indirect costs of 17.5% are applied for long-term O&M, also as agreed by the FA Work Group for FNMO's RCEs (see Appendix C).
- **Reclamation Timeframe**: This earthwork cost estimate assumes that reclamation occurs relatively evenly (in terms of dollars spent) over a 17-year period. Revegetation monitoring, operations, and maintenance are assumed to be completed at the end of 12 years in each area after the initial revegetation. Other earthwork reclamation and facility monitoring, operations, and maintenance are assumed to be fully completed at the end of 100 years (i.e., year 99 or 2118).

2.3 Direct Quotes

Direct quotes are used in the RCE as a source of information to prepare unit costs which are discussed in Section 3.0 and presented in the RCE cost spreadsheet. Direct quotes include the following:

- **Articulated Concrete Blocks (ACBs):** The ACB unit cost is based on a quote for materials and installation obtained in September 2018 from the Armortec Area Manager (West) for Contech Engineered Solutions, the manufacturer and distributor of ACBs currently used at Chino Mine.
- **Revegetation Materials:** Costs for seed and hay mulch used for reclamation are taken from a quote provided by Rocky Mountain Reclamation in April 2018.
- **Well Abandonment:** The well abandonment unit costs are based on a quote from Layne Christensen Company obtained in July 2018 (Appendix B.5).
- **Well Replacement:** Well replacement cost are from Wilcox Professional Services with an estimated cost for a 5.5-inch bore (Appendix B.5).

2.4 Deviations from CCP and Scope of Work

The specific sources for data and assumptions used to prepare the RCE are identified in the spreadsheet notes, some of which have been updated from the CCP (Golder Associates, 2018), Scope of Work (Telesto Solutions, Inc., 2017), and 9 WRS CCP (Golder Associates, 2017). These changes include the following:

- Pregnant leach solution (PLS) area is a part of water treatment and, therefore, is not included in the earthwork RCE.
- Groundhog #5 requires 1 foot of cover.
- A swell factor of 0% is applied to native rock, whereas the 2018 CCP assumed a value of 15%.
- Updated quantities are used (Appendix A) (Golder Associates, 2018).
- Indirect costs are 30% of capital costs (Appendix C).
- Indirect costs are 17.5% of O&M costs (Appendix C).
- EquipmentWatch equipment costs are updated to 2019 values.
- Wastes requiring special handling is included in building demolition.
- New haul road unit cost is included.

- Revegetation unit cost is based on R.S. Means (R.S. Means, 2019) and EquipmentWatch (Penton Media, 2019).
- ACBs are used for downdrains instead of riprap.
- Labor rates are updated to reflect 2019 values.
- The duration of earthwork reclamation occurs over 17 instead of 12 years.
- Additional costs are included to account for the dynamic nature of mining. This approach is intended to allow greater flexibility in meeting the mine planning schedule and reduce the number of FA amendments. Unplanned future disturbance areas may include small staging areas, utility corridors, haul roads, pull-offs, stockpile expansions, or other miscellaneous unforeseen changes in the mine plan. The cost to reclaim the unplanned future disturbance is estimated assuming a reclamation area of 200 acres.
- Fuel cost is updated for 2019 based on discussions with the FA Work Group in the fall of 2018 (see Appendix B.6); historical local quotes are correlated with public data to estimate the fuel cost.
- Material weights from the Chino Scope of Work (Telesto Solutions, Inc., 2017) instead of the 9 WRS CCP (Golder Associates, 2017) are utilized.
- Bench channel sizes from the Scope of Work (Telesto Solutions, Inc., 2017) instead of the 9 WRS CCP (Golder Associates, 2017) are utilized.
- Downdrain sizes from the quantity takeoffs prepared by Golder (Appendix A) are utilized instead of downdrain sizes in the Scope of Work (Telesto Solutions, Inc., 2017) or 9 WRS CCP (Golder Associates, 2017).
- Equipment utilized in the RCE may differ from the Scope of Work (Telesto Solutions, Inc., 2017) or 9 WRS CCP (Golder Associates, 2017).
- Equipment production factors are revised to be consistent with CPH Editions 29, 35, 41, 44, 47, and 48 (Caterpillar, Inc., 1998; Caterpillar, Inc., 2004; Caterpillar, Inc., 2011; Caterpillar, Inc., 2014; Caterpillar, Inc., 2017; Caterpillar, Inc., 2018), and EquipmentWatch (Penton Media, 2019).
- The amount of time required for O&M groundwater monitoring is decreased from the Chino Scope of Work to more accurately account for the level of effort required to sample 53 wells.
- The previously planned Santa Rita Stockpile reclamation is replaced with the South and East In-Pit Stockpiles reclamation.
- The disturbed area around Reservoir 5 is added to the cost estimate.
- The list of impoundments included in the earthwork RCE is modified in coordination with the water treatment RCE to avoid duplication.

Table 1 Facility Overview

Site	Status EOY 2018 and Reclamation Description	Reclamation Activities to be Performed at Location
North Mine Area		
Stockpiles		
Triangle Area	Angle of repose slopes–reclaim top and outslopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
Groundhog #5	Reclaimed–add 1 ft of cover, continue O&M	Dozer Assist, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Lampbright	Leach Stockpile, Angle of repose–reclaim top and outslopes	Rip Before Scraping, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Downdrain Excavation, Place Downdrain/Dissipater ACBs, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
Southwest Lambright	Waste Rock Stockpile, Angle of repose slopes–reclaim top and outslopes	Rough Grading, Dozer Assist, Rip Rough Grade, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Lee Hill	Leach Stockpile, Angle of repose slopes–reclaim top[1]	Rough Grading, Dozer Assist, Rip Rough Grade, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
North	Waste Rock Stockpile, Angle of repose slopes–reclaim top	Rough Grading, Dozer Assist, Rip Rough Grade, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Northeast	Waste Rock Stockpile, Angle of repose slopes, most material was removed in 2014–reclaim stockpile	Rough Grading, Dozer Assist, Rip Rough Grade, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Northwest	Waste Rock Stockpile, Angle of repose slopes–reclaim top and north outslope	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetation, O&M
South and East In-Pit Stockpiles	Stockpiles, Angle of repose slopes–reclaim stockpiles[1]	Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
South	Leach Stockpile, Angle of repose slopes–reclaim top and western outslopes	Rip Before Scraping, Rough Grading, Dozer Assist, Rip Rough Grade, Load & Haul Cover, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Downdrain Excavation, Place Downdrain/Dissipater ACBs, Revegetate, O&M
STS2	Waste Rock and Overburden Stockpile, overburden material will be used as a cover source during closure–reclaim and provide drainage for remnant outslopes and top	Rough Grading, Dozer Assist, Rip Rough Grade, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
Upper South	Waste Rock and Overburden Stockpile, overburden material will be used as a cover source during closure–reclaim and provide drainage for remnant outslopes and top	Rough Grading, Dozer Assist, Rip Rough Grade, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
West	Leach and Waste Rock Stockpile, Angle of repose slopes–pull back and reclaim top and outslopes	Rip Before Scraping, Rough Grading, Dozer Assist, Dozer Assist Scraper, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Downdrain Excavation, Place Downdrain/Dissipater ACBs, Plug Abandoned Wells, Replace Wells, Revegetate, O&M
9 Waste Rock	Waste Rock Stockpile, Angle of repose slopes–reclaim top and outslopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Construct Top Channels, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Downdrain Excavation, Place Downdrain ACBs, Revegetate, O&M
Seepage Collection		
Dam 15	Stormwater containment/control-reclaim	Breach Dam, Rough Grade, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Dam 16	Stormwater containment/control- reclaim	Breach Dam, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Dam 20	Stormwater containment/control–reclaim	Breach Dam, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Elmo's Pond	Stormwater runoff pond–reclaim	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade

Site	Status EOY 2018 and Reclamation Description	Reclamation Activities to be Performed at Location
		Cover, Revegetate, O&M
Lower Lined Pond	HDPE Lined Stormwater runoff pond–reclaim	Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Upper Lined Pond	HDPE Lined Stormwater runoff pond–reclaim	Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Reservoirs		
Fleming Pond	Lined process water pond–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
PLS Pond & Launder	Lined process water pond–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
5900 PLS Sump	Lined process sump–reclaim	Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
6300 PLS Booster Station	Lined process booster station–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Raffinate Pond	Lined process water pond–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Reservoir 17	Stormwater management pond, lined–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Reservoir 2	Stormwater management pond, unlined–reclaim	Breach Dam, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Reservoir 6	Stormwater management pond, unlined–reclaim	Breach Dam, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Reservoir 7	Process water pond, unlined–reclaim	Breach Dam, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Tailing Thickener 1	Lined process water pond–reclaim	Breach Dam, Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Miscellaneous		
Lee Hill #2 Booster	Lined process water pond–reclaim	Puncture Liner, Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Filter Plant	Reclaim	Dozer Assist, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Disturbed Area Around Reservoir 5	Land surrounding Reservoir 5	Dozer Assist, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
200-Acre Unplanned Future Disturbance	Unplanned disturbed area–reclaim	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Roads		
Chino Portion Cobre Haul Road	Removed for cover–reclaim disturbed area (road)	Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Northwest Haul Road	Part outside Open Pit Surface Drainage Area (OPSDA)–reclaim top area	Revegetate, O&M
East Pit Access Disturbed Area	Outside OPSDA–reclaim top area and slopes	Dozer Assist, Load & Haul Cover, Place & Grade Cover, Revegetate, O&M
Highway to Heaven Haul Road	Reclaim road surface and side slopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
South Mine Area		
Stockpiles		

Site	Status EOY 2018 and Reclamation Description	Reclamation Activities to be Performed at Location
Slag Pile	Approximately 90% of area is reclaimed–reclaim remainder after Filter Plant reclamation	Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Roads and Misc Areas		
35-Acre Misc Area	Reclaim	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Revegetate, O&M
Tailing Ponds		
1	Reclaimed–Continue O&M	O&M
2	Reclaimed–Continue O&M	O&M
B	Reclaimed–Continue O&M	O&M
C	Reclaimed–Continue O&M	O&M
4E	Reclaimed–Continue O&M	O&M
4W	Reclaimed–Continue O&M	O&M
6E	Partially reclaimed–Continue O&M on reclaimed portion, reclaim remaining top and outslopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Excavate Downdrains, Place Downdrain ACBs, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
6W	Partially reclaimed–Continue O&M on reclaimed portion, reclaim remaining top and outslopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Excavate Downdrains, Place Downdrain ACBs, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
7	4H:1V outslopes–reclaim tops and outslopes	Rough Grading, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Excavate Downdrains, Place Downdrain ACBs, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M
Axiflo	Reclaim sideslopes and pond bottom, armor dam breach channel	Breach Dam, Rough Grade, Dozer Assist, Load & Haul Cover, Rip Rough Grade, Place & Grade Cover, Bench Grading, Excavate Bench Channels, Make Riprap, Load & Haul Riprap, Place Riprap, Revegetate, O&M

[1] Inside Open Pit Surface Drainage Area (OPSDA) and MMD waiver area

Table 2 North Mine Area Stockpiles - Cost Estimating Reclamation Activities

	Rip Before Scraping	Rough Grading	Dozer Assist Loading	Dozer Assist Scraping	Load Cover	Haul Cover	Rip Rough Grade	Rip Cover Stockpiles	Place & Grade Cover	Bench Grading	Excavate Downdrains	Excavate Bench Channels	Make Riprap	Load Riprap	Haul Riprap	Place ACB Downdrains	Place ACB Dissipaters	Place Riprap Bench Channels	Plug and Abandon Wells	Replace Wells	Scarify & Seed / Revegetate	O&M
North Mine Area																						
Stockpiles																						
Triangle	-	X	X	-	X	X	X	-	X	X	-	X	X	X	X	-	-	X	-	-	X	X
South	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	X	X
West	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lambright	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	-	-	X	X
Southwest Lampbright	-	X	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
South and East In-Pit Stockpiles	-	-	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
Northwest	-	X	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
Lee Hill	-	X	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
Northeast	-	X	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
North	-	X	X	-	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
STS2	-	X	-	-	-	-	X	-	-	X	-	X	X	X	X	-	-	X	-	-	X	X
Upper South	-	X	-	-	-	-	X	-	-	X	-	X	X	X	X	-	-	X	-	-	X	X
White House	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Ground Hog #5	-	-	X	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	X
9 Waste Rock Stockpile	-	X	X	-	X	X	X	-	X	X	X	X	X	X	X	X	-	X	-	-	X	X

Table 3 North Mine Area Other Facilities – Cost Estimating Reclamation Activities

	Breach Dam	Puncture Liner	Rough Grading	Dozer Assist Loading	Load Cover	Haul Cover	Rip Rough Grade	Place & Grade Cover	Rip & Seed / Revegetate	O&M
North Mine Area										
Roads										
Chino part of Cobre Haul Road	-	-	-	X	X	X	X	X	X	X
East Pit Access Disturbed Area	-	-	-	X	X	X	-	X	X	X
Northwest Haul Road	-	-	-	-	-	-	-	-	X	X
Highway to Heaven[1]	-	-	X	X	X	X	X	X	X	X
Haul Road – Upper South and White House	-	-	-	X	X	X	X	X	X	X
Reservoirs/Impoundments										
Fleming Pond	X	X	X	X	X	X	X	X	X	X
PLS Pond & Launder	X	X	X	X	X	X	X	X	X	X
5900 PLS Sump	-	X	X	X	X	X	X	X	X	X
6300 PLS Booster Station	-	X	X	X	X	X	X	X	X	X
Raffinate Pond	X	X	X	X	X	X	X	X	X	X
Reservoir 17	X	X	X	X	X	X	X	X	X	X
Reservoir 2	X	-	X	X	X	X	X	X	X	X
Disturbed Area Around Res. 5	-	-	-	X	X	X	-	X	X	X
Reservoir 6	X	-	X	X	X	X	X	X	X	X
Reservoir 7	X	-	X	X	X	X	X	X	X	X
Elmo's Pond	-	-	X	X	X	X	X	X	X	X
Lower Lined Pond	-	X	X	X	X	X	X	X	X	X
Upper Lined Pond	-	X	X	X	X	X	X	X	X	X
Seep Collection										
Dam 15	X	-	X	X	X	X	X	X	X	X
Dam 16	X	-	X	X	X	X	X	X	X	X
Dam 20	X	-	X	X	X	X	X	X	X	X
Misc. Areas										
200-Acre Unplanned Future Disturbance	-	-	X	X	X	X	X	X	X	X
Tailing Thickener 1	X	X	X	X	X	X	X	X	X	X
Lee Hill #2 Booster	X	X	X	X	X	X	X	X	X	X
Filter Plant	-	-	-	X	X	X	-	X	X	X

[1] Reclamation of Highway to Heaven Haul Road includes a riprap-lined channel to drain runoff from road.

Table 4 South Mine Area – Cost Estimating Reclamation Activities

	Breach Dam	Rough Grading	Dozer Assist Loading	Load Cover	Haul Cover	Rip Rough Grade	Rip Cover Stockpiles	Place & Grade Cover	Bench Grading	Excavate Downdrains	Excavate Bench Channels	Make Riprap	Load Riprap	Haul Riprap	Place ACB Downdrains	Place ACB Dissipaters	Place Riprap Bench Channels	Seed & Revegetate	O&M
Reservoirs																			
Axiflo	X	X	X	X	X	X	-	X	X	-	X	X	X	X	-	-	X	X	X
Roads																			
None	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stockpiles																			
Slag Pile Outslopes	-	-	X	X	X	X	-	X	-	-	-	-	-	-	-	-	-	X	X
Tailing Ponds																			
Tailing Pond 6	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X	X
Tailing Pond 7	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X	X
Tailing Pond 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Tailing Pond 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Tailing Pond B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Tailing Pond C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Tailing Pond 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Misc. Areas																			
35-Acre Misc. Area	-	X	X	X	X	X	-	X	-	-	-	-	-	-	-	-	-	X	X
Borrow Areas																			
Borrow Area F	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-
North of Borrow Area F	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-
Borrow Area E	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-
Borrow Area H	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-
West of Borrow E&H	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-

Table 5 Earthwork Equipment Production Factors

Parameter	Value	Comment/Reference
Swell Factor Stockpiles and Tailings(1)	0% for native rock 8% for cover load & haul sites	Virgin materials are being excavated to generate cover. A swell factor is applied to the excavated native volume. Cover material volumes are calculated based on the reclaimed area and the cover depth. A swell factor is included in the cost estimate while calculating the bank cover volume.
Coarse Regrading Tops and Outslopes (D11T CD)		
Operator Factor (1)	1.0	Due to large job size assume operator with excellent skills (CPH 48: 19-55, excellent)
Material Factor	1.2 1.0	(CPH 48: 19-55) 1.2 for fine grading cover, other surfaces, and channel, 1.0 for coarse regrading stockpiles and tailing
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Grade Factor – Tops	1.0	(CPH 48: 19-55) 1 to 5% Slope
Grade Factor - Outslopes(1)	1.6	(CPH 48: 19-55) 3H:1V Slopes
Material Weight (lb/cy)	3,300 2,900	Stockpiles Tailing, cover materials
Production Method/Blade Factor	1.2	(CPH 48: 19-55) Slot dozing
Visibility Factor	1.0	(CPH 48: 19-55) Clear, dust controlled by water trucks
Elevation Factor	1.0	(CPH 48: 30-7) Horsepower reduction table
Direct Drive Transmission	1.0	-
Fine Grading Cover, Other Surfaces, and Channels (D11T CD, D9T, D6T, 16M, 14M)		
Material Factor	1.2	(CPH 48: 19-55) fine grading cover
Grade Factor – Tops	1.0	(CPH 48: 19-55) 1-5% slopes
Grade Factor – Outslopes(1)	1.6	(CPH 48: 19-55) 3H:1V Slopes
Material Weight (lb/cy)	2,900	Fine grading cover material and tailing
Production Method/Blade	1.2 1.0	(CPH 48: 19-55, slot dozing) No correction applied channels, downdrains, and benches
Effective Blade Width (feet [ft])	22.0 ft D11T CD Universal Blade 14.08 ft D9T Semi Universal Blade 16 ft 16M, 14 ft 14M 10.67’ D6T SU	(CPH 48: 19-17, 19-49) (CPH 48: 19-47) (CPH 48: 11-17) (CPH 48: 19-10, 19-43)
Speed (miles/hr)	2.5 mph D11T CD, 16M, and 14M 1.0 mph D9T and D6T	(CPH 48: 11-19, 19-24, 19-25) maximum equipment speeds based on information provided in the Cat Handbook and Safe mining practices
Operator Factor(1)	0.75	(CPH 48: 19-55) Average operator skill
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Visibility Factor	1.0	(CPH 48: 19-55) Clear, dust controlled by

Parameter	Value	Comment/Reference
		water trucks
Elevation	1.0	(CPH 48: 30-7)
Direct Drive Transmission	1.0	-
Ripper (D11T CD Multi-shank [w/MSR-359H])		
Ripping Length (ft)	1,000 large surface areas 100 liners	-
Penetration (in)	18	Scope of Work (Telesto Solutions, Inc., 2017)
Pocket Spacing (in)	59	(CPH 48: 19-72)
Number of Pockets	3	(CPH 48: 19-72)
Turn Time (min/pass)	0.25	(CPH 48: 19-72 to 19-75)
Speed (mph)	1	(CPH 48: 19-72 to 19-75)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Distance between passes (in)	59	Maintain pocket spacing value between passes (Scope of Work (Telesto Solutions, Inc., 2017))
Loader (992K)		
Struck Capacity (cy)	16.0	(CPH 48: 23-223, 23-365)
Loader Cycle Time (load, dump, and maneuver; min)	0.65	(CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) $\geq$ 1" Loose Material
Speed (mph)	7.6 12.8	(CPH 48: 23-18) 7.6 mph loaded, forward 2nd gear; 12.8 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Loaders (988H, 980H)		
Struck Capacity (cy)	8.3 (988H) 7.5 (980H)	(CPH 41: 19-75) (CPH 48: 23-213, 23-214)
Loader Cycle Time (load, dump, and maneuver; min)	0.575 (988H) 0.525 (980H)	(CPH 44: 23-223) (CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) $\geq$ 1" Loose Material
Speed (mph)	7.3 12.9	(CPH 41: 12-7 [988H], 48:23-17 [980H]) 7.3 mph loaded, forward 2nd gear; 12.9 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Loader (966H)		
Struck Capacity (cy)	5.5	(CPH 48: 23-209, 23-210)
Loader Cycle Time (load, dump, and maneuver; min)	0.525	(CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) $\geq$ 1" Loose Material
Speed (mph)	7.8 13.7	(CPH 48: 23-16) 7.8 mph loaded, forward 2nd gear; 13.7 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Shovel (Hitachi EX3600-5/CAT 5230B FS) (2)		
Net Bucket Capacity (cy)	27.4	EquipmentWatch Spec for Hitachi EX3600-5
Loader Cycle Time (min)	0.45	(CPH 35: 4-236)
Bucket Fill Factor	1.025	(CPH 48: 30-2) assuming rock dirt mixture factor range from 1.00 to 1.05
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Trucks (CAT 789D/Komatsu 730E) (3)		

Parameter	Value	Comment/Reference
Struck Capacity (cy)	101	EquipmentWatch Spec for Komatsu 730E
Heaped Capacity (cy)	145	EquipmentWatch Spec for Komatsu 730E
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	35.5	(CPH 48: 10-14) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Trucks (CAT 769D)		
Struck Capacity (cy)	22.2	(CPH 29: 9-2) Capacity assumed for bench channel materials
Heaped Capacity (cy)	31.7	(CPH 29: 9-2) Capacity assumed for bench channel materials
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	47	(CPH 29: 9-2) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Trucks (CAT 725)		
Struck Capacity (cy)	14.5	EquipmentWatch spec
Heaped Capacity (cy)	19.0	EquipmentWatch spec
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	34	(CPH 48: 1-2) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Scraper (657G) Push-Pull		
Heaped Capacity (cy)	44	(CPH 48: 24-4)
Struck Capacity (cy)	32	(CPH 48: 24-4)
Rated Load (lb)	104,000	(CPH 48: 24-4)
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Load Time (min)	0.85	(CPH 48: 24-17) 0.6 to 1.1
Maneuver & Spread Time (min)	0.65	(CPH 48: 24-17) 0.6 to 0.7
Push Cycle Time (min)	0.10 Boost Time 1.19 return time (140% of scraper	(CPH 48: 28-10)

Parameter	Value	Comment/Reference
	load time) 0.15 maneuver time	
Speed (mph)	33	(CPH 48: 24-4)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Excavator (319D L)		
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Heaped Capacity (cy)	1	EquipmentWatch spec
Sheepsfoot Roller Length (ft)	3	Estimated
Maximum Reach at Ground Level (in)	380	EquipmentWatch spec
Swing Time (Loaded) (min)	0.09	(CPH 48: 7-247)
Swing Time (Empty) (min)	0.07	(CPH 48: 7-247)
Deere 7430 (and Finn B260 Mulcher, MSR-189H Ripper)		
Operating Width (ft)	12	Assigned based on typical width of revegetation equipment/implements
Speed (mph)	3	Assigned as average speed of tractor pulling revegetation equipment/implements
Work Hour (min/hr)	50	Assigned for consistency with other earthwork operations

CPH = Caterpillar Performance Handbook Editions 29, 35, 41, 44, 47, and 48 (Caterpillar, Inc., 1998; Caterpillar, Inc., 2004; Caterpillar, Inc., 2011; Caterpillar, Inc., 2014; Caterpillar, Inc., 2017; Caterpillar, Inc., 2018)

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

(2) Performance information for the CAT 5230B FS is used for parameters unavailable for the Hitachi EX3600-5.

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

Table 6 Labor and Equipment Unit Costs

Equipment Description	Fuel Cost ($/hr)	Total Rental Cost (w/o fuel) ($/hr)	NMDOL Operator Group	NMDOL Labor Rates	Total Cost (Equipment, Fuel, Labor) ($/hr)
Cat D11T CD, U Blade	$69.62	$254.44	Equipment Operator IV	$27.41	$351.47
Cat D9T, SU Blade	$33.58	$198.37	Equipment Operator IV	$27.41	$259.36
Cat D6T, SU Blade	$16.89	$63.65	Equipment Operator IV	$27.41	$107.96
Cat D6T XL, SU Blade	$18.25	$65.52	Equipment Operator IV	$27.41	$111.18
Cat 319D L	$12.29	$52.38	Equipment Operator VI	$27.70	$92.37
Cat 992K	$59.97	$216.23	Equipment Operator VI	$27.70	$303.90
Cat 988H	$35.57	$128.76	Equipment Operator VI	$27.70	$192.03
Cat 980H	$25.27	$77.56	Equipment Operator VI	$27.70	$130.53
Cat 966H	$19.61	$73.11	Equipment Operator VI	$27.70	$120.42
Cat 16M	$22.23	$93.51	Equipment Operator IV	$27.41	$143.15
Cat 14M	$19.40	$86.71	Equipment Operator IV	$27.41	$133.52
Finn B260	$9.66	$15.92	Truck Driver III	$24.27	$49.85
Cat D11T CD Multi-shank (w/MSR-359H)	$69.62	$259.35	Equipment Operator IV	$27.41	$356.37
Ripper (MSR-189H)	--	$6.77	--	--	$6.77
Cat 657G	$100.29	$195.03	Equipment Operator IV	$27.41	$322.74
Hitachi EX3600-5	$193.56	$507.98	Equipment Operator VI	$27.70	$729.25
Deere 7340	$13.99	$38.00	Truck Driver III	$24.27	$76.27
Cat 769D	$22.79	$108.01	Truck Driver III	$24.27	$155.07
Cat 725	$14.09	$73.11	Truck Driver III	$24.27	$111.47
Komatsu 730E/ CAT 789D	$78.34	$221.79	Truck Driver III	$24.27	$324.40
Off-Hwy Water Tanker Truck,6,000-gal.	$26.33	$67.69	Truck Driver III	$24.27	$118.28
1 Deck Screening Plant (5X16, 48X60)	$11.35	$40.59	Laborer I	$23.09	$75.02
3 Deck Screening Plant (5X16, 42X60)	$11.35	$41.16	Laborer I	$23.09	$75.60

Table 7 Miscellaneous Unit Costs

Activity	Base Per Unit Cost	Fuel Per Unit Cost	Units	Source	Reference
Fuel	$2.34	-	gal	N/A	Diesel fuel cost is estimated by correlating historical local quotes with public data, as agreed upon in November 2018 discussions with the agencies. Fuel cost includes direct and indirect costs at $2.34/gal.
Revegetation	$820.12	$3.85	ac	N/A	See unit rates calculations - Cost is based on a calculated unit rate that includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch.
Revegetation - Seed Only	$210.00	-	ac	N/A	Rocky Mountain Reclamation, April 2018
Revegetation - Mulch Only	$490.00	-	ac	N/A	Rocky Mountain Reclamation, April 2018: $245 per ton applied at 2 tons per acre
Bench Grading Stockpile	$1.52	$0.37	ft	N/A	See unit rates calculations
Bench Grading Tailings Pond	$1.52	$0.37	ft	N/A	See unit rates calculations
Downdrain Construction	$374.38	-	ft	N/A	See unit rates calculations
Downdrain Dissipater	$14,556.48	-	ea	N/A	See unit rates calculations
Bench Channel Construction	$4.39	$0.94	ft	N/A	See unit rates calculations
Top Channel Construction	$2.04	$0.44	ft	N/A	See unit rates calculations
Erosion Control	$2,923.36	$382.26	day	Modified Crew B-13A	Erosion control for O&M - includes 1 foreman, 2 laborers, 1 equipment operator, 2 truck drivers, 1 loader (4 cy), 2 dump trucks (8 cy)
Structure Demolition	$0.25	-	cf	Means Line Item 024116.13 0100	Building demolition, large urban projects, mixture of types, excludes foundation demolition, dump fees
Concrete Slab Demolition	$0.62	-	sf	Means Line Item 024116.17 0400	Building footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees
Storage Tank Demolition	$1,005.97	-	ea	Means Line Item 130505.75 0530	Selective Demolition - Storage Tanks, steel tank, single wall, above ground, not including foundations, pumps or piping, 5,000 thru 10,000 gallon
Power Line Demolition	$0.63	-	ft	Means Line Item 260505.10 0370	Electrical Demolition - Nonmetallic sheathed cable 3 wire; assume similar enough in cost to overhead powerlines.
Power Pole Demolition	$216.24	-	ea	Means Line Item 024113.80 0200	Selective Demolition - wood utility poles 35-45 ft high
Sludge/Water Removal from Pipelines	$0.13	-	ft	Means Line Item 026510.30 0320	Removal of underground storage tanks, petroleum storage tanks, non-leaking, remove sludge, water and remaining product from bottom of tank w/vacuum truck, 9,000-12,000 gal tank ($306.69/each); unit cost calculated assuming 1/3 of 18-inch pipe filled with sludge/water
Well Plug & Abandon	$10.47	-	ft	N/A	Layne Christensen Company, 7/31/18 Tyrone estimate is $10,000 mobilization and demobilization plus $5,704.94 for one 1500 ft well
Well Replacement	$66.43	-	ft	N/A	Wilcox Professional Services, 8/2011, est. cost for 5 ½ in bore, $173,500 for 3000 ft total ($57.83/ft). Escalated 2% 2011-2018= $66.43/ft
Reinforced Concrete Wall Demolition	$199.20	-	hr	Means Crew B-12C	Standard Union Crew: 1 equipment operator (crane), 1 laborer, 1 hydraulic excavator, 2 cy, approximately 40 hrs to demo 200 ft reinforced concrete dam.
Cover Haul Road Construction	$29.88	$7.38	ft	UC Haul Road Sheet	Assume dozer construction, 1:1 original slope, 120 ft wide
Disc Harrow Attachment, for Tractor	$616.33	-	month	Means Line Item 015433.20 1500	Equipment rental costs
Cast-in-Place Concrete	$254.97	-	cy	Means Line Item 033053.40 6200	Structural concrete, in place, gravity retaining wall (3000 psi), includes forms and reinforcement
Cleanup & Disposal of Wastes Requiring Special Handling	$335.20	-	ton	Means Line Item 028120.10 1120/1130	Solid pickup; average of minimum and maximum
Transport of Wastes Requiring Special Handling	$4.78	-	mile	Means Line Item 028120.10 1260/1270	Transportation to disposal site (Truckload = 80 drums or 25 cy or 18 tons); average of minimum and maximum
Road Maintenance	$4,945.96	$1,240.32	month		Road maintenance for O&M - includes one 14M motor grader and one 6,000-gal water truck
Groundwater Monitoring	$2,282.94	-	day		Groundwater monitoring for O&M - includes 1 foreman, 1 laborers, rental equipment, misc. field equipment, and aqueous chemistry

Means data are obtained from RS Means online (2019) for Las Cruces.

3.0 CALCULATIONS

This section describes the elements included in estimating the reclamation costs for the Chino Mine, utilizing the data and assumptions discussed in Section 2.0. Key equations used for the cost estimate calculations are presented in Appendix D, and the spreadsheet within which the calculations are performed and documented is presented in Appendix E. Design parameters, assumptions, and other information are also provided within the spreadsheet to support the cost estimation. The steps to complete the earthwork RCE are as follows:

1. Project the effort required to perform each of the various reclamation activities (i.e., material quantities, distances, slopes, equipment choices, work type).
2. Based on construction industry information and labor and fuel costs, estimate the unit cost of each reclamation activity.
3. Multiply the corresponding quantities by the unit costs to calculate the sub-total cost for each reclamation activity and sum for a total.
4. Multiply the indirect percentage rate to the total to complete the cost estimate.

Overall, the cost estimating process is the typical, standard approach used in the engineering and construction industries, consistent with the R.S. Means Construction Cost Estimating (R.S. Means, 2019) and CPH (Caterpillar, Inc., 1998; Caterpillar, Inc., 2004; Caterpillar, Inc., 2011; Caterpillar, Inc., 2014; Caterpillar, Inc., 2017; Caterpillar, Inc., 2018). Figure 5 summarizes the costing steps for one piece of equipment used in developing the fleet.

Estimating costs for earthwork is an iterative process. To estimate equipment costs, first the type of equipment is selected based on project size to complete the desired construction steps or activities. Then, productivity (in acres per hour or cubic yards per hour) of the selected equipment is calculated to complete each activity.

The task time is calculated to complete an activity at each location based on the productivity and the area or volume of material to be moved or altered at that location.

The total earthwork cost estimate is based on the number of hours it takes each task to be completed and is independent of the number of pieces of equipment except when two pieces of equipment are used for one activity. For example, the number of trucks per hydraulic shovel is optimized when loading and hauling cover material and the number of scrapers per dozer is optimized when a dozer is assisting a scraper for grading.

The main reclamation activities for the RCE for stockpiles, tailing ponds, reservoirs, seepage collection, roads, and other activities including well abandonment, building demolition, utility demolition, pipelines, pipeline corridors, and 200 acres of unplanned future disturbance are presented in this section.

3.1 Stockpiles

This RCE includes cost estimates for reclaiming the stockpiles at Chino. Cost calculations are presented in the Appendix E spreadsheet file. The main activities comprising this cost estimate include the following:

- Regrading top surfaces and outslope benches where applicable
- Ripping top areas
- Loading, hauling and grading cover material
- Grading benches
- Completing surface water channels to route stormwater
- Scarifying and revegetating covered areas
- Placing erosion protection (riprap in bench channels or ACBs in downdrains)

3.2 Tailing Ponds

Costs to reclaim the unreclaimed portions of the tailing ponds are also estimated. The reclamation costs reflect updated quantity takeoffs recently prepared by Golder (Appendix A). Cost calculations are presented in the Appendix E spreadsheet file. Reclamation activities at the tailing ponds include the following:

- Regrading top surfaces and outslope benches
- Constructing benches and outslope channels

- Loading, hauling and grading cover material
- Scarifying and revegetating covered areas
- Placing erosion protection (ACBs in downdrains)

3.3 Reservoirs

Surface impoundments and reservoirs, if not covered by stockpile reclamation activities or used as part of the post-closure stormwater management and water treatment system, will be reclaimed. Cost calculations are presented in the Appendix E spreadsheet file. The main activities associated with this cost estimate include the following:

- Breaching dam where applicable
- Ripping liners and burying in place
- Regrading
- Loading, hauling and grading cover material
- Scarifying and revegetating covered areas (includes ripping)

3.4 Seepage Collection

There are several seepage collection systems located in the NMA. Seepage collection areas not designated for PMLU or used in water treatment will be reclaimed and buried as part of stockpile reclamation. Costs for ongoing seepage collection are addressed in the water treatment part of the RCE. Cost calculations are presented in the Appendix E spreadsheet file. Reclamation costs for elimination of seepage collection systems include the following activities:

- Breaching dam where applicable
- Regrading
- Loading, hauling and grading cover material
- Scarifying and revegetating covered areas

3.5 Roads

All haul roads, with the exception of those located within the OPSDA, designated for PMLU, or used during O&M, are included in the reclamation cost estimate. Cost calculations are presented in the Appendix E spreadsheet file. The main activities involved in other roads not needed for PMLU include the following:

- Regrading where applicable
- Loading, hauling and grading cover material
- Scarifying and revegetating covered areas

3.6 Other Reclamation Costs

Other reclamation activities covered in the earthwork RCE include well abandonment, building demolition, utility demolition, pipelines, pipeline corridors, 200 acres of unplanned future disturbance, and O&M. Cost estimation for these other activities is discussed below.

3.6.1 Well Abandonment and Replacement

An estimated 1,700 feet of wells will be abandoned and replaced under the earthwork RCE. The well abandonment unit costs are based on a quote from Layne Christensen Company obtained in July 2018 (Table 7, Appendix B.5).

3.6.2 Building Demolition

A number of facilities are designated for Industrial PMLU. Those facilities not designated for Industrial PMLU will be demolished, removed, and/or buried or otherwise closed, covered, and revegetated in accordance with an approved plan.

Estimated demolition costs for buildings and other miscellaneous structures are presented in the Appendix E spreadsheet file. The main activities and design parameters used for this part of the RCE include the following:

- All equipment and above-grade structures are demolished and removed from the area or buried
- Debris is buried in place
- Demolition areas and debris are covered with 36 inches of cover material, scarified, and revegetated

- The volume of wastes requiring special handling is assumed to be in the same proportion to the structural material volume as for the Continental Mine RCE

3.6.3 Utility Demolition

Costs for demolition of utilities serving buildings to be demolished are presented in the Appendix E spreadsheet file. Costs include removal of power poles, powerlines, telephone lines, and light poles.

Powerlines to be demolished include existing powerlines that are not used during water treatment. Unit costs for powerlines and power poles are developed based on recent cost information (R.S. Means, 2019). The total footage of each is multiplied by the respective unit cost. Light poles and telephone wires/pole unit costs are assumed to be equivalent to unit costs to demolish powerlines and power poles.

3.6.4 Pipelines

To estimate pipeline reclamation costs, unit costs are developed from cost data for sludge/water removal (R.S. Means, 2019) (Table 7), applied to a typical pipeline assuming sludge/water occupies one-third of the total volume of an 18-inch-diameter pipeline. Additionally, the reclaimed pipelines are covered and buried in place with a 36-inch-thick cover and 3H:1V side slopes. Reclamation is applied to 50% of the entire length of pipeline on site to exclude pipelines to be used during water treatment, pipelines within the pit area, pipelines under and adjacent to impoundments and stockpiles, and fresh water and sewer pipelines that will continue to be used under PMLU. Cost calculations are presented in the Appendix E spreadsheet file.

3.6.5 Pipeline Corridor Area

Cost estimates for the narrowing of the Pipeline Corridor Area (PCA) upon closure include the costs to revegetate the adjacent areas in the PCA that are not needed for post-closure O&M. Cost calculations are presented in the Appendix E spreadsheet file.

3.6.6 Unplanned Future Disturbance Areas

Additional reclamation costs are included to account for the dynamic nature of mining. This approach is intended to allow greater flexibility in meeting the mine planning schedule and reduce the number of FA amendments. Unplanned future disturbance areas, estimated to total 200 acres, may include small staging areas, utility corridors, haul roads, pull-offs, stockpile expansions, or other miscellaneous unforeseen changes in the mine plan.

3.6.7 Operations and Maintenance

Post-closure O&M estimated costs include revegetation maintenance, erosion control, road maintenance, and groundwater monitoring. Revegetation maintenance is included (O&M Sheet 1) in reclamation O&M for Years 0 through 29. 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. Other O&M costs are assumed to diminish with time over 100 years.

4.0 RESULTS

The total current dollar cost for earthwork reclamation is estimated to be $176,900,000 plus $8,546,000 O&M for a total of $185,446,000**.** A summary of the cost estimate is provided in Table 8. Facility Characteristics Forms and estimated costs, by location, are presented in Appendix F. The costs presented in this RCE are current (2019) dollar costs.

Table 8 Earthwork Cost Estimate Summary

Item	Direct Cost	Indirect Cost	Total Estimated Cost
Facility		**30% of Direct**	
Triangle Stockpile	$2,302,946	$690,884	$2,993,830
South Stockpile	$32,235,067	$9,670,520	$41,905,588
West Stockpile	$20,111,955	$6,033,586	$26,145,541
Lambright Stockpile	$37,892,017	$11,367,605	$49,259,621
Southwest Lampbright	$1,705,486	$511,646	$2,217,132
South and East In-Pit Stockpiles	$480,759	$144,228	$624,987
Northwest Stockpile	$75,797	$22,739	$98,535
Lee Hill Stockpile	$224,370	$67,311	$291,682
Northeast Stockpile	$140,266	$42,080	$182,346
North Stockpile	$73,516	$22,055	$95,570
STS2	$164,831	$49,449	$214,281
Upper South Stockpile	$408,741	$122,622	$531,363
9 Waste Rock	$1,485,534	$445,660	$1,931,194
Ground Hog #5	$6,249	$1,875	$8,124
Stockpile Subtotal	**$97,307,534**	**$29,192,260**	**$126,499,794**
Miscellaneous NMA	$497,178	$149,153	$646,332
Miscellaneous SMA	$478,356	$143,507	$621,863
200-Acre Unplanned Future Disturbance	$1,303,973	$391,192	$1,695,164
Upper South & White House (to Lampbright)	$675,875	$202,763	$878,638
Miscellaneous Subtotal	**$2,955,382**	**$886,615**	**$3,841,996**
Demolition	$4,591,210	$1,377,363	$5,968,573
Demolition Subtotal	**$4,591,210**	**$1,377,363**	**$5,968,573**
Dams and Reservoirs	$152,819	$45,846	$198,665

Item	Direct Cost	Indirect Cost	Total Estimated Cost
Dams & Reservoirs Subtotal	**$152,819**	**$45,846**	**$198,665**
Axiflo	$1,072,368	$321,710	$1,394,078
Tailing Pond 6	$4,026,681	$1,208,004	$5,234,685
Tailing Pond 7	$25,065,046	$7,519,514	$32,584,560
Tailing Pond Subtotal	**$30,164,095**	**$9,049,228**	**$39,213,323**
White House	$59,145	$17,743	$76,888
Borrow Area F	$46,946	$14,084	$61,030
North of Borrow Area F	$64,238	$19,271	$83,509
Borrow Area E	$104,052	$31,215	$135,267
Borrow Area H	$156,271	$46,881	$203,152
West of Borrow E&H	$475,028	$142,508	$617,537
Borrow Area Subtotal	**$905,679**	**$271,704**	**$1,177,383**
Closure Costs Total	**$136,076,720**	**$40,823,016**	**$176,899,735**
O&M		**17.5% of Direct**	
Full Site O&M Costs Total	**$7,273,158**	**$1,272,803**	**$8,545,960**
Total Cost (Closure + O&M)	**$143,349,877**	**$42,095,818**	**$185,445,696**

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