Freeport-McMoRan Cobre Mining Company
2014 Continental Mine

Closure/Closeout Plan Update

Prepared for

Freeport-McMoRan

Cobre Mining Company

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December 2014

Revised February 2018

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Signature Page

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List of Acronyms and Abbreviations

AGP	Acid-generating Potential
AMSL	Above Mean Seal Level
ANP	Acid-neutralizing Potential
BLM	Bureau of Land Management
CCP	Closure/Closeout Plan
CDM	Camp Dresser & McKee Inc.
Chino	Freeport-McMoRan Chino Mines Company
CHR	Cobre Haul Road
Cobre	Freeport-McMoRan Cobre Mining Company
CQA	Construction Quality Assurance
CQC	Construction Quality Control
DBS&A	Daniel B. Stephens and Associates, Inc.
DP	Discharge Permit
EOY	End of Year
Golder	Golder Associates
LG WRF	Low Grade Waste Rock Facility
M3	M3 Engineering & Technology Corp.
MGTI	Magnetite Tailings Impoundment
MMD	Mining and Minerals Division, New Mexico Energy, Minerals and Natural Resources Department
MTI	Main Tailings Impoundment
MWMP	Meteoric Water Mobility Procedure
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMMA	New Mexico Mining Act
NMSA	New Mexico Statutes Annotated
NNP	Net Neutralization Potential
NOBS	North Overburden Stockpile
NPAG	Not Potentially-acid Generating
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OB	Overburden
OSE	Office of the State Engineer
PLS	Pregnant Leachate Solution
PMLU	Post-Mining Land Use

RCM	Reclamation Cover Material
SSE	self-sustaining ecosystem
SMI	Shepherd Miller, Inc.
SWRDF	South Waste Rock Disposal Facility
SWPPP	Storm Water Pollution Prevention Plan
SX/EW	Solution Extraction/Electrowinning
Telesto	Telesto Solutions, Inc.
TDS	Total Dissolved Solids
USSR&M	United States Smelting, Refining, and Mining Company
WQCC	Water Quality Control Commission
WRF	Waste Rock Facility
URS	URS Corporation

1.0 INTRODUCTION

Freeport-McMoRan Cobre Mining Company (Cobre) owns and operates an existing mining operation (The Continental Mine) authorized under State issued mining permit No. GR002RE. The Continental Mine is located northeast of Santa Clara, New Mexico (Figure 1). Active mining and milling of copper ore ceased in 1999. Cobre is planning to resume mining activities in the near future and continue for approximately 10 years.

An existing Closure/Closeout Plan (CCP) is approved for the Continental Mine operation under Permit No. GR002RE, issued by the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department, and under Discharge Permit-1403 (DP-1403), issued by the New Mexico Environment Department (NMED). The CCP describes measures to close and reclaim the Continental Mine if the closure/closeout work had to be performed by a third-party contractor. This 2014 CCP includes an updated cost estimate for the closure/closeout measures and post-closure/closeout maintenance.

1.1 Purpose

This 2014 CCP Update is written to satisfy the requirements of:

1. MMD Permit Revision 12-1 to Permit No. GR002RE (GR002RE 12-1, Section 9.EE)
2. Copper Mine Rules [New Mexico Administrative Code (NMAC) 20.6.7]

This CCP Update is also intended to update the pending DP-1403 renewal application with more current information.

The 2014 CCP Update also conforms to all applicable mine reclamation regulations set forth by the U.S. Bureau of Land Management (BLM; 43 CFR 3809). The land that is planned to be disturbed by future mining is either managed by the BLM or owned by Cobre.

This CCP provides a conceptual plan for closure and reclamation (technical scope of work) of the site. Upon the approval of the scope of work, a cost estimate will be calculated to meet the financial assurance requirement of the State of New Mexico and BLM guidelines. It should be noted that a portion of the site including the Cobre to Chino Haul Road are regulated by BLM and MMD. The NMED deemed it a non-discharging unit.

1.2 Organization

The overall organization of this 2014 CCP Update is:

- **Section 1.0** provides an overview of the 2014 CCP update and history
- **Section 2.0** summarizes Cobre's permit and discharge plans, and permitted facilities
- **Section 3.0** describes the existing mine facilities, land use, and environmental setting
- **Section 4.0** presents completed reclamation projects
- **Section 5.0** describes the performance objectives and general reclamation design for each facility type
- **Section 6.0** describes the post mining land use designations
- **Section 7.0** describes the post-closure monitoring, reporting, and contingency plans
- **Section 8.0** presents a summary of the capital and operation and maintenance (O&M) cost estimates
- **Section 9.0** presents a closeout schedule
- **Section 10.0** lists the references used in preparation of this 2014 CCP Update
- **Tables**
- **Figures**
- **Drawings** are reclamation design drawings
- **Appendix A** includes the facility characteristic forms
- **Appendix B** includes the earthwork cost estimate summary report. Only an explanation of the proposed changes to the original 2014 CCP Update is provided herein, pending approval of the technical scope of work.
- **Appendix C** includes the water management cost estimate summary report. Only an explanation of the proposed changes to the original 2014 CCP Update is provided herein, pending approval of the technical scope of work.

- **Appendix D** includes an electronic copy of this 2014 CCP Update report. An excel file of the cost estimate will be provided, after approval of the technical scope of work.

1.3 Regulatory Authority

In 1993, the New Mexico legislature enacted the New Mexico Mining Act (NMMA) requiring that closeout plans be put into place for applicable mines within the state. Rules to implement the conditions of the NMMA were promulgated in 1994. This plan was prepared to comply with all applicable regulations and conditions stipulated in the NMMA, the Mining Act Rules for Existing Mining Operations, (19.10.5 NMAC), the New Mexico Water Quality Act, and the New Mexico Water Quality Control Commission (WQCC) Regulations (20.6 NMAC, Parts 2 and 7). In 2013, NMED adopted new rules for the copper mining industry. Applicable conditions of these new rules (Copper Mine Rules 20.6.7 NMAC) have been addressed in this 2014 CCP Update.

1.3.1 The New Mexico Mining Act and Administrative Rules

The NMMA established a goal of promoting responsible utilization and reclamation of lands impacted by mining while also recognizing that mining is vital to New Mexico's economy. The program is administered by the MMD, and approved existing mine permits apply for the life of the operation. The Continental Mine is regulated as an "existing mine" under the NMMA because it produced marketable minerals for a total of at least two years between January 1, 1970 and the effective date of the NMMA.

1.3.2 Closeout Planning

The MMD's Mining Act Rules (Rules) and advisory Closeout Plan Guidelines provide a foundation for the development of closeout plans. The Rules state that, "*closeout plans shall be based on site-specific characteristics and the anticipated life of the mining operation. Site-specific characteristics include, but are not limited to, disturbances from previous mining operations, past and current mining methods utilized, geology, hydrology and climatology of the area*" (19.10.5.506.A NMAC). The MMD guidelines recognize that each site presents a unique set of circumstances and that many of the existing mines subject to closure conditions were largely developed prior to the NMMA without the condition for reclamation.

Closeout must be designed to achieve a "self-sustaining ecosystem" (SSE), unless achieving an SSE is not consistent with the contemplated post-mining land use (PMLU), which must be approved by the Director of the MMD. PMLUs include, but are not limited to, agricultural (e.g. cropland, grazing land, or forestry), commercial, industrial, or ecological uses that would comply with applicable laws and regulations. Specific mine areas may also be granted a waiver from achieving a SSE. Specific closeout requirements are described in Permit GR002RE, which identifies the currently-approved PMLUs. Determining future land-use is the first step in developing a closeout plan and establishing financial assurance for the site. The PMLU applicable to the Continental Mine and its facilities are wildlife habitat and industrial. The CCP is designed to achieve a SSE for areas with an approved wildlife habitat PMLU, but not for areas with an approved industrial PMLU. The Continental Pit was granted a conditional waiver from achieving a SSE.

1.3.3 Closure Planning

In addition to the NMMA and Rule requirements for closeout, this CCP is designed to meet the closure requirements under the New Mexico Water Quality Act and the Water Quality Control Commission Regulations. Cobre's current closure requirements are specified in DP-1403. Additional closure requirements have recently been adopted as part of the Copper Mine Rule, 20.6.7.33 NMAC. Those requirements have not yet been incorporated into Cobre's discharge permits; however, this plan has been prepared to meet those requirements. Permitted activities are further described in DP-181 and DP-1056. In general, closure of the Continental Mine involves mine process water management, protection of groundwater quality outside of the area of open pit hydrologic containment, in accordance with the Copper Mine Rule, and earth work and revegetation designed to establish a SSE and to achieve a wildlife habitat PMLU for the waste rock stockpiles, tailing impoundments, and other facilities, except for areas with an approved industrial PMLU or subject to the conditional waiver.

Cobre has conducted a broad range of specialized environmental studies directed under Permit GR002RE and the discharge permits related to groundwater, stormwater drainage, slope stability, airborne material, cover design and test plots, and water treatment to evaluate the economic and environmental impacts of various closure considerations. Environmental and closure studies were formally started in 1993 (CDM, 1994). Environmental studies have continued through the present day. The salient points of the studies are that:

- Deep groundwater north of the confluence of Poison Spring Drainage is captured by the Continental Mine underground workings and Continental Pit
- The Continental Pit will function as a hydrologic evaporative sink
- Existing seeps at the toes of Waste Rock Facilities (WRFs) are:
  - sourced from precipitation
  - manageable with existing infrastructure
  - will cease after reclamation when the vegetative cover system is in place
- The Main Tailings Impoundment (MTI) is in a draindown condition and will reach an equilibrium in a minimum of 30 to 50 years after tailings deposition cessation (last deposition: 1999)
- Adequate reclamation cover material (RCM) exists on site to meet reclamation conditions for current disturbance, planned mine expansion, and unconstructed facilities

In addition to the findings from these ongoing comprehensive studies, Cobre is currently developing a groundwater abatement (GWA) plan to identify and address potential impacts to groundwater. Stage 1 of the GWA plan includes investigation of the site and Stage 2 provides an evaluation and proposal of appropriate abatement measures. Cobre submitted a Stage 1 GWA plan in February 2005 (Telesto, 2005a) followed by an addendum in June 2005 (Telesto, 2005b). An interim Stage 1 GWA plan was submitted to NMED in 2011 (Telesto, 2011) which described the general characteristics of the groundwater system associated with the Continental Mine facilities. Cobre and NMED personnel have met on several occasions to review the GWA approach and a work plan for completion of the Stage 1 GWA report is being developed. Once the Stage 1 report is approved, Cobre will prepare Stage 2 of the GWA plan.

Cobre continues to conduct closure studies, monitoring, and data collection in accordance with MMD and NMED permits. In the future, these ongoing efforts may show that other alternatives are available for closure. The Copper Mine Rule is designed to encourage and allow for these advancements. Thus, Cobre reserves the right to update the CCP as studies, monitoring data, and reclamation science and technology improve.

1.3.4 Office of the State Engineer

The Office of the State Engineer (OSE) Water Rights Division administers New Mexico public waters use under the authority of the New Mexico Statutes Annotated (NMSA) 1978, Chapter 72. The OSE administers Cobre's seven water rights, which allow an average of 2,167 acre-feet per year of withdrawal, through monitoring and permitting points of withdrawal. The OSE also issues permits for drilling new wells, including wells used for monitoring and remediation of impacted groundwater, as well as the closure of wells and exploration holes.

Additionally, the OSE is responsible for public safety associated with dams and water retention structures that are over 25-feet high with a capacity to contain more than 15 acre-feet of storage (i.e., jurisdictional dams). The OSE regulates jurisdictional dams through a registration program. The two tailings impoundments at Cobre's Continental Mine are jurisdictional dams registered with the OSE.

1.4 History of CCP Submittal

The following section presents the chronology of CCP submittals and other CCP related documents for Cobre:

- In 1994, Cobre submitted a mining operations site assessment and an existing mining operation permit application. The permit application was approved by the MMD on December 3, 1996
- Cobre submitted a preliminary CCP for constructed and unconstructed facilities in June of 1998
- An addendum CCP for mining at Hanover Mountain, the North WRF, and the Union Hill portion of the South WRF was submitted by Cobre in October 1998
- An addendum CCP for the Fierro Leach Pad was submitted in 1998
- Also in 1998, Cobre submitted a closure-plan supplement for Cobre's proposed Humbolt leach facility

- Cobre submitted a closure/closeout conceptual design summary report for constructed and unconstructed facilities in November 1999
- In November 1999, Cobre submitted a conceptual design summary for its proposed Fierro Leach Pad and Pregnant Leachate Solution (PLS)/Raffinate Pipeline
- In April 2001, Cobre submitted an End-of-Year 2001 through Year 2006 CCP (M3, 2001)
- In February 2001, Cobre submitted a waste rock handling plan for Hanover Mountain which included Continental Pit material (Geotrans, 2001)
- In January 2005, Cobre submitted an update to the 2001 CCP including reclamation cost estimates (Telesto, 2005c)
- In June 2005, Cobre submitted a Closure Plan for mining at Hanover Mountain, Condition 21, DP-1403 (Telesto, 2005d)
- In December 2005, Cobre submitted a standby permit application to the MMD and an interim plan (related to standby) to the NMED, approved respectively by NMED (2006) and MMD (2007)
- In August 2009, Cobre submitted the 2009 Cobre CCP (Telesto, 2009a)
- In January 2012 Cobre applied for a renewal of standby status and received conditional approval on November 21st, 2013. One of the conditions of approval included the development and submission of this CCP
- In August 2014, Cobre submitted a new unit application for the Cobre Haul Road (CHR), which included a slight modification to the MMD permit boundary and a closeout plan; both are incorporated herein. The CHR was approved on 11/07/2016 as a Revision to Permit GR002RE.

Cobre submitted the original 2014 Continental Mine CCP Update in December 2014. Since that submittal, a number of documents applicable to the ongoing technical review have been produced by MMD, NMED or Cobre as part of ongoing environmental permitting and/or as part of the CCP Update technical review. These documents are listed below:

- June 29, 2016 NMED Request for Additional Information, 2014 Continental Mine Closure/Closeout Plan Update, Cobre Mining Company, Cobre Mine
- Nov. 8, 2016 MMD approval of Permit GR002RE, Rev. 14-1, incorporating the Cobre to Chino Haul Road Project
- Jan. 31, 2017 Freeport-McMoRan Cobre Mining Company: Discharge Permit (DP)-1403, Request for additional information- MMD Closure Closeout Plan response letter

- April 10, 2017 Freeport-McMoRan Cobre Mining Company- GR002RE Rev. 15-1, Response to Agency and Public Review Comments
- July 10, 2017 NMED Request for Additional Information, Closure/Closeout Plan, DP-1403
- Sept. 7, 2017 Freeport-McMoRan Cobre Mining Company- Response to Request for Additional Information, Closure/Closeout Plan, DP-1403
- Dec. 6, 2017 NMED Request for Additional Information, Closure/Closeout Plan, DP-1403
- Jan. 29, 2018 Freeport-McMoRan Cobre Mining Company Discharge Permit-1403, Request for additional information Closure Closeout Plan response letter

1.5 Description of Updated Plan

The MMD and NMED require that existing mines prepare a CCP and the entity responsible for the mine must put into place financial assurance, “sufficient to assure the completion of the performance requirements of the permit, including closure and reclamation, if the work had to be performed by the director or a third party contractor.”

Facility characteristics, reclamation designs, and the reclamation cost estimate presented in this 2014 CCP Update are based on projected conditions at the Continental Mine by EOY 2019. The planned configuration and reclamation of the mine at EOY 2019 is depicted in Drawing Sheets 1 through 10. The configuration for EOY 2019 is the year with the greatest area of disturbance requiring reclamation. Consequently, the cost estimate for closure and closeout measures for the period between 2015 and 2019 would be highest at EOY 2019, hypothetically assuming that the CCP would be implemented for conditions existing at EOY 2019. The NMED and MMD approved using the EOY 2019 configuration for the 2014 Updated CCP on October 23, 2014.

Cobre’s 2014 mine expansion plan anticipates first constructing the CHR, then proceeding with active mining for approximately 10 years with the potential to extend the mine life to accommodate advances in technology or additional copper resources in the area. In general, the plan consists of constructing the CHR between the Continental Mine and Freeport-McMoRan Chino Mines Company’s Chino Mine (Chino) where beneficiation of ore will occur, mining Hanover Mountain and the Continental Pit, constructing the North Overburden Stockpile

(NOBS), expanding the South Waste Rock Disposal Facility (SWRDF), and relocating various infrastructure.

In August 2014, Cobre submitted an application to the MMD to revise GR002RE to expand the approved permit boundary and design limits for the construction of the CHR. Figure 19 shows the proposed MMD beneficiation design limit. The application was declared administratively complete on October 7, 2014 and was approved as Permit Revision 14-1 to Permit GR002RE on Nov. 7, 2016by the MMD. The 2014 CHR Closeout Plan is attached in Appendix B.4 of this document (pending approval of the technical scope of work). It was submitted as Appendix A in the application to revise Cobre's mining permit and was updated in February 2016 to reflect agreements reached during agency review of Permit Revision 14-1.

1.6 History of the Continental Mine

The area referred to herein as the Continental Mine is reported to have produced commercial amounts of copper since 1858 (Hart, 1984) with approximately one million pounds of copper ore produced between 1858 and 1861 (Forrester, 1972). In addition to copper, iron ore has also been mined at the site. Iron ore production reached its peak (200,000 tons per year) between the years 1916 and 1931 (Forrester, 1972), when the mine was owned and operated by the Hanover Bessemer Iron and Copper Company, an eventual subsidiary of U.S. Smelting, Refining and Mining Company (USSR&M). The mine was subsequently operated by a series of lessees until additional copper mineralization was discovered around 1947. Following this discovery, copper ore was produced at the rate of 250 tons per day and processed at the USSR&M's Bullfrog Mill, located approximately six miles south of the present day Continental Mine.

The establishment of the Continental Mine has been dated to 1964, commencing with the construction of a production shaft and underground workings (Hart, 1984). The No. 1 flotation mill was completed in 1967 with a 4,000 ton-per-day capacity and was designated primarily to process underground ore. A second flotation mill (No. 2 Mill), with an 8,000 ton-per-day capacity, was completed in 1973 to process ore derived from the newly constructed Continental Pit. From 1974 to 1992, the mine was owned by a series of companies including U.V. Industries, Sharon Steel, and Bayard Mining Corporation. Cobre Mining Company acquired the property in the early 1990s and re-initiated mining operations. A subsidiary of Phelps Dodge Corporation acquired Cobre Mining Company in 1998 and active mining and milling of copper ore ceased in 1999. Following the 2007 merger of Phelps Dodge Corporation and Freeport-McMoRan Copper & Gold Inc., Cobre Mining Company was renamed as Freeport-McMoRan Cobre Mining Company.

The majority of the mine operations are located on patented mining claims and private lands; however, isolated parcels of BLM land lie within the mine permit area. A portion of the property immediately surrounding Cobre's holdings is public land managed by the BLM and U.S. Forest Service.

2.0 PERMIT AND DISCHARGE PLANS

Cobre holds several federal and state permits and authorizations as an existing mining operation. Table 1 lists Cobre's permits and Tables 2A and 2B summarize permitted existing facilities and permitted unconstructed facilities, respectively. Tables 2A and 2B also identify which permit each facility is listed in. The following sections briefly summarize each permit. Mining at Hanover Mountain is permitted under the facility name Hanover Mountain Mine. This document refers to the Hanover Mountain Mine as the Hanover Mountain Deposit.

2.1 Mining Act Permit

The MMD issued Permit GR002RE 01-1 to Cobre on March 4, 2005, which incorporates Cobre's April 2001 CCP (M3, 2001) and an earthworks cost estimate update (Telesto, 2005c). Permit GR002RE requires submittal of a revised CCP every five years after the initial submittal and submittals to correspond to the renewal of DP-1403. In recognition of the five-year term of discharge permits issued by NMED, Cobre's 2014 CCP Update identifies and is based upon currently-planned changes in mining operations over the next five years. Permit GR002RE specifies the conditions required to mitigate and reclaim disturbed areas and establish a SSE, except for areas designated as Industrial PMLU or areas that have been granted a waiver. Revision 14-1 to Permit GR002RE, incorporating the Cobre Haul Road was issued on Nov. 8, 2016. The provisions of the revision are integrated into this CCP Update.

2.2 Discharge Plans

DP-1403 was issued on December 10, 2004 and contains the closure conditions that address discharges of contaminants that may move into groundwater from Cobre's permitted facilities. The NMED has also issued two Operational Discharge Permits, DP-181 and DP-1056 (NMED, 2008). DP-181 was renewed on March 2, 2007 and covers existing facilities. DP-1056 was issued on September 19, 2008 and covers unconstructed facilities. Applications for the renewal of all three discharge plans are currently under NMED review.

DP-181 and DP-1056 regulate discharges that may occur during mine operations from existing and proposed facilities, respectively. DP-1403 supplements DP-181 and DP-1056 and contains closure conditions for discharging facilities associated with the mine after closure. The DP-181 renewal application, submitted in 2011, proposed to restructure the existing discharge permits (DP-181 and DP-1056) to include 2014 mine plan permitted facilities in a single permit. The DP-1056 renewal application, submitted in 2013, included unconstructed permitted facilities, not planned in the 2014 mine expansion plan.

2.3 National Pollutant Discharge Elimination System Permit

Cobre maintains a Storm Water Pollution Prevention Plan (SWPPP) for the mine in accordance with the United States Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (Table 1). The SWPPP details procedures and best management practices for managing stormwater discharge associated with industrial activities. The SWPPP is kept up to date and is available on site.

2.4 BLM Permitting

The Continental Mine includes several small pieces of land managed by the BLM and maintains a Mine Plan of Operations (Cobre, 2012) in accordance with BLM surface management regulation 43 CFR 3809. The Mine Plan of Operations Amendment No. 5 proposes to utilize approximately 36 additional acres of BLM land to resume operations at the Continental Mine. The Mine Plan of Operations was submitted in December 2012, and includes in part, a proposal by Cobre to utilize approximately eight acres of BLM land for the construction of the CHR. The CHR would be located to the east of the communities of Hanover and Fierro. The locations and acreage of all lands included in Amendment No. 5 are shown on the following table.

Cobre Amended MPO Location	**Acres**
Hanover Mountain	0.29
North Overburden Stockpile and Haul Road	19
South Waste Rock Disposal Facility (SWRDF)	6.3
Connecting Haul Road	8.7
SWRDF Dam 2	0.63
Utility Corridor and Substation	1.3
Total	**36**

The BLM issued a Decision Record Approving Amendment No. 5 to the Mine Plan of Operations on May 13, 2015.

2.5 Other Permits

Table 1 also lists other registrations and permits held by Cobre. Cobre and Chino constitute a single “source” under the federal Clean Air Act, as implemented by the State of New Mexico. Therefore, current and planned Cobre and Chino activities are unified in two types of air emissions permits to protect air quality: 1) Construction permit (typically known as New Source Review permit) and 2) a State Title V Operating permit.

The Continental Mine holds a Nationwide Section 404 Clean Water Act permit, overseen by the US Army Corps of Engineers, for the construction of the CHR. Areas requiring a nationwide permit are associated with the CHR crossing Hanover Creek, a small drainage next to the Kearney Mine, and an existing road expansion in upper Grape Gulch.

3.0 FACILITIES AND CONDITIONS

The following sections describe the Continental Mine’s existing facilities, planned facilities, past and current land uses, and environmental setting.

3.1 Description of Existing Mine Facilities

Figure 3 provides an overview of the facilities associated with the Continental Mine on an aerial base map. Figure 4 provides a similar overview of the Continental Mine area on a topographic base map and provides a location key for Figures 5 through 8. Figures 5 through 8 show existing topography, facilities, permit boundaries, and main mine components in more detail. The main mine components are described in the following Sections 3.1.1 through 3.1.11.

3.1.1 Main Tailings Impoundment

Construction of the Main Tailings Impoundment (MTI) began in 1967 and continued until production was temporarily halted in the spring of 1999. The impoundment currently covers approximately 142 acres including the Reclaim Pond, which covers an area of approximately 27 acres. The Reclaim Pond is located at the northern end of the impoundment and is separated from the main impoundment by a filter dike. Activities permitted under DP-181 allow the expansion of the MTI to the west and northwest to an area of approximately 269 acres, not to exceed 7,140 feet above mean sea level. The 2014 CCP Update assumes that the MTI will remain in its existing state, ready for future mine activity, through EOY 2019.

Tailings dam embankments run along the east and south sides of the impoundment for a distance of approximately 5,000 feet, with outslopes ranging from approximately 1.4:1 (horizontal: vertical) to approximately 2.5:1. The impoundment was built using upstream construction methods, with tailings spigotted upstream of raised berms composed of mine rock. Stability buttresses, which reinforce the tailings dam embankments, were constructed along portions of the east and south embankments in 2005 (URS, 2006), and is still stable (Golder, 2009a). The MTI is regulated by the OSE and meets or exceeds all of the regulatory criteria for structural stability.

The physical and chemical properties of tailings materials present in the MTI have been characterized and documented in multiple reports [(SMI, 1997), Daniel B. Stephens and Associates, Inc.; (DBS&A, 1999a), (DBS&A, 1999b), (Geotrans, 2001), (Golder, 2004a), and (Golder, 2004b), (Telesto, 2005e), (Telesto, 2005f), (Golder, 2006), (Telesto, 2008a), (Telesto, 2009b)]. Tailings consist of finely ground material, generated in the milling of ore, composed of silicate material, with a considerable portion of carbonate bearing material with substantial neutralizing capacity (Telesto, 2008a). Tailings samples have been classified as Not Potentially-acid Generating (NPAG). GR002RE (Section 9.D.2.b) approves the upper foot of tailings material for use in a three-foot thick cover. NMED has requested additional geochemical information to demonstrate that the upper foot of tailing does not have the potential to generate ground water contaminates that would cause an exceedance of groundwater standards. Cobre is conducting a field and laboratory testing program to confirm this. The results of the testing will be submitted to the NMED by April 30, 2018.Based on current observations of vegetation on the tailings, as well as historical geochemical testing, it appears that the proposed upper foot of tailing may meet the requirements of Section 20.6.7.33.F(3) of the Copper Mine Rule.

In addition to typical mill tailings, relatively minor amounts of magnetite from the magnetite tailing storage facility have been moved to the top surface of the main tailing impoundment and placed adjacent to the filter dike. The minor quantity of magnetite placed in this area was moved because it was not marketable as magnetite because it was mixed with either A) local natural soil and rock or B) mill tailings from Mills 1 and 2 that was discharged on top of the magnetite tailing storage facility during operational upset conditions.

In 2007, a six-inch-thick soil/rock cover was placed over approximately 90 percent of the impoundment surface, to alleviate wind-blown tailings. The cover material was sourced from the Overburden Stockpile #5, approved for use as RCM. In accordance with DP-1403 (Condition 77), approximately 7.6 acres of reclamation test plots were constructed to evaluate cover performance, erosion rates, and vegetation success.

3.1.2 Magnetite Tailings Impoundment

The Magnetite Tailings Impoundment (MGTI) contains magnetite that was recovered from the milling process. The impoundment currently covers approximately 63 acres. The MGTI embankment was built using upstream construction methods that included tailings spigotted upstream of raised berms, which were composed of mine rock.

Production records indicate that approximately 2,881,000 tons of magnetite tailings were produced between 1969 and 1982. Current estimates of impounded tailings tonnage are based on a drilling and sampling program conducted in 2001 and records of ongoing sales. Ongoing sales of magnetite have removed approximately 598,000 tons of tailings through EOY 2013. The approximately 1,587,000 tons of magnetite remaining in the impoundment are considered marketable. The MGTI also includes approximately 172,000 tons of magnetite tailings mixed with rock/soil and approximately 379,000 tons of other non-magnetite solids (primarily embankment material). The MGTI is regulated by the Office of the State Engineer.

The physical and chemical properties of magnetite tailings materials have been characterized and documented in multiple reports [(SMI, 1999), (Telesto, 2005e), (Telesto, 2005f), (Telesto, 2008a), and (Telesto, 2009b)]. Magnetite tailings have been characterized as fine-grained material with an iron oxide content ranging up to 70% by weight. The magnetite tailings are neither significantly acid generating nor strongly acid neutralizing.

Although sales of magnetite will continue, the area of disturbance and the defining features of the MGTI are not anticipated to substantially change by EOY 2019.

3.1.3 Continental Pit

Construction of the Continental Pit began in 1973 and was temporarily halted in the spring of 1999. The ore body was mined using a 20-foot high, multiple bench open-pit techniques and conventional drilling, blasting, excavating, and hauling methods to move ore and waste from the active mining area. Currently, the open pit comprises an area of approximately 143 acres and is 500 feet deep. After dewatering of the Continental Underground Mine ceased in August of 2000, the underground workings began to fill with groundwater. The water expressed itself in the bottom of the open pit in March 2012 and an open pit lake was visible by July 2012 and continues to expand. Predictions in Telesto 2008a and 2008e indicate that the open pit lake will be a hydrologic evaporative sink. Activities planned under DP-181 renewal will allow expansion of the Continental Pit to 250 acres. Per GR002RE, the Continental Pit has been granted a conditional waiver from achieving a SSE.

3.1.4 Waste Rock Facilities

The existing WRFs include five contiguous stockpiles permitted under DP-181: the East (82.2 acres), West (53.3 acres), Buckhorn (28.4 acres), and South and Union Hill (100 acres). Waste rock was last placed in 1999. Per DP-1403 (Condition 77) and Section 9.M. of Permit GR00RE, Rv. 01-1, reclamation test plots were constructed on the East WRF (3.9-acre test plots) and the West WRF (8.5-acre test plots) to evaluate cover performance, erosion rates, and vegetation success. Activities permitted under DP-181 allow expanding the WRFs to approximately 400 acres.

The physical and chemical properties of waste rock present at Cobre's mines have been characterized and documented in multiple reports [(SMI, 1999), (DBS&A, 1999a), (DBS&A, 1999b), (Geotrans, 2001), (Golder, 2004a), and (Golder, 2004b), (Telesto, 2005e), (Telesto, 2005f), (Golder, 2006), (Telesto, 2008a), (Telesto, 2009b)]. Approximately 400 samples were analyzed from 180 surface locations to characterize various waste rock types. Telesto (2008a) provides the most comprehensive summary of waste rock characteristics to date.

3.1.5 Other Stockpiles

Other stockpiles at the Continental Mine include: the Low Grade Waste Rock Facility (LG WRF), High-Grade Ore Stockpile, No. 3 Shaft Stockpile, overburden (OB) stockpiles 1 through 5, East OB stockpile, and a Topsoil Stockpile (Figure 3). The LG WRF consists of two adjacent stockpiles located along the eastern edge of the Continental Pit (Figure 3). The LG WRF was initially developed between 1967 and 1970, and has changed in configuration throughout time. The High-Grade Ore Stockpile is located northeast of the Continental Pit, north of the Poison Springs Drainage, and west of the No. 2 Mill. No. 3 Shaft Stockpile is located southeast of Mill Building #1, near the No. 3 Shaft. The No. 3 Shaft Stockpile is composed of non-ore material produced from the construction of the Continental No. 3 Shaft (SMI, 1999). The materials in the High-Grade Ore Stockpile will be sent to the Chino Mill and the No. 3 Shaft stockpile will be mined or incorporated into a haul road prior to EOY 2019.

OB Stockpiles 1, 2, 3, and 5 are composed largely of Colorado Formation leach cap from Hermosa Mountain that has been stockpiled for use as RCM. The origin of the materials in the

Topsoil Stockpile and OB Stockpile 4 is from stripping operations at the start of the Continental Pit. The East OB Stockpile is located on top of the East WRF and is composed of carbonate material from the Continental Pit.

As part of the 1999 CCP studies, DBS&A (1999b) conducted a borrow materials investigation, which has been since supplemented by Golder (2006). The principal finding of this study was that traditional topsoil resources were limited in the vicinity of the Continental Mine. Area soils found were considered marginally suitable, mainly because they are shallow and/or occur on steep slopes. Salvaging and stockpiling the identified limited topsoil resources within the footprints of planned facility expansions is included in the plan, where practicable. There are adequate volumes of RCM at the Continental Mine for all existing and planned operations. Borrow materials are further described in Section 5.2.

3.1.6 Haul and Exploration Roads

Approximately five miles of haul road have been constructed between the Continental Pit, WRFs and the mill facilities. These roads vary from 80 to 120 feet wide.

Previous exploration projects have occurred in areas at the Continental Mine including: Hanover Mountain, the area to the west of the MTI, and areas on Hermosa Mountain west of the Continental Pit. The exploration drilling program included approximately 20 miles of 12-foot wide exploration roads and drill pads. The exploration roads associated with Hanover Mountain are anticipated to be mined out by EOY 2019, leaving approximately 15 miles of exploration roads near the MTI and Hermosa Mountain.

3.1.7 Surface Impoundments

The Continental Mine water management system utilizes surface water impoundments to control stormwater and collect seepage (Figure 5 through Figure 8). Collected stormwater and seepage are sent through the Bullfrog Pipeline to Chino for inclusion in the Chino water management system. A list of surface impoundments with their type and status at EOY 2019 can be found in Table 3.

3.1.8 Mine Shafts and Underground Workings

Historical underground workings adjacent to the Continental Pit include the Continental Underground Mine, Pearson-Barnes Mine, and Union Hill Mine located to the north, southwest, and east of the Continental Pit. The Continental Underground Mine was mined until 1998 and was dewatered until August of 2000. Prior to 1964, historical dewatering occurred in several shafts. During 1964, the No. 3 Shaft was created and became the main dewatering shaft (SMI, 1997). The No. 2 Shaft was mined out as the Continental Pit expanded and became the No. 2 Portal (north side of the Continental Pit). During operations, ore was removed from the underground workings through the No. 2 Portal and the No. 3 Shaft. The No. 2 Portal was also used for ventilation for the underground workings. The No. 3 Shaft, which is located near the mine office, was used for ventilation and served as the principal service and production hoisting shaft. The No. 4 Shaft, located east of the No. 3 Shaft, was sunk as an emergency escape and ventilation shaft. Later in mine life, the 11-T-2 Borehole Shaft (located southwest of the No. 3 Shaft) was installed to enhance ventilation. Dewatering activities were suspended in August 2000.

3.1.9 Hanover-Empire Zinc Mine Area

Hanover-Empire Zinc (Figure 2) is a historical mine area located southwest of the Continental Pit. A reclamation plan for the area was implemented and completed in 2007, with additional constructed channel work completed in 2008. Cobre received Financial Assurance release for the Hanover-Empire Zinc Mine Area in January 2010 (NMED, 2010).

3.1.10 Pearson-Barnes Mine Area

The Pearson-Barnes Mine Area (Figure 3) is a historical mine area located southwest of the Continental Pit. Initial reclamation of the Pearson-Barnes Mine Area was completed in 2005 and additional reclamation efforts were necessary to address diversion channel issues soon after (Telesto, 2008b). Subsequent to the channel repairs, the Pearson-Barnes reclamation site underwent subsidence in the fills placed as part of reclamation. As a result, Cobre replaced the damaged channels, addressed the cover erosion, and is utilizing ongoing monitoring and yearly maintenance to ensure the cover and channels stay intact. In the 2014 mine expansion plan the

Pearson-Barnes Mine Area will be included in the SWRDF. However, by EOY 2019 the Pearson-Barnes Mine area will likely still be in its existing configuration and would require that it is reclaimed in accordance with established closure agreements (MMD, 2011). For the purpose of this 2014 CCP Update, it is assumed that an additional 36-inch cover of approved RCM with net neutralizing potential (NNP) would be placed over the graded area since this facility is already graded to a 3:1 slope.

3.1.11 Other Ancillary Facilities, Buildings and Systems

Other smaller ancillary facilities requiring consideration at closure include pipelines; electrical distribution systems, buildings, and wells. Buildings as well as their existing and EOY 2019 PMLU are shown in Figure 9 and Table 4.

3.2 Description of Planned Mine Facilities

Planned activities include:

- Mining at the Hanover Mountain Deposit
- Expanding the existing WRFs into the expanded SWRDF
- Creation of the NOBS
- Management of overburden material for stockpile salvage (e.g., South OB Stockpile)
- Development of new internal haul roads and the CHR (Drawing Sheet 2)

The Hanover Mountain Deposit is planned to be mined from 2016 through 2020 (now equivalent to 2018 to 2022). At the planned extent, the mine will encompass an area of approximately 156 acres. At the end of mining, the area will be reclaimed and stormwater will drain to the south. However, by EOY 2019 (now equivalent to EOY 2021) that final excavation will not have occurred and stormwater would be contained within the Hanover Mountain excavation area. Containment of this water will not result in the formation of an open body of water. There will be no run-on and inflows will be limited to incident precipitation and minor seepage faces on mine highwalls. If necessary, excess stormwater will be directed to Cobre's water management system. Post-closeout, accumulated precipitation will evapotranspire and a small amount of infiltration will recharge to the Continental Pit's area of open pit hydrologic containment.

Waste rock mined from Hanover Mountain and the Continental Pit will be added to the five existing WRFs to form the expanded SWRDF (approximately 436 acres at full capacity). It is anticipated that by EOY 2019 approximately half of the proposed SWRDF material will be placed. Placement of waste rock within the SWRDF will conform to a material handling plan that takes advantage of Cobre's unique opportunity to selectively place waste rock with the SWRDF to limit the potential for the generation and subsequent transport of acidic leachate (Telesto, 2017). Each of the currently existing waste rock facilities that will comprise the SWRDF has been characterized to determine its acid generation potential (AGP). In addition, the AGP of waste rock to be mined from Hanover Mountain and the Continental Pit has been predicted based on its mineralogy and testing of materials derived from exploratory drilling. Based on these characterizations, a conceptual waste rock handling plan was developed to selectively place waste rock and final RCM in a manner that will yield an expanded SWRDF composition that exhibits net alkalinity at all locations. Net alkaline conditions limit the formation of acidic leachates within the SWRDF, leading to a lower potential for water quality impacts.

The basic elements of Cobre's current waste rock management plan include:

1. Plating of exposed drainages within the SWRDF footprint with the highly alkaline waste rock currently existing in the WRFs
2. Partitioning the Hanover Mountain waste rock into potentially acid-generating (PAG) or not potentially acid-generating (NPAG) based on field testing
3. Placement of the Hanover Mountain PAG materials over the existing highly alkaline East, South, and Union Hill WRFs within the SWRDF
4. Partitioning of Hanover Mountain NPAG materials into NPAG and NPAG-Cover. Criterial for making this partitioning are proposed in the Hanover Mountain soil and cover material evaluation performed by Golder Associates (Golder, 2015).
5. A final cover of alkaline SWRDF materials would be placed as necessary over PAG materials to achieve an overall column of materials at all locations with net alkalinity and to provide an upstream alkalinity source to minimize potential ARD from the underlying PAG
6. Final closure would integrate a vegetative cover to limit deep percolation of meteoric water

Figure 16 shows a plan view of the proposed conceptual placement of Hanover Mountain PAG materials within the SWRDF and Figure 17 shows a conceptual cross-section of the proposed placement approach.

Where practicable, non-acid generating Hanover Mountain material and any topsoil scavenged from with WRF expansion deemed suitable for RCM will be hauled to the proposed NOBS and South OB Stockpile. These stockpiles are anticipated to be in place by EOY 2019. At closure the stockpiles will be used as a source of RCM.

By EOY 2019, expanded haul roads located between facility footprints will total approximately 3 miles in length with an approximately 120-foot wide driving surface. A proposed haul road (CHR) will be used by haul trucks to transport ore from the Continental Mine to Chino and will be in place by EOY 2019. The CHR includes disturbances that will cover approximately 105 acres, including approximately 91 acres of land controlled by Cobre, 8.7 acres of BLM administered land, and 5 acres of land controlled by Chino.

3.3 Past and Current Land Uses

As shown in Figure 11, several historical mines surround the Continental Mine. Mining has been the primary land use and economic support for the area. Surrounding lands have a variety of uses including residential, grazing, timber, aggregate mining, and recreation.

3.4 Environmental Setting

The description of environmental setting includes topography, geology, climate hydrology, soils, vegetation, and wildlife.

3.4.1 Topography

The Continental Mine is bounded by the Piños Altos mountain range to the north and by Hermosa and Humbolt Mountains to the west. The undulating topography of the Santa Rita Hills forms the eastern boundary. These highlands delineate a watershed drained by Hanover Creek. South of the Continental Mine, this drainage network forms a relatively low-lying, north-south trending valley (Figure 11).

The mountainous areas to the north and west rise to an elevation of approximately 8,000 feet above mean sea level (AMSL). The elevation steadily decreases to the south, following the gradient of Hanover Creek, to an elevation of 6,200 feet AMSL downgradient of the crossing at Highway 152.

3.4.2 Regional Geology

The Continental Mine is located within the Santa Rita Quadrangle, which lies in a broad transitional zone between the Colorado Plateau and the Basin and Range Province (Jones, et al., 1967). To the south and southwest of the quadrangle, Paleozoic to Mesozoic sedimentary rocks and younger volcanic rocks are exposed in northwest-trending ranges. To the north, sedimentary formations thicken and form the broad highlands of the Colorado Plateau (Figure 12A–12C).

Within the Santa Rita Quadrangle, northwest-trending faults (the Mimbres and Silver City Faults) and northeast-trending faults (the Barringer, Nancy, and Groundhog Faults) define a broad area of uplift in the region called the Santa Rita Horst. The Santa Rita Horst has a surface area of approximately 40 square miles (Hillesland, et al., 1995).

3.4.3 Local Geology

Jones et al. (1967) provides a comprehensive chronology of structural and igneous events of the district. Locally, the features most relevant to the ore at the Continental Mine are the Barringer Fault and the Hanover-Fierro Stock.

Sedimentary Rocks

The stratigraphic section in the Continental Mine area includes approximately 2,400 feet of Paleozoic sedimentary rocks and 1,200 feet of Mesozoic sedimentary rocks located above Precambrian gneiss and schist. Lower Paleozoic formations are dominated by limestone and dolomite and include the Bliss Formation, the El Paso Limestone, and the Montoya and Fusselman Dolomites. The Montoya and Fusselman Dolomites are indistinguishable in the Continental Mine area (Jones, et al., 1967). Upper Paleozoic units contain mostly limestone and include the Percha Shale, the Lake Valley Limestone, and the Oswaldo, Syrena, and Abo

Formations. The Syrena and Abo Formations are often indistinguishable in the area. Mesozoic formations, including the Beartooth Quartzite and the Colorado Formation, consist largely of fine- to medium-grained clastic units and are overlain by up to a few hundred feet of andesitic breccia and tuff (Hillesland, et al., 1995). The Continental Pit exposes mainly Paleozoic rocks, while Hanover Mountain contains mainly Mesozoic rocks (Cobre, 1997).

Igneous Rocks

More than 30 distinct varieties of intrusive rocks are found within the Santa Rita Quadrangle, with ages between the Late Cretaceous period and the Miocene epoch. Intrusive rocks found in the area include the Hanover-Fierro Stock (granodiorite), mafic stock, and mafic dikes, syenodiorite, and quartz diorite porphyries. Volcanic rocks include andesite breccia, among other tertiary units (Hillesland, et al., 1995).

Structure

The Barringer Fault, and associated extension fractures and conjugate shears, are the most important structural features at the Continental Mine as they contain economic mineralization and the faults act as barriers to groundwater flow. The Barringer Fault trends approximately N40°E across the entire Continental Mine site. Dips range from 55 to 75 degrees to the northwest. Vertical displacement along the Barringer Fault ranges from 1,200 to 1,600 feet (Jones, et al., 1967). In the Continental Pit, the fault zone is up to 200 feet wide and is associated with strong iron-oxide staining (Hillesland, et al., 1995). The Barringer Fault is stopped by northeast-trending lobes of the Hanover-Fierro Stock. The Barringer Fault does not offset the northwest contact of the Hanover-Fierro Stock, indicating that the Stock postdates most movement of the fault (Jones, et al., 1967).

3.4.4 Climate

The Continental Mine is located in a semi-arid region of New Mexico. Meteorological data are collected at the Fort Bayard, New Mexico, National Weather Service Station. This station is located approximately five miles southwest of the Continental Mine and is considered to be representative of the area, including:

- Mean annual precipitation of 15.7 inches per year (Fort Bayard; 1897–1993)
- Mean annual temperature of 54.9 degrees F (Fort Bayard)
- Mean minimum temperature of 25 degrees F during the month of January and mean maximum temperature of 86.7 degrees F during the months of June and July (Fort Bayard)
- Mean annual pan evaporation rate of 79.7 inches per year (Chino)

Precipitation measurements from the Fort Bayard National Weather Service Station show a distinct wet season during the months of July through September. Pan evaporation is greater than precipitation throughout the year, even during the cooler winter months.

Two weather stations are located at the Continental Mine. One is located at the Surge Tank, and second on the East WRF. These weather stations monitor average hourly wind speed, wind direction, temperature, relative humidity, solar radiation, and rainfall. Approximately 15 years of data is available from the Continental Mine weather stations. The mean annual precipitation at the Continental Mine is approximately 18.3 inches per year, estimated to range from 14 inches per year at lower elevations to 24 inches per year at higher elevations.

3.4.5 Surface Water Hydrology

The Continental Mine is located within the Hanover Creek drainage area. The elevation of the drainage area ranges from approximately 6,000 feet where Hanover Creek enters Whitewater Creek, to 7,820 feet north of Hanover Mountain in the Piños Altos Range. Hanover Creek flows only in response to substantial precipitation events.

The total drainage area of Hanover Creek is 10.9 square miles, of which approximately 70 percent is located downstream of mining activities (Telesto, 2008c). Figure 3 shows the main ephemeral tributaries within or adjacent to the mine including: Grape Gulch, Poison Spring Drainage, and Buckhorn Gulch.

3.4.6 Groundwater Hydrology

Local groundwater flow is controlled by the geology in the area of the Continental Mine. Perched groundwater exists ephemerally along upper Buckhorn Gulch, lower Poison Spring

Drainage, lower Grape Gulch, and along Hanover Creek where alluvium or highly weathered bedrock (granodiorite) is present [(SMI, 1997), (Telesto, 2008c) and (Telesto, 2011)]. Deeper groundwater exists in three flow systems:

1. North Paleozoic Aquifer
2. South Paleozoic Aquifer
3. Cretaceous Aquifer

Figure 13 through Figure 15 provide groundwater elevations projected in the first quarter of 2014 for each of the aquifers.

The Cretaceous Aquifer (shallow) and North Paleozoic Aquifer (deep) both exist north of the Barringer Fault. These aquifers are separated by low-permeability units of the Colorado, Beartooth and Abo formations. (Telesto, 2008c). Groundwater in these systems is sourced through meteoric water recharge and either discharged through evaporation or captured by the hydrologic evaporative sink associated with the Continental Mine Underground Workings and Continental Pit (Telesto, 2011). The Continental Pit, its evaporative sink and interconnection with underground mine workings form an area of open pit hydrologic containment in the underlying north and south Paleozoic flow systems. This area can be inferred from the potentiometric map provided on Figure 14. Cobre will use updated potentiometric data to generate a map of the area of open pit hydrologic containment at Cobre and submit it to NMED/MMD for review in support of this technical scope of work. Water in the South Paleozoic Aquifer is sourced from meteoric recharge south of the Barringer Fault. A groundwater divide exists in the South Paleozoic Aquifer (Figure 14). Groundwater in the northern South Paleozoic Aquifer discharges to the Continental Mine underground workings and groundwater in the southern South Paleozoic Aquifer likely discharges to the Santa Rita Open Pit (Chino).

3.4.7 Vegetation

The distribution of vegetation is locally complex and reflects the combined influences of variations in soils and climate, disturbance histories (drought, floods, fire, and wildlife), and management practices. Five vegetation cover types have been identified within the areas of disturbance for activities in the 2014 mine expansion plan. These vegetation cover types include: Madrean Plateau Piñon Juniper Woodland, Rocky Mountain Ponderosa Pine Woodland, Madrean Juniper Savannah, Inter Mountain Basins Semi Desert Grassland, and Riparian. Detailed descriptions of these areas are available in the Administrative Draft Cobre EA (BLM, 2014). Special status plant surveys were conducted; however, no sensitive plant species was observed [(ENSR, 1995), (ENSR, 1996), and (Metric Corporation, 1997)]. In addition, a finding of no significant impact by the BLM, based on the Cobre EA for Amendment #5 to the Continental Mine Plan of Operations, was received by Cobre on May 13, 2015. This impact analysis included a review of special status plant species and their habitats.

3.4.8 Wildlife

Diverse habitats are found in the valley systems, mountain slopes, and drainages surrounding the mine area and these areas support a variety of wildlife species. Mule deer are the principal big game species in the area, with limited populations known to occur in the immediate mine vicinity (Hayes, 1995). No designated seasonal ranges or important migration corridors are present in the vicinity of the mine (BLM, 1993). Other mammals potentially occurring in the project area include: elk, white-tailed deer, black bear, coyote, bobcat, javelina, badger, raccoon, porcupine, and black-tailed jackrabbit [(CDM, 1994), and (ENSR, 1995)]. Mountain lion are prevalent in the area and have been reported in the town of Fierro during periods of drought (Hayes, 1995). Resident bats comprise a component of the small-mammal community in the vicinity of the mine (ENSR, 1996).

Resident and migratory birds are also found in the area including the red-tailed hawk, Cooper's hawk, great horned owl, long-eared owl, wild turkey, Montezuma quail, Western kingbird, Cassin's kingbird, band-tailed pigeon, plain titmouse, and chipping sparrow. No active raptor nests have been documented in the mine area or surrounding vicinity (CDM, 1994). Other bird species observed during a reconnaissance of the mine area on April 27, 1994, included the American robin, dark-eyed junco, mourning dove, scrub jay, turkey vulture, western bluebird, and white-throated swift (CDM, 1994).

No water bodies exist that can support fisheries mainly due to the lack of perennial waters, limited flows in small stretches that are perennial, and lack of connectivity with other perennial waters. Aquatic species observed near the mine include caddis fly larvae, mayfly larvae, damselfly and dragonfly adults and larvae, water striders, diving beetles, water boatmen, and canyon tree frogs.

In addition, a finding of no significant impact by the BLM, based on the Cobre EA for Amendment #5 to the Continental Mine Plan of Operations, was received by Cobre on May 13, 2015. This impact analysis included a review of special status wildlife species and their habitats.

4.0 DESCRIPTION OF COMPLETED RECLAMATION PROJECTS

Ongoing and completed reclamation projects since 2001 include the Hanover-Empire Zinc Mine Area, Pearson-Barnes Mine Area (Section 3.1.10), and numerous historical mine shafts and related structures. Areas where reclamation has been completed are assumed to require no additional capital expenditures, but include operations and maintenance costs.

Reclamation of the Hanover-Empire Zinc Mine Area was completed in 2007, with channel maintenance work completed in 2008. The site included over 55 historical mine shafts and related structures, seven open pits, and numerous waste stockpiles. Approximately 3,000 feet of stream bank and bottom was reconstructed to handle the peak flow induced by a 100-year, 24-hour storm (Telesto, 2007).

Reclamation has also been completed for other numerous historical mine shafts and related structures (DP-1403, Condition 63c). In a letter to Mr. Lawrence Shore and Mr. James Hollen, dated March 13, 2009, (Cobre, 2009), Cobre notified NMED of the closure of approximately 83 historical mine shafts and related structures, and that Cobre considered the closure work to be complete. To date, Cobre has closed over 250 historical features.

5.0 RECLAMATION DESIGN CRITERIA

This section summarizes the reclamation design criteria for the 2014 CCP Update at the Continental Mine. The reclamation plan was developed in consideration of the site-specific conditions that exist at the Continental Mine, including materials, geologic, hydrologic, ecological, operational, and economic constraints.

The key design criteria are described in Table 5 and Appendix B, and include outslope designs and gradients, channels, downdrains, and conveyance channels for each facility (The water conveyances and channels will be designed to convey the peak flow generated by 100-year, 24-hour storm event). Reclaimed areas will be revegetated in accordance with the standards presented in Permit GR002RE 01-1, Appendix C.

The planned configuration of the Continental Mine at EOY 2019 is depicted in Drawing Sheet 1. Drawing Sheet 3 shows the EOY 2019 reclaimed configuration. Design details of slopes and channel cross-sections can be found on Drawing Sheet 4. Sheet 5 illustrates conceptual cover haul routes. Reclamation designs for the MTI, MGTI, SWRDF, and Hanover Mountain Deposit are provided on Drawing Sheets 6 through 10. Further, detailed information can be found in Appendix B and C. The following sections describe the PMLU, reclamation performance objectives, cover design and materials, and water management and water quality monitoring.

5.1 Reclamation Performance Objectives

Performance objectives were developed with the intent of meeting criteria and conditions associated with the WQA, WQCC Regulations, NMMA, and Copper Rules. The following sections describe the performance objectives for the major facilities at the Continental Mine.

5.1.1 Tailings Impoundments

The performance objectives for the top surfaces and outslopes of the tailings impoundments are:

1. Establishment of a SSE
2. Control of fugitive dust
3. Control of runoff and erosion
4. Prevention of overtopping
5. Reduction of ponding and infiltration

Deposition of tailings to the MTI ceased in 1999, and Cobre does not have plans to resume deposition during the period covered by this plan. Although there is the ongoing sale and shipping of magnetite material, the previous MGTI reclamation plan, based on 2004 topography, is still valid. Therefore, the updated MGTI reclamation cost used here is based on 2004 topography.

Relatively minor amounts of magnetite (referenced in Section 3.1.1) have been placed on the top surface of the MTI and covered with a dust cover of local borrow material. These materials are insignificant (from a volume perspective and are physically similar to the rest of the materials at the surface of the MTI) and have been placed on the MTI top surface in a manner that they will not affect the reclamation plans or require additional costs to deal with at closeout.

Grading Plan and Stability

The MTI is a jurisdictional dam registered with the OSE and meets or exceeds all applicable regulatory stability criteria [(URS, 2005) and (URS, 2006)]. The MTI dam embankments that run along the east and south sides of the impoundment are composed of large rocks with naturally occurring vegetation in areas of finer grained soils. The MTI buttresses and embankments are stable [(URS, 2005), (URS, 2006) and (Golder, 2009a)] in their current configurations. The buttresses are consistent with a wildlife habitat PMLU (see Sections 6.1 and 6.5), and thus, will be left in their existing stable configuration (see Table 5 for reclamation slope angles) at closure/ post closure. Rock embankments around the southeast side of the MTI will be graded to reclamation slopes as shown in Table 5. The southwest corner of the MTI will be left in its current configuration to:

- Preserve the existing habitat associated with the Weber Pond area (Figure 6)
- Maintain stability associated with the rock face dam embankment
- Not encroach on the Continental Pit high wall

Due to its proximity with the Continental Pit, leaving the southwest corner of the MTI in its current configuration is consistent with the Continental Pit waiver. The MTI top surface, Reclaim Pond, and MGTI top and outslopes will be regraded according to the criteria in Table 5.

Tailings Impoundment Erosion and Drainage Control

Drainage and erosion control for both tailings impoundments will be achieved by providing stormwater conveyance mechanisms (i.e., sheet drainage and/or directed flow in appropriately armored channels), stable-slope configurations, and revegetation. The Reclaim Pond will be reclaimed along with the MTI (Drawing Sheet 6) and stormwater from the reclaimed surface of the MTI will be routed through channels and appropriate erosion controls. Channels will be added to the existing buttresses to control drainage and erosion. Surface Impoundments are discussed in more detail in Section 3.1.7. Water management for the MTI is described in Section 5.3.

Tailings Impoundment Cover and Revegetation

RCM for the tailings impoundments will come from an overburden stockpile, nearby native soils or directly hauled from Hanover Mountain. As described in Permit GR002RE, Cobre will construct a cover for the tailings impoundment surface composed of both RCM and tailings (Table 5).

Regrading of tailings impoundment surfaces is required prior to cover placement. Specific grading criteria are provided in Table 5.

Earth-moving equipment will be used to smooth the surfaces and facilitate access for supplemental RCM placement, seeding, and drainage/stormwater management.

5.1.2 Stockpiles

The performance objectives for reclamation of the stockpiles are to establish a SSE; reduce infiltration; contain seeps and minimize sediment loading; maintain mass stability; and control runon, runoff, and discharge. Additionally, expansion of the stockpiles will incorporate waste rock handling and placement strategies with the performance objective of protecting the quality of water resources after closure. This conceptual plan is described in Section 3.2. The stockpile facilities at the Continental Mine include the WRFs combined into the expanded SWRDF by EOY 2019 and the LG WRF. GR002RE and DP-1403 provide conditions for reclamation of the stockpiles.

Grading Plan and Stability

Stability analyses of the existing stockpiles indicate that the waste rock piles will be stable in regraded configurations (Golder, 2009a). Similarly, the SWRDF material will be placed at the same slopes required for reclamation, the same slopes evaluated in the stability study, and will likewise remain stable under post-closure conditions.

Stockpile material will be composed of blasted rock placed on 40- to-50-foot high lifts through end-dumping at angle of repose, which results in benches at the required overall reclamation slopes with catch benches on each lift. Therefore, SWRDF material will be placed at the reclamation slopes during mining and will require minimal regrading to achieve proper drainage. The top surface will require grading at closure. Outslopes will require minor regrading for benches to facilitate cover placement and/or stormwater removal. Specific grading criteria are provided in Table 5.

Stockpile Erosion and Drainage Control

Erosion control for the stockpiles will be achieved by designing and placing outslopes at appropriate slope angles and slope lengths. Outslopes will be graded to be compatible with the cover material being utilized for each stockpile. The slope angles and slope lengths proposed for the SWRDF are outlined in Table 5. Appropriately armored channels will be used as necessary to convey stormwater off the stockpiles. Stockpile water management is described in Section 5.3.

Stockpile Cover and Revegetation

RCM for the SWRDF is located in OB Stockpiles 1, 2, 3, and 4; Topsoil Stockpiles; the proposed South OB Stockpile, and the NOBS. RCM for the LG WRF is located in an OB stockpile.

As outlined in the "Aquifer Evaluation and Management of the South Waste Rock Disposal Facility at the Continental Mine" (Telesto, 2017), waste rock and RCM will be characterized and selectively placed within the SWRDF to assure that any precipitation infiltrating through the SWRDF will pass through a column of waste rock with net excess alkalinity. This placement, along with the installation of a stockpile cover meeting the requirements of 20.6.7.33.F NMAC, will minimize the potential for an exceedance of applicable standards at agency-approved downgradient monitor well locations due to impacts from the stockpile.

5.1.3 Continental Pit

The performance objectives for the open pit facility are safety, operational access, and groundwater control. Cobre will place a combination of chain link fences and berms around the circumference of the Continental Pit. Signs will be posted on the fencing at 500-foot intervals and at all access points, and will warn of potential hazards present (MMD, 2005). Berms will also be placed to prevent stormwater runon into the open pit. The proposed berm will be 5 feet high, with 2:1 sideslopes, and a 10-foot top width.

As described in Section 3.1.3, the Continental Pit has in the past and will in the future fill with water after pumping ceases and dewatering operations are halted. The open pit will be a hydrologic evaporative sink with respect to groundwater. Predictions in SMI 1999 were updated in 2008 (Telesto, 2008d) (Telesto, 2008c) with additional information to enhance the prediction and make it more reliable. Consequently, the ground water quality standards of 20.6.2.3103 NMAC will not apply to water within the “area of open pit hydrologic containment.” 20.6.7.33.D NMAC. Consequently, Cobre does not plan to pump water from the Continental Pit in the 2014 CCP Update.

5.1.4 Hanover Mountain Deposit

The performance objectives for closure are runon control, safety, operational access, and surface water and groundwater control. The topography will consist of 50-foot high benches that will be wide and relatively flat (Drawing Sheet 10). A combination of berms and fences will be placed along the perimeter of the area at closure.

Hanover Mountain Deposit Erosion and Drainage Control

Highwalls will be sufficiently stable due to the absence of fractures and faults. If materials are eroded from the highwalls, it will be deposited at the toe of the highwall and contained on the benches due to the shallow slope of the benches.

Hanover Mountain Deposit Cover and Revegetation

Accessible bench surfaces will be reclaimed. Accessible bench surfaces are defined as areas that can be accessed safely. This includes haul road driving surfaces and flat areas 50 feet or greater from a highwall for the purposes of the 2014 CCP Update. Accessible bench surfaces that are acid generating and safely accessible will be covered, ripped, and seeded. Other accessible bench surfaces will be ripped, and seeded. Where the benched surface is compacted, it will be ripped prior to RCM placement to provide a roughened surface that will enhance seeding operations. RCM for the accessible areas of the remaining benches will come from an OB stockpile.

Hanover Mountain Deposit Surface and Groundwater Control

The Hanover Mountain Deposit will be reclaimed. The majority of the flat surfaces at the mine will be reclaimed with three feet of RCM. Cobre will place RCM in as many safely accessible benches as practical. There will be no stormwater run-on and inflows will be limited to incident precipitation and short periods of seepage on mine highwalls. If necessary, excess stormwater will be directed to Cobre's water management system. The mine will not intersect the water table and storm water is not expected to emanate from steep pit walls in significant quantities. Any potential ARD in these areas will flow onto the mine floor rubble that is not safely accessible and not covered. This minor amount of water will evaporate, or infiltrate and be captured in the Continental Mine hydrologic sink. It is not expected to flow onto the covered portions; however, the CCP contains costs for monitoring, maintenance, and repairs if an issue arises. Facility characteristics, reclamation designs, and the reclamation cost estimate presented in this 2014 CCP Update are based on projected conditions at the Continental Mine by EOY 2019 (this is assumed to be five years after mining resumes) and is depicted in Drawing Sheets 1 through 10.

5.1.5 Roads

Haul and exploration roads outside of PMLU area not needed for post closure access will be reclaimed. Performance objectives include creation of a SSE and erosion control. Performance objectives and reclamation criteria for the CHR are described in the 2014 Cobre Haul Road

Closeout Plan, attached in Appendix B.4, which was submitted as Appendix A in the Revision to Mining Permit GR002RE Application (Cobre, 2014).

5.1.6 Borrow Areas

Performance objectives for any other disturbed borrow area or construction area include creation of a SSE and erosion control. The topsoil stockpile, five OB stockpiles, NOBS, and South OB Stockpile are borrow areas and will likely be completely used for RCM. The footprints of the stockpiles will be left in a condition with stable slopes. Disturbed borrow areas will be ripped and seeded per Table 5 after facility reclamation is complete.

Cover Design and Materials

A cover placement plan is provided in Permit GR002RE 01-1, Section 9, and DP-1403. Cover conditions include a minimum cover thickness of 36 inches for stockpiles and tailings impoundments, and provide for inclusion of in-place material as part of the 36-inch thickness. RCM will consist of non-acid generating material, capable of supporting plant growth and have erosion resistant characteristics. The cover will comply with Copper Rules (20.6.7.33.F NMAC) and shall be a store and release cover system with a thickness of 36 inches, capable of sustaining plant growth without continuous augmentation, and have erosion resistant characteristics and will limit net percolation.

DP-1403, Condition 76, requires Cobre to perform a comprehensive cover performance evaluation; and Condition 77 requires a cover, erosion, and revegetation test plot study. Conditions 76 and 77 are also required by Section 8 of MMD permit GR002RE-01 and test plot study is also required by MMD Condition M.1. of permit GR002RE-01. Studies are ongoing to evaluate the cover potential of the carbonate, leach cap and blends of the two materials from various locations at the mine. To date, these studies have shown a propensity of carbonate materials to be an effective material for vegetation establishment, as demonstrated from East Stockpile test plots, which use carbonate material mined from the Continental Pit.

Other potential RCM identified at the Continental Mine include native soils and leach cap material from Hanover Mountain, Hermosa Mountain, the Continental Pit, and the tailings in the

MTI. The characteristics and suitability of these materials have previously been evaluated [(DBS&A, 1999b), (Golder, 2004a), (Golder, 2004b), and (Golder, 2006)]. Additionally, a compositional model of various waste rock stockpiles was developed by (DBS&A, 1999a), and the lithology of several WRFs was evaluated by (Geotrans, 2001).

The results of the borrow materials investigation and a subsequent assessment [(Golder, 2004a), (Golder, 2004b), and (Golder, 2006)] indicate that soils, non-acid generating OB, carbonate rock, tailings, and leach cap materials are adequate sources of cover for areas disturbed by mining activities. Where practicable, pre-stripping of native soils and regolith prior to the construction at the SWRDF and Hanover Mountain Deposit will also enhance RCM availability.

The major facilities that require RCM at EOY 2019 are the MTI, MGTI, SWRDF, benches in the Hanover Mountain Deposit, Pearson-Barnes Mine Area, and the LG WRF. Currently there is approximately 2 million cubic yards of material available in the five OB Stockpiles, the East OB Stockpile, and Topsoil Stockpiles that are suitable as RCM (Golder, 2006).

Additionally, the East WRF covers an area of approximately 62 acres and averages approximately 100 feet thick. Therefore, it is estimated to contain almost 10 million cubic yards of suitable material. Assuming that 75 percent of the material is associated with the carbonate rocks, the East WRF represents a potential RCM source of approximately 7.5 million cubic yards (Golder, 2006). The East WRF will ultimately be incorporated into the SWRDF. Cover materials in the East OB Stockpile are still accessible by EOY 2019.

At EOY 2019, an additional 3.5 million cubic yards will be available in the NOBS and South OB Stockpile. This volume may also include minor amounts of soil materials salvaged during clearing and grubbing of the NOBS prior to overburden placement. Cobre has sufficient volume of cover to close existing facilities in the short term and will have adequate amounts of borrow once mining resumes and new facilities are constructed.

5.2 Water Management and Water Quality Monitoring

Reclamation plans are intended to meet applicable WQCC standards for groundwater and surface water at post-closure. The reclamation plan will meet the performance objectives by minimizing runon and by managing waters collected within the disturbed area that do not meet applicable standards for discharge as required by DP-1403 and the GWA process. Waters that meet applicable standards for discharge will be released to the watershed.

Tanks, small dams, and surface impoundments are described in Table 3 including their status at EOY 2019, and are shown in Figures 5 through 8. Surface Impoundment maintenance is included in Appendix C and surface impoundment reclamation in Appendix B. A table including post reclamation use and closure schedule is included in Appendix C, Table C.1.

Water management includes the following:

- Hanover Mountain Deposit
  - Diversion of runon where feasible
  - Capture of runoff
- MTI and Reclaim Pond
  - Diversion of runon from the Upper Poison Spring Drainage into Grape Gulch
  - Conveyance of runoff from the reclaimed surface
  - Capture and conveyance of seepage from the south and east and drainage from the decant line is sent to Chino through the Bullfrog Pipeline (anticipated to cease flowing after reclamation; details located in Appendix C)
- Magnetite Tailings Impoundment
  - Conveyance of runoff from the reclaimed surface
  - Capture and conveyance of seepage to Chino through the Bullfrog Pipeline (anticipated to cease flowing after reclamation; details located in Appendix C)
- Waste Rock Facilities
  - Diversion of runon from upgradient drainages

  - Conveyance of runoff from the reclaimed surface
  - Capture and conveyance of seepage to Chino through the Bullfrog Pipeline (anticipated to cease flowing after reclamation; details located in Appendix C)
- Pearson-Barnes Mine Area and LG WRF
  - Diversion of runon from upgradient drainages
  - Maintain existing channels
- Continental Pit
  - Diversion of runon away from the open pit around the perimeter where feasible

Figure 10 portrays the relationships between components of the water management system. The water management collection systems and sediment controls built during mine operation will continue to be used for water management after closure and any additional required systems will be constructed during the reclamation period. The collection systems will remain in place as long as required to collect and contain water that does not meet applicable standards for discharge from disturbed areas as provided by DP-1403. Once water meets applicable standards for discharge from disturbed areas, the associated collection systems will be removed and areas reclaimed.

The MTI seeps are expected to cease flowing after reclamation at approximately reclamation year 9. Seeps associated with waste rock facilities are currently sent to Chino through the Bullfrog Pipeline. Waste rock facility seeps are expected to decrease quickly and cease flowing after facility reclamation as predicted in Condition 83 (Golder, 2009b). Seep collection systems locations are shown in Figure 5 through Figure 8.

Stormwater runoff will be sent to detention basins for sediment control and then released. The anticipated flow rates for pre-reclamation are provided in Appendix C, Table C.2. Seepage is expected to cease flowing in reclamation year 5 for a most of the site and approximately in reclamation year 9 for the MTI (See Appendix C).

6.0 POST-MINING LAND USE DESIGNATION

The approved PMLUs for the permit area are wildlife habitat and industrial use. The Continental Pit was granted a conditional waiver from achieving a SSE. The following sections describe the PMLU for the Continental Mine.

6.1 Wildlife Habitat PMLU

Cobre proposed the wildlife PMLU as a practical target use for the reclaimed lands at the site, and the MMD has approved this PMLU for the reclaimed lands. Certain shop and processing structures, not designated for industrial PMLU, will be demolished and/or removed. Footings, slabs, walls, pavement, manholes, vaults, stormwater controls, and other foundations will be covered with a minimum of 36-inches of RCM, graded for stormwater control, and revegetated.

Achieving a wildlife PMLU involves the establishment of SSEs (e.g., native vegetation and habitat types compatible with the surrounding life zone and geo-hydrologic structure). The reclamation seed mixes from Permit GR002RE and proposed plant diversity standards are provided in Tables 6 and 7. The seed mix was selected to initiate achievement of plant density and provide diversity, and includes cool and warm season grasses, perennial shrubs, and forbs. Additionally, the seed mix includes a number of valuable, nutritious forage and browse species. Seed mix and rates are subject to change based on future investigations and availability. Alternate or substitute species lists are available in Permit GR002RE.

6.2 Industrial PMLU

The EYO 2019 buildings and their PMLU are listed in Table 4 and the MMD conditions for Industrial PMLU can be found in Permit GR002RE 01-1 J.1. Structures listed in Permit GR002RE 01-1, Appendix D, which have since been removed, are not included in Table 4. Several buildings located within planned haul road footprints or within the vicinity of the Hanover Mountain Deposit, are expected to be removed and some replaced by EOY 2019. Industrial PMLU areas have the infrastructure necessary to support a variety of future industrial uses. The buildings are currently being used, and are well maintained and have electrical power. Many buildings also have shop and warehouse storage capacity with highway and railroad access.

6.3 Continental Pit Waiver

In a letter from MMD dated February 23, 2005, the Continental Pit was granted a conditional waiver from achieving a SSE, subject to Permit GR002RE 01-1 (Section G). Studies and information collected since the conditional waiver was issued in 2005 support the assumptions and circumstances upon which the condition waiver approval was granted. As described in this CCP, Cobre has included the closeout measures required by conditions of the Conditional Waiver Approval.

6.4 Other Ancillary Facilities, Structures, and Systems

Pipelines, electrical distribution systems, wells, exploration holes, and underground mine access points exist at the Continental Mine. A majority of the water management pipelines will be removed at closure. The tailing pipelines will be flushed and buried. The approximately 40,000-foot long Bullfrog Pipeline, which is currently used to transfer water from the Continental Mine to Chino, will be used for Industrial PMLU. Electrical distribution systems providing power to the Industrial PMLU area will be left in place. Electrical distribution systems providing power to pumps that are part of the water management system will be closed along with the pumps once they are no longer needed for water management. Water management is discussed in Section 5.3. Cobre currently maintains and monitors several monitoring wells, seven of which will be used for post-closure monitoring. The proposed locations of these wells are shown on Figure 18. All exploration holes have been closed in accordance with the OSE conditions with the exception of some located on Hanover Mountain, which will be mined out by EOY 2019.

The Continental Mine has several underground mine access points including the No. 2 Portal, the No. 3 Shaft, the No. 4 Shaft, and ventilation shafts. Entrances to the underground workings, including the No. 2 Portal, and ventilation shafts will be closed at the termination of mining activities. The No. 4 Shaft will be mined out during the mining of the Hanover Mountain Deposit. The No. 2 Portal and several ventilation shafts will be reclaimed in conjunction with building demolition using appropriate closure methods. The No. 3 Shaft will remain accessible for water supply use. All infrastructure not used will be removed and disposed of in an approved manner or stabilized prior to closing the access points. Cobre will safeguard all shafts, adits, and other underground mine openings within the Permit area as appropriate according to GR002RE 01-1 J.7 and previously established practices (Cobre, 2009).

6.5 Revegetation Success Guidelines

Areas designated as wildlife habitat PMLU (with exceptions noted below), will be revegetated in accordance with the revegetation standards presented in Permit GR002RE 01-1, Appendix C. Table 6 and Table 7 provide proposed seed mixes and plant diversity standards (respectively) as outlined in Permit GR002RE 01-1, Appendix C.

The reclamation success guidelines required by the MMD vary depending on the PMLU. Canopy cover, shrub density, and vegetation diversity are the revegetation success guidelines that are typically used to judge revegetation success on lands designated as wildlife habitat. The vegetation success guidelines include numerical standards to address the canopy cover and shrub density requirements of the NMMA. The plant diversity guidelines are addressed through a technical standard and are complemented by a qualitative assessment of plant colonization and regeneration to corroborate the establishment of a self-sustaining ecosystem. Site-specific revegetation success guidelines for each of the PMLU areas are based on the vegetation cover and shrub density requirements listed in the Permit. Based on the results of the test plots and vegetation monitoring studies at Chino and Tyrone, the requirement for cool-season grasses was eliminated. The elimination of the cool-season grasses is consistent with the surrounding ecosystem and will not negatively affect the post-mining land use. The proposed seed mixes and numerical diversity guidelines for the Continental mine are listed in Tables 6 and 7 respectively.

There are two primary areas approved as wildlife habitat PMLU that cannot be revegetated as described previously; however, these areas provide a valuable component in the wildlife habitat landscape. Highwalls of the Hanover Mountain deposit and areas near highwalls where safe access is not possible, as well as the minor portion of rocky MTI embankment (to be left in its current configuration), provide valuable wildlife habitat. The highwalls, rocky areas adjacent to highwalls, and the unmodified portion of the MTI embankments mimic natural talus slopes and bluffed terrain common to the surrounding region. These areas may have sparse vegetation and will not meet revegetation success standards described above, however these areas provide a critical component of the overall SSE and provide valuable wildlife habitat diversity.

7.0 POST-CLOSURE MONITORING, REPORTING, AND CONTINGENCY PLANS

All closure and post-closure ground water, surface water, seep, spring, and piezometer monitoring data will be reported under the appropriate DP. Additionally, as specified under approved modifications to Condition 59 of DP-1403, Cobre submits semi-annual potentiometric maps based on monitoring well data to NMED. Cobre also submits seepage measurements taken at facility seeps to NMED. The annual test plot study reports are submitted to NMED and MMD in accordance with Condition 77 of DP-1403 and Permit GR002RE, respectively. The MMD guidelines require monitoring of revegetation during the 12-year post-closure vegetation monitoring period to evaluate revegetation success, and WQCC Regulation 3107.A.11 requires the development of post-closure monitoring and contingency plans that are consistent with the terms and conditions of the applicable DP. Additional closure and closeout monitoring and reporting associated with public health and safety, vegetation, wildlife, meteorology, erosion, and construction quality assurance (CQA)/construction quality control (CQC) plans are specific in Permit GR002RE and DP-1403. Closure and post-closure monitoring and reporting specified in the Copper Mine Rules include: CQA/CQC plans, seepage interceptor system inspections and reporting; water quality monitoring and reporting, and reclamation monitoring and reporting.

Post-closure inspections will continue until lands have been released under the NMMA. This section summarizes the general approach that will be used to meet these conditions.

7.1 Erosion Monitoring

Cobre will perform inspections when one or more inches of rain is received in a 24-hour period, as recorded by the Continental Mine weather stations, as well as monthly inspections for the first year, and quarterly inspections until vegetation is established. Cobre will monitor for erosion, including substantial rill, gully, or sheet erosion on the reclaimed facility surfaces. These areas will be inspected in accordance with nationally recognized standards of the U.S. Natural Resource Conservation Service or alternative, equivalent best management practices, per the permit conditions. As conditioned, Cobre will provide the MMD and NMED a report that describes substantial erosion features identified. A corrective action plan will be developed for substantial erosion features within 30 days of identification of the problem and the plan will be implemented as soon as practicable following approval.

7.2 Water Quality Monitoring

Cobre will conduct water quality monitoring according to Permit GR002RE and DP-1403, with cessation of specific monitoring requirements under the conditions specified in the permits. Samples will be collected at established intervals at all monitoring locations required in the NMED discharge permits. Cobre reserves the right to request amendments to the sampling frequency outlined in the permits based on water quality trends observed.

Contingency and emergency response plans have also been prepared that contain details for addressing potential failures of individual components in Cobre's water management system (Telesto, 2014). If an unapproved discharge occurs, Cobre will perform appropriate mitigation in accordance with Section 20.6.1203.A.9 NMAC or in accordance with DP-1403 if required by NMED. In addition, Cobre maintains a current SWPPP, described in Section 2.3 that monitors surface water quality around the perimeter of facilities.

7.3 Vegetation Success Monitoring

Cobre will conduct post-reclamation vegetation monitoring according to the terms of Permit GR002RE 01-1 O.2. Areas where vegetation has not been successfully established will be reseeded or inter-seeded. Revegetation monitoring will include canopy cover, vegetation diversity, and woody stem density. The canopy cover survey and woody stem density survey will be conducted using the survey techniques approved by MMD. The revegetation monitoring will be conducted in the third and sixth year after seeding and also two years out of the four finals years prior to bond release. Cobre will submit a vegetation monitoring plan, for MMD approval, at least 90 days before vegetation monitoring is conducted. Results of the vegetation sampling will be provided to MMD.

7.4 Wildlife Monitoring

Pursuant to Permit GR002RE, Cobre will document wildlife use of reclaimed areas through monitoring, which include deer pellet group counts and bird diversity surveys. The wildlife monitoring study would be conducted six years after seeding and two years out of the four final years prior to bond release. The bird survey will be conducted once between January to early February for overwintering species and once during the peak breeding season of late May to early June. Deer pellet group count will be conducted between late May and early June. The pellet count will be planned to coincide with the peak breeding season bird survey. The results of the wildlife surveys will not be a condition of, or given consideration with regard to financial assurance release.

7.5 Public Health and Safety

Pursuant to Section G.2 of the MMD Permit, Cobre will submit written details and maps showing the locations of berms and fences that will be placed around the open pit to restrict access by unauthorized personnel and provide for public safety within 180 days of cessation of operations. Quarterly visual inspections will be conducted to monitor stability of the open pit walls to identify potential failure areas, which may adversely impact the environment and public health or safety. If such potential failure areas are identified through monitoring, Cobre will propose measures to mitigate the hazard within 30 days of identification for MMD approval.

7.6 Construction Quality Assurance Plan

Pursuit to Permit GR002RE, Cobre will submit a CDQA Plan to MMD and NMED for approval no less than 180 days prior to regrading of a facility and placement of any RCM for final closure. The CDQA Plan will be supplemented with a CQA Report to be submitted to the MMD within 180 days after completion of construction.

8.0 CAPITAL, OPERATION, AND MAINENANCE COST ESTIMATES

This section provides a description of the reclamation cost estimate that is used in determining the value of the financial assurance. The cost estimate and net present value calculation will be provided upon the agencies approval of the technical scope of work. Inflation and discount rates used in the net present value calculation will be proposed based on available agency guidance.

Cobre employs thorough cost estimating methods and best practices accepted in the engineering and construction industries. Cobre's approach to cost estimating is completely consistent with industry standards outlined in references such as the RS Means Estimating Handbook. This approach achieves meets the objectives of the regulations cited in Section 1.1 of this CCP. The cost estimate is developed in the format preferred by the MMD and NMED, that provides a transparent and consistent spreadsheet format. The scope of work for closure/closeout activities may be divided into two basic categories: Earthwork and Water Treatment. A basic input for the cost estimate are the quantities or "material takeoffs" taken from the drawings and plans presented in this CCP. The material takeoffs are provided in this CCP. The cost for both the earthwork and water treatment categories will include capital construction costs and operation and maintenance costs. Once the technical scope of work is approved and will not change further, Cobre will develop the financial assurance cost estimate following the steps:

1. Break the scope of work down into basic tasks (work breakdown structure) to which equipment fleets, manpower and materials can be uniformly applied to complete work.
2. Evaluate and apply the most efficient equipment spread and manpower labor crews to construct/complete the work entailed by each task.
3. Develop the unit cost for individual tasks and subtasks from the most up-to-date source of construction data – e.g., Equipment Watch and RS Means Construction data and in some cases from a third party contractor quote.
4. Multiply the unit costs by the quantities or hours for equipment and labor to yield the direct costs.
5. Multiply the direct costs by the appropriate indirect cost multiplier to account for administrative and support to yield the total cost of the project work. Indirect multipliers may include Mobilization/demobilization, Contingencies, Engineering redesign fees, Contractor profit and overhead (per RSMeans process definition) and Project management costs if they have not already been incorporated into the direct costs.

8.1 Earthwork

The Drawings depict reclamation based upon the EOY 2019 mine plan. The Drawings were used to develop reclamation quantities used in the reclamation cost estimate.

8.1.1 Capital Costs

The earthwork reclamation cost estimate will be based on a template originally created by the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD, 1996). The estimate will include reclamation earthwork and site operations and maintenance costs and will be based on the reclamation designs.

8.1.2 Operations and Maintenance Costs

Operations and Maintenance (O&M) costs include: erosion control, road maintenance, and revegetation maintenance. Operations and maintenance costs are assumed to diminish with time:

- Erosion Control:
  - Reclamation Years 0–12: 12 days/year
  - Reclamation Years 13–39: 4 days/year
  - Reclamation Years 40–99: 1 day/year
- Road Maintenance:
  - Reclamation Years 0–19: 4 months/year at 24 hours/month
  - Reclamation Years 20–39: 2 months/year at 24 hours/month
  - Reclamation Years 40–99: 1 month/year at 24 hours/month
- Revegetation Maintenance:
  - Reclamation Years 0–11: Based on observations of previously reclaimed areas, the annual vegetation failure is conservatively estimated to be 2% failure every year for a total of 12 years, starting the year reclamation is completed.

8.2 Water Management

The water management cost estimate is a time-series accounting of costs associated with the long-term maintenance of the water management system. The estimate includes costs related to ponds, pumps, pipelines, electrical systems, and water quality sampling. Nearly all the water management infrastructure required is currently in place or will be in place by EOY 2019 as a result of past and current operations. Capital water management costs include replacement or removal of infrastructure. The water management O&M costs account for the long-term operation of the water management infrastructure including: routine maintenance, electricity, fuel, and sampling.

9.0 RECLAMATION SCHEDULE

The anticipated duration for reclamation activities is shown in Table 11. The schedule is based on the estimated amount of labor, equipment and other resources that would be necessary to complete reclamation, sequential closure of the facilities, and the acreage to be reclaimed in the unlikely condition of forfeiture based on anticipated EOY 2019 configuration. The reclamation durations presented in Table 11 include reclamation through seeding. The estimated duration for reclamation of each facility does not include regulatory design review and approval processes.

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Tables

Table 1 Summary of Closure/Closeout Related Permits

Environmental Media/ Regulatory Framework	Permit Number	Permit Name	Issuing Agency	Status as of October 2014
Air Quality [1]	298M6R4 P066R1	New Source Review (NSR) State Title V	NMED Air Quality Bureau/ EPA	Current
Drinking Water Federal SDWA	WSS 800-09	Non-Community, Non-Transient Public Water Supply	NMED	Current
Groundwater New Mexico Administrative Code 20 Chapter 6, Water Quality	DP-181	Groundwater Discharge Permit for the Continental Mine, Concentrator, Tailings, and Waste Rock Facilities	NMED	Current, Application Under Review
	DP-1056	Groundwater Discharge Permit for Hanover Mine, Fierro/Humbolt Leach Pads, SX/EW Plant, #3 Shaft Stockpile and North Overburden Stockpile	NMED	Current, Application Under Review
	DP-1403	Supplemental Discharge Permit for Closure	NMED	Current, Application Under Review
Hazardous Materials Transporter	051013 550 049VW	Hazardous Material Certificate of Registration	U.S. DOT	Current
Hazardous Waste Generator	NMD980507958	Notification of Status as Generator of Hazardous Waste	New Mexico Department of Public Safety/ EPA	Current
New Mexico Mining Act	GR002RE	Closeout Plan and Financial Assurance	MMD	Current
Operations on Land Administered by BLM (43 CFR 3809)		1993 Approved Plan of Operations and 5 subsequent amendments	BLM	Current
Surface Water Quality Federal Clean Water Act	NMR05GB66	Stormwater/ NPDES MSGP Authorization	EPA	Current
Water Rights	M-2559, M-4124, M-2575, M-2576, M-2502, M-5092, M-2515		New Mexico Office of State Engineer	Current

[1]Cobre and Chino are combined under both permits.

Table 2A Permitted Existing Facilities Summary

Permit[1]	Permit Section	Permitted Existing Facilities	Financial Assurance Coverage
GR002RE 01-1	9	Main Tailings Impoundment	Yes, see Appendix B, Section 2.0
		Magnetite Tailings Impoundment	Yes, see Appendix B, Section 3.0
		Waste Rock Facilities (West, Buckhorn, Union Hill, East and South WRFs)	Yes, see Appendix B, Section 4.0
		Open Pit (Continental Pit)	Covered by Open Pit Waiver
		Pipelines	Yes, see Appendix B, Section 9.0
		Ancillary Facilities	Yes, see Appendix B, Section 8.0
		Other Non-specified Areas (miscellaneous disturbed areas)	Yes, see Appendix B, Section 9.0
		Hanover-Empire Zinc Mine Area	Reclamation was completed in 2007 and financial assurance release was grated in January 2010. See section 3.1.9
DP-1403	I	Pearson-Barnes Mine Area	Yes, see Appendix B, Section 9.0
		Continental Pit	Covered by Open Pit Waiver
		Waste Rock Piles (Waste Rock Facilities; West, Buckhorn, Union Hill, East and South WRFs)	Yes, see Appendix B, Section 4.0
		Main Tailings Impoundment	Yes, see Appendix B, Section 2.0
		Crusher	Yes, see Appendix B, Section 2.0
		No. 1 and No. 2 Mills and Concentrator Facilities	Yes, see Appendix B, Section 8.0, and Table 4
		Underground Mining Operations	Yes, see Section 6.4
		Seepage Interception Systems	Yes, see Section 5.3
		Stormwater Detention Impoundments (Surface Impoundments)	Yes, see Section 5.3 and also Appendices B and C
		Maintenance Area	No, All the shops will be removed except the small truck shop which has an industrial PMLU
		No. 3 Shaft Stockpile	Yes, will be mined out or incorporated into the CHR which already has financial assurance in place
DP-1056 (additional facilities not covered in other permits)	III	PLS/Raffinate Pipeline from the Fierro and Humbolt Leach Pads to the Chino SX/EW plant	No because construction is not anticipated in the next five years

[1]DP-181 (NMED, 2007) covers discharges from the existing facilities listed in GR002Re 01-1 and DP-1403 and does not list additional facilities

[2]The No. 3 Shaft Stockpile is covered under the DP-181 renewal application, submitted in 2011, as part of an effort to

Table 2B Permitted Unconstructed Facilities Summary

Permit[1]	Permit Section	Permitted Unconstructed Facilities	Financial Assurance Coverage
GR002RE 01-1	9	North Overburden Stockpile	Yes, see Appendix B
		Cobre Haul Road	Yes, see Appendix B.4
		South Overburden Stockpile	Yes, see Appendix B
		Hanover Mountain Mine (Hanover Mountain Deposit)	Yes, see Appendix B
		Fierro Leach Pad	No, because construction is not anticipated in the next five years
		Fierro Solution Extraction/Electrowinning (SXEW) Plant	No, because construction is not anticipated in the next five years
		South Waste Rock Disposal Facility (SWRDF)	Yes, see Appendix B
		North Waste Rock Facility	No, because construction is not anticipated in the next five years
DP-1403	I	Hanover Mountain Mine (Hanover Mountain Deposit)	Yes, see Appendix B
		SX/EW Plant	No, because construction is not anticipated in the next five years
		Humbolt Leach Pad	No, because construction is not anticipated in the next five years
		Fierro Leach Pad	No, because construction is not anticipated in the next five years
		North Waste Rock Pile	No, because construction is not anticipated in the next five years
DP-1056 (additional facilities not covered in other permits)	III	PLS/Raffinate Pipeline from the Fierro and Humbolt Leach Pads to the Chino SX/EW plant	No, because construction is not anticipated in the next five years

[1]DP-181 (NMED, 2007) covers discharges from the existing facilities listed in GR002Re 01-1 and DP-1403 and does not list additional facilities

[2]The No. 3 Shaft Stockpile is covered under the DP-181 renewal application, submitted in 2011, as part of an effort to

Table 3 Surface Impoundment Information

Impoundment Designation	Surface Area (acres)	Mine Use	Liner	Status at EOY 2019
Collection Containment and Pumping Systems				
Blackman's Seep	0.01	Seep	HDPE	Existing
Buckhorn CF	0.11	Seep	HDPE	Removed by EOY 2019
Cement Pond and Cement Pond Interceptor Trench	NA	Seep	Concrete Dam Unlined	Removed by EOY 2019, Replaced by East WRF Containment
Decant Pond #4	0.62	Seep and Stormwater	HDPE	Existing
Grape Gulch Pond #3	0.38	Stormwater	HDPE	Existing
North Tailings Decant Pond	0.46	Stormwater	Concrete Dam Unlined	Existing
Magnetite Seepage Pond	0.2	Seep and Stormwater	HDPE	Existing
Reclaim Pond	16	Emergency Water Management, Seep and Stormwater	Concrete Dam Unlined	Existing
Surge Tank	0.18	Emergency Water Management, Seep and Stormwater	Stainless Steel	Existing
SWRF Dam 1 (181-2003-Dam 1)	0.52	Stormwater	Concrete Dam Unlined	Existing
SWRF Dam 2 (181-2003-Dam 2)	0.34	Stormwater	Concrete Dam Unlined	Existing
SWRF Dam 3 (181-2003-Dam 3)	0.84	Stormwater	Concrete Dam Unlined	Existing
Upper Creek Containment Pond 1	0.74	Seep and Stormwater	HDPE Lined	Existing
Seeps Routed to Upper Creek Containment Pond 1*				
Borehole Seep and Borehole Access Road (Vent Seep)	NA	Seep	Unlined	Existing
East Haul Road & Rock Dam Seep	NA	Seep	Unlined	Existing
Unnamed Seep	NA	Seep	Unlined	Existing
Cottonwood Seep	NA	Seep	Unlined	Existing
Seeps Routed to Decant Pond # 4				
Dam Toe Seep	NA	Seep	Unlined	Existing
East WRF Containment	NA	Seep and Stormwater	HDPE Lined	In place by EOY 2019
Estrada Seep	NA	Seep	Unlined	Existing
Magnetite Interceptor Trench	NA	Seep	Unlined	Existing
Peach Tree Spring Seep	NA	Seep	Unlined	Existing
Union Hill Adit Seep	NA	Seep	Unlined	Existing
Weber Pond	NA	Seep	Unlined	Existing
Seeps Routed to Buckhorn CF				
Buckhorn Waste Rock Facility Seeps	NA	Seep	Unlined	Removed by EOY 2019
WWRDF Inceptor Trenches (Grand Canyon Seeps)	NA	Seep	Unlined	Removed by EOY 2019

*Seeps may be routed to the Surge Tank in the future.

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	Removed [2]
Explosives Storage	10	12	12		Demolish	Removed [2]
Garage	26	12	10		Demolish	Removed [2]
General Offices	118	38	20		Industrial PMLU	Removed and replaced Industrial PMLU[1]
Machine Shop	141	40	20		Industrial PMLU	Removed [2]
Magnetic Separator	15	20	14		Demolish	Removed [2]
MCC (Power Generation) Building	40	24	20		Industrial PMLU	Removed [2]
Mill Building #1 and Concentrator	160	140	70		Demolish	Removed [2]
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	Removed [2]
Ore Bin (large)			90	30	Demolish	Removed [2]
Ore Bin (small)			70	30	Demolish	Removed [2]
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	Removed [2]
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	Removed [2]
Sewage Treatment Facility	25	40	12		Industrial PMLU	Removed and replaced Industrial PMLU[1]
Small Truck Shop	102	40	20		Industrial PMLU	Removed and replaced Industrial PMLU[1]
Stacker Hoist	28	23	18		Demolish	Demolish
Substation No. 2	66	50	30		Industrial PMLU	Removed and replaced Industrial PMLU[1]
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	Removed [2]
Thickener Tank (60-ft diam.)			20	60	Demolish	Removed [2]
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	Removed [2]
Water Tank (on Hanover Mountain)			20	15	Demolish	Removed [2]
Water Tank (on Hanover Mountain)			50	35	Demolish	Removed [2]

[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, PBC 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 5 Summary of Key Reclamation Design Criteria

Area Covered	Reclamation Activities	Criteria			
		Regrading	Top Surface Channels/Downdrains/ Outslope Channels	Cover/Ripping/Revegetation	Miscellaneous
Main Tailings Impoundment	• Regrading top surface and southeast rock embankment • Completing surface water channels to route stormwater • Hauling and grading cover material • Riping and revegetating covered areas	• Minimum 0.5% top surface slope • 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. • 200-foot maximum interbench length • Maximum 3H:1V interbench slopes • Southwest rock embankment and Weber Pond area left in existing configuration	• Top surface channels: convey runoff from the impoundment top surface and surrounding tributary area or to the embankment toe. • Construct downdrains • Outslope channels: - 20-foot wide - 5.0% maximum cross-bench slope - 2.0% longitudinal bench slope (max 5%)	• 36-inch top cover consisting of 24 inches of hauled in cover (accounting for existing cover materials already placed) and the upper 12 inches of tailing (GR002RE D.2.b and DP-1403, Condition 77) • 36 inch outslope cover • Rip and revegetate covered surfaces	• Tailing Pipelines: Flushed, capped and buried in place with 36-inches cover • Benches-30-foot bench width (maximum 50-feet), 5.0% maximum cross-bench slope, 2.0% longitudinal bench slope and 3-feet of cover
Magnetite Tailings Impoundment	• Regrading top and outslope • Completing a downdrain channel • Hauling and grading cover material • Riping and revegetating covered areas	• Maximum 3H:1V interbench slopes; • Minimum 0.5% top surface slope.	• Construct downdrain to drain the top surface and discharge on the west side of the embankment.	• 36-inch top and outslope cover • Rip and revegetate covered surfaces.	NA
SWRDF	• Regrading top surfaces and outslope benches • Hauling and grading cover material • Completing surface water channels to route stormwater • Riping and revegetating covered areas	• 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: convey runoff to downdrains • Construct downdrains • Outslope channels -20-foot wide - 5.0% maximum cross-bench slope -2.0% longitudinal bench slope (max 5%)	• 36-inch top and outslope cover • Rip and revegetate covered surfaces	• Benches-30-foot bench width (maximum 50-feet), 5.0% maximum cross-bench slope, 2.0% longitudinal bench slope
Low Grade WRF	• Surface grading • Hauling and grading cover material • Completing surface water channels • Rip and revegetate covered areas	• Maximum 3H:1V interbench slopes	NA	• 36-inch top and outslope cover • Rip and revegetate covered surfaces	NA
Hanover Mountain Deposit	• Hauling and grading cover material in accessable areas • Riping and revegetating covered areas • Fencing and Berms	NA	NA	• 36-inch cover in accessable areas • Rip and revegetate covered surfaces	• Fencing-A combination of 6-foot chain link fencing and berms • Rip and revegetate disturbance area used to construct the chain link fencing, and berm
Continental Pit	• In GR002RE 01-1 the Continental Pit was granted a conditional waiver from achieving a self-sustaining ecosystem. The Continental Pit is unchanged by EOY 2019 • Fencing and Berms	NA	NA	NA	• Fencing-A combination of 6-foot chain link fencing and berms • Rip and revegetate disturbance area used to construct the chain link fencing, and berm
Surface Impoundments	• Ripping liners and burying in place • Grading to drain • Hauling and grading cover material • Riping and revegetating covered areas	NA	NA	• 36-inch cover • Rip and revegetate	NA
Pearson-Barnes Mine Area	• Hauling and grading cover material • Riping and revegetating covered areas	NA	NA	• 36-inch cover, tapering down to leaving existing channels • Existing channels will remain in their current configuration • Rip and revegete covered surfaces	NA

Table 5 Summary of Key Reclamation Design Criteria

Area Covered	Reclamation Activities	Criteria			
		Regrading	Top Surface Channels/Downdrains/ Outslope Channels	Cover/Ripping/Revegetation	Miscellaneous
Haul Roads	• Grading to drain •Hauling and grading cover material • Riping and revegetating covered areas	NA	NA	• Roads are ripped to a depth of 18 to 24 inches. • 36-inch cover • Rip and revegetate	NA
Cobre Haul Road	• Grading to drain and incorporate berm material into the road • A smaller (approximately 12-14 feet in width) will remain on the CHR for post closure maintenance. • Road crossing at forest access road and Hanover Creek will be removed and demolished • Ripping and Revegetating of CHR surfaces	NA	NA	• Rip to a depth of 18 to 24 inches, grade, and revegetate	NA
Borrow Areas	• Ripping and revegetating	NA	NA	• Borrow areas left in a condition such that they can be directly ripped and revegeted	NA
Building/Structural Demolition (non-Industrial PMLU Areas)	• All equipment and above-grade structures are demolished and removed from the area or buried • Debris is placed either into the stockpiles or other designated area • Any new buildings constructed prior to reclamation have an Industrial PMLU • Hauling and grading cover material for demolition areas and/or debris • Riping and revegetating distrubed areas	NA	NA	• Demolition and demolition debris areas: 36-inch cover, ripped and revegetated	NA
Operations and Maintenance	• Erosion control • Road Maintenance • Revegetation Maintenance	NA	NA	• 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	NA
Water Management	• Ponds, tanks, pipelines, pumps, and electrical infrastructure maintenance, replacement and removal • Water monitoring	NA	NA	NA	NA

Table 6 Proposed Interim Seed Mix and Rates

Species[1]	Life-Form	Duration	Seasonality	Rate [1,2]
Blue gramma (*Boutelouagracilis*)	Grass	Perennial	Warm	0.25
Side-oats grama (*Boutelouacurtipendula*)	Grass	Perennial	Warm	1.25
Green sprangletop (*Leptochloadubia*)	Grass	Perennial	Warm	0.15
Plains lovegrass (*Eragrostis intermedia*)	Grass	Perennial	Intermediate	0.06
Bottlebrush Squirreltail (*Sitanionhystrix*)	Grass	Perennial	Cool	1.25
Black gramma (Bouteloua eriopoda)	Grass	Perennial	Warm	0.1
Apache plume (*Fallugiaparadoxa*)	Shrub	Perennial	NA	0.09
Mountain mahogany (*Cercocarpusmontanus*)	Shrub	Perennial	NA	1.00
Winterfat (*Eurotialanata*)	Shrub	Perennial	NA	0.60
White prairie clover (*Dalea candidia*)	Forb	Perennial	NA	0.15
Globe mallow (*Sphaeralcea sp.*)	Forb	Perennial	NA	0.10
Blue flax (*Linumlewisii*)	Forb	Perennial	NA	0.15
Total Pure Live Seed (lbs/ac)				5.15

[1] Seed mix and rates subject to change based on future investigations and availability. Alternate or substitute species lists are available in the MMD Permit GR002RE.
[2]Rate is in pounds of pure live seed per acre; Substitutions may change seeding rates.
NA = not applicable.

Table 7 Proposed Plant Diversity Guidelines

Class	Seasonality	Number	Minimum Occurrence (% cover)
Grasses	Warm	3	1
Shrubs	NA	2	0.5
Forbs	NA	2	0.1

Table 8 Earthwork Capital Costs - TBD following technical approval

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital			
Tailing Ponds			
Magnetite Tailing Pond			
Main Tailings Impoundment			
Subtotal			
Waste Rock and Ore Piles			
SWRDF			
Hanover Mountain Deposit			
Low Grade WRF			
Subtotal			
Continental Pit			
Total			
Surface Impoundments			
Subtotal			
Historic Sites			
Pearson-Barnes Mine Area			
Other Disturbed Areas			
Haul and Exploration Roads			
Wells			
Subtotal			
Demolition			
Buildings			
Cover			
Rip & Revegetation			
Subtotal			
Total Capital Cost			

CHR Total Capital Cost*			

Total			

*From 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

Table 9 Earthwork O&M Costs- TBD following techical approval

Total Earthwork O&M Cost[1]				
Period (years)	Erosion Control	Road Maintenance	Revegetation Maintenance	Total (Current Year $)
Overall Site				
0 to 19				
20 to 39				
40 to 99				
Totals				
CHR[2]				
0 to 11				
Totals				

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

[2] From 2014 Cobre Haul Road Closeout Plan (Telesto, 2014)

Table 10 Water Management Costs- TBD following technical approval

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital and Replacement			
Ponds and Tanks			
Pumps			
Pipelines			
Electrical			
Subtotal			
Removal[1]			
Pumps			
Pipelines			
Electrical			
Subtotal			
Operations and Maintenance			
Ponds and Tanks			
Pumps			
Pipelines			
Electrical Infrastructure			
Materials			
Electricity and Fuel			
Environmental Sampling			
Subtotal			
Total Estimated Cost			

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

Table 11 Closure Schedule

Facility	Anticipated Duration (Years) [1]
South Waste Rock Disposal Facility	2.5
Low Grade WRF and High Grade Ore Stockpile	2.5
Main Tailings Impoundment and Reclaim Pond	2
Magnetite Tailings Impoundment	1.5
Hanover Mountain Deposit	3.5
Surface Impoundments	0.5
Haul Roads	0.5
Exploration Roads	0.5
Pearson-Barnes Mine Area	0.5
Continental Pit	1.5
North Overburden Stockpile	2.5
South Overburden Stockpile	2.5
Overburden Stockpiles 1, 2, 3, 4, 5	1.5
Top Soil Stockpile	1.5
Water Management	12
Building/Structural Demolition (non-Industrial PMLU Areas)	2.5

[1] Estimated duration for reclamation does not include regulatory design review and approval processes. Some areas may be left open to be used in

FIGURES

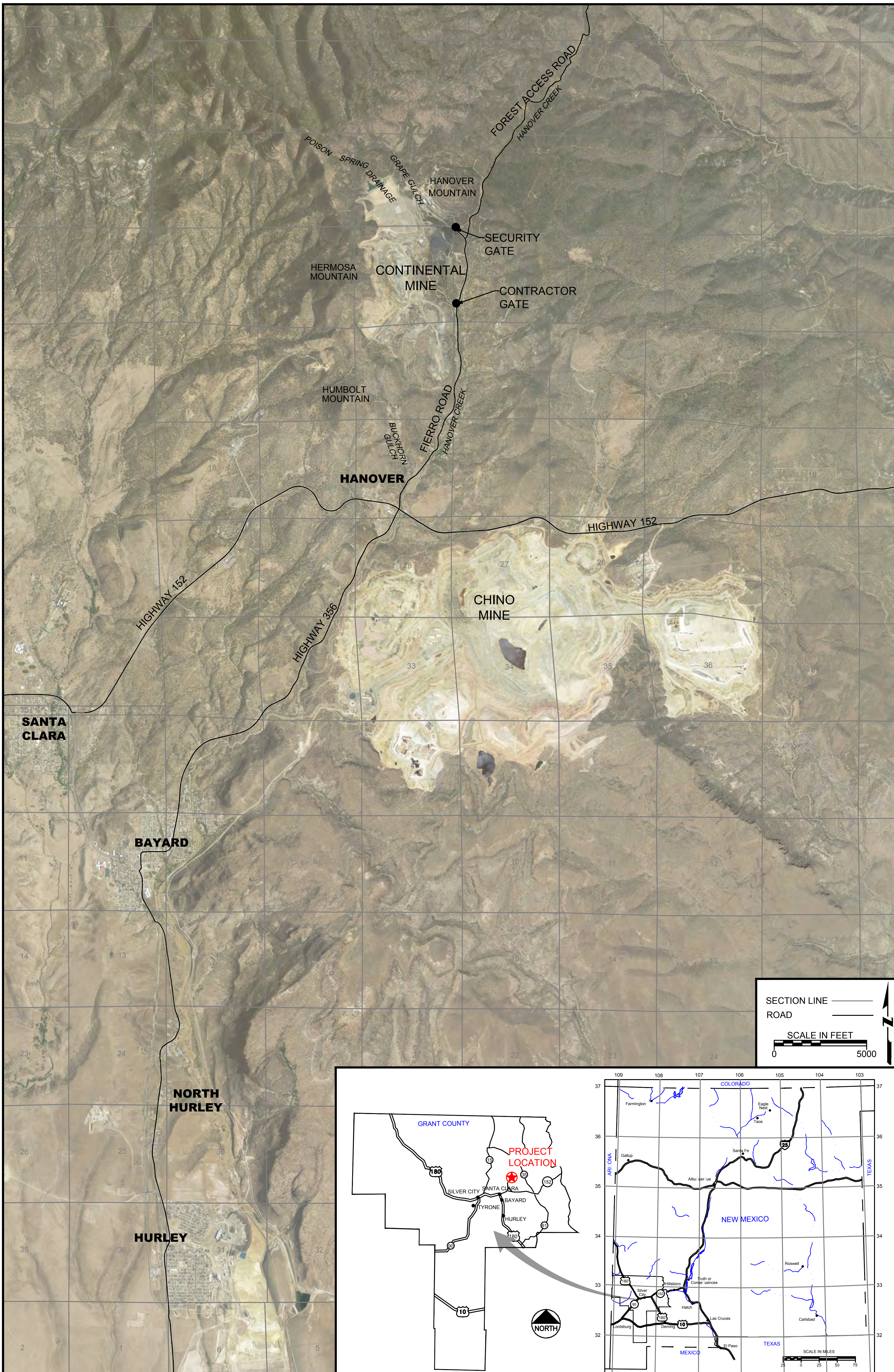

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FIGURE 1
CONTINENTAL MINE LOCATION MAP

PREPARED FOR:
FREEPORT-McMoRAN

Date: 12/10/2014 User: dolson

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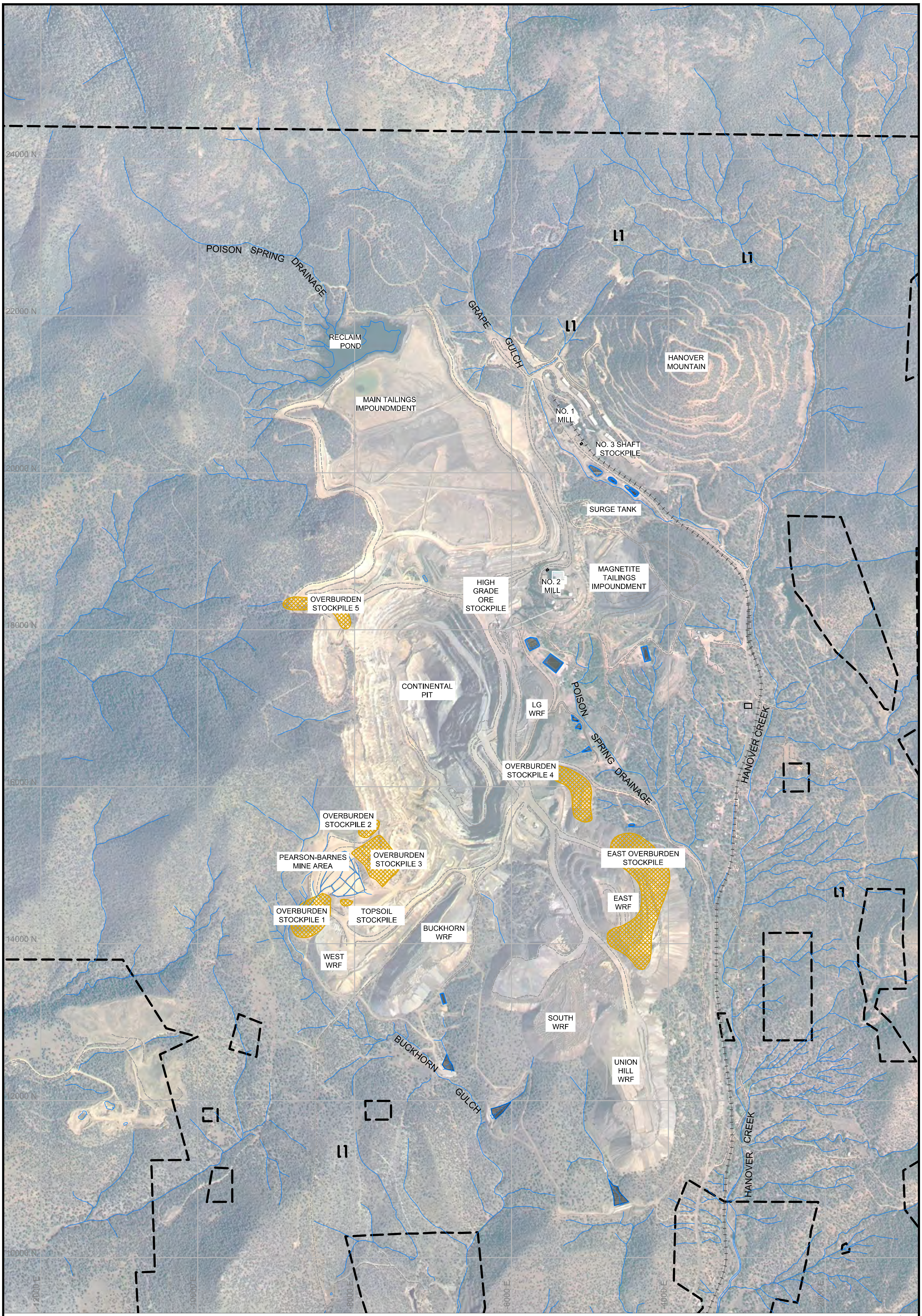
FIGURE 2
CONTINENTAL MINE MMD PERMIT BOUNDARY

PREPARED FOR:
FREEPORT-MCMORAN



LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY*
- BORROW AREA
- SURFACE IMPOUNDMENTS
- DRAINAGES

ACRONYMS:

LG - LOW GRADE

WRF - WASTE ROCK FACILITY

* (UNDER MMD REVIEW, SEE APPENDIX B.4)

REFERENCE: AERIAL PHOTOGRAPHY BY COOPER AERIAL SURVEYS CO., TUCSON ARIZONA, DATE: DECEMBER 15, 2013.

SCALE IN FEET

0 1200

COORDINATES CHINO LOCAL MINE

N

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FIGURE □

E□ISTING FACILITIES AT THE CONTINENTAL MINE

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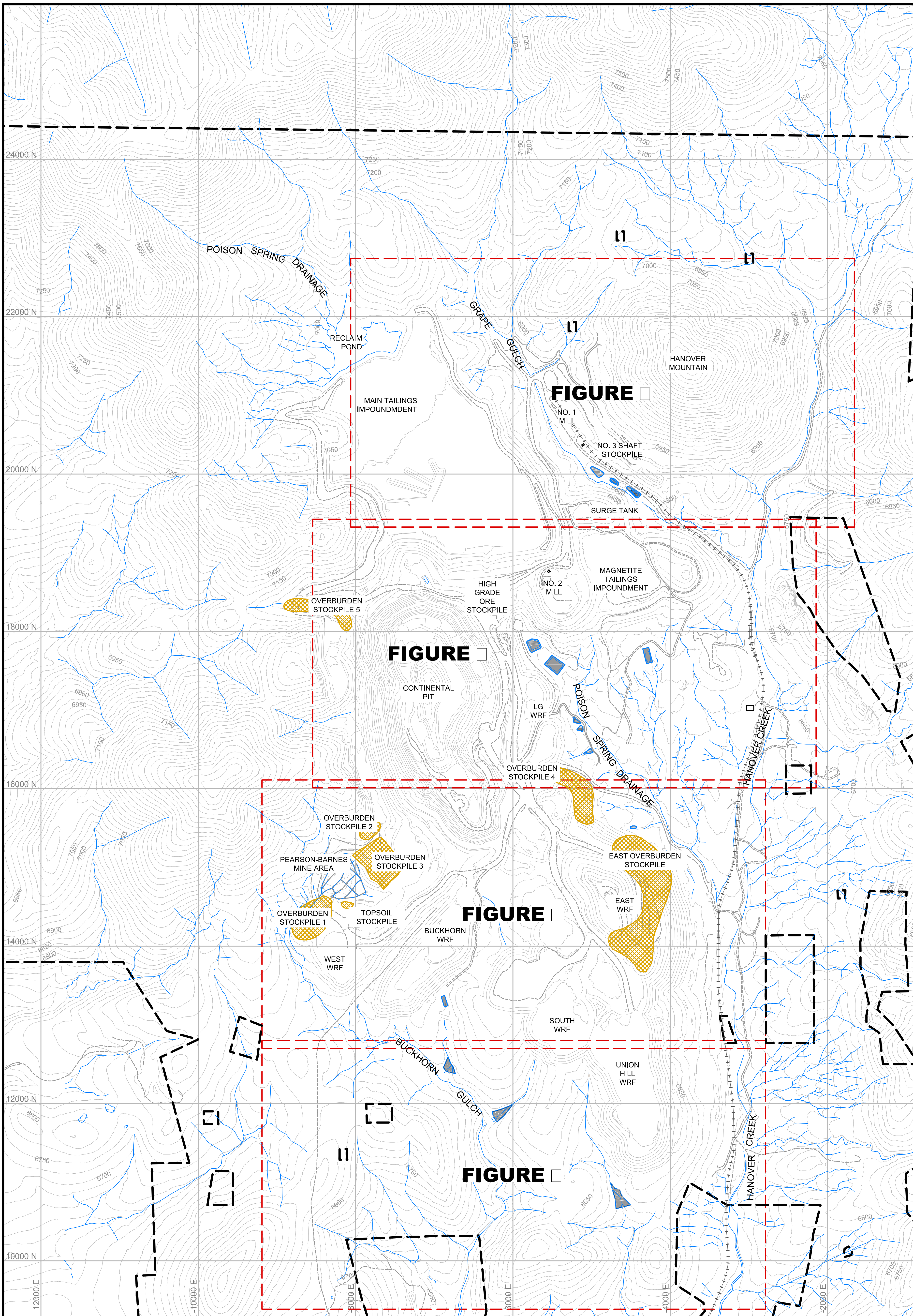

LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY*
- BORROW AREA
- SURFACE IMPOUNDMENTS
- EXISTING TOPOGRAPHIC CONTOURS (25' INTERVAL)
- DRAINAGES
- FIGURE BOUNDARY

ACRONYMS:

LG - LOW GRADE

WRF - WASTE ROCK FACILITY

* (UNDER MMD REVIEW, SEE APPENDIX B.4)

REFERENCE: TOPOGRAPHY BY COOPER AERIAL SURVEYS CO., TUCSON ARIZONA, DATE: DECEMBER 15, 2013.

SCALE IN FEET

0 1200

COORDINATES CHINO LOCAL MINE

N

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FIGURE □

E□ISTING CONTINENTAL MINE AREAS AND FACILITIES FIGURE GUIDE

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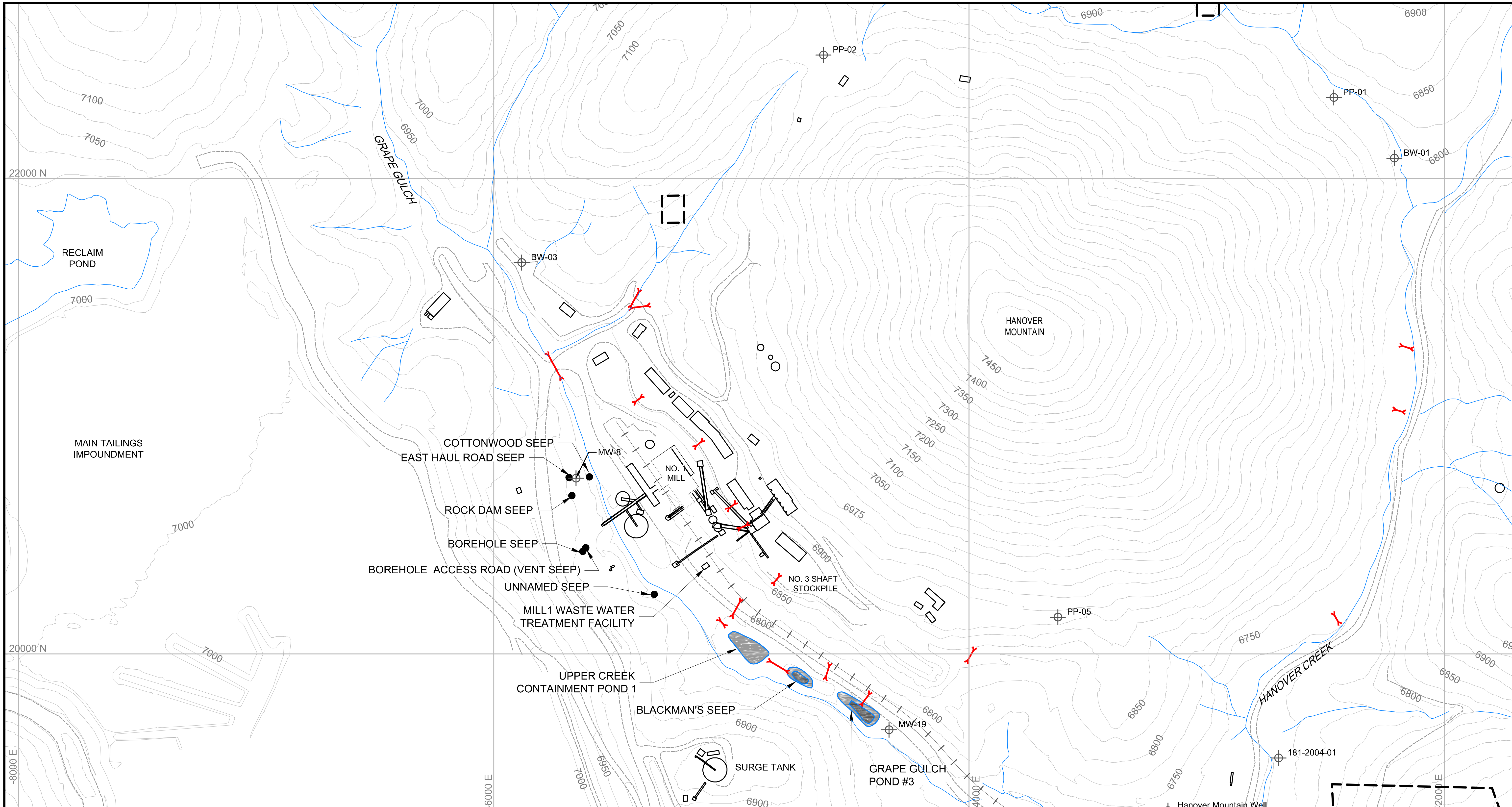

LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY*
- SURFACE IMPOUNDMENTS
- CULVERT
- FACILITIES
- USGS TOPOGRAPHIC CONTOURS (25' INTERVAL)
- DRAINAGES
- WELL
- SEEP

*(SEE CHR CP APPENDIX B.4 FOR DETAILS)

0 400
SCALE IN FEET

COORDINATE SYSTEM
CHINO LOCAL MINE

FIGURE □
UPPER GRAPE GULCH AND HANOVER CREE□ AREA□CONTINENTAL MINE

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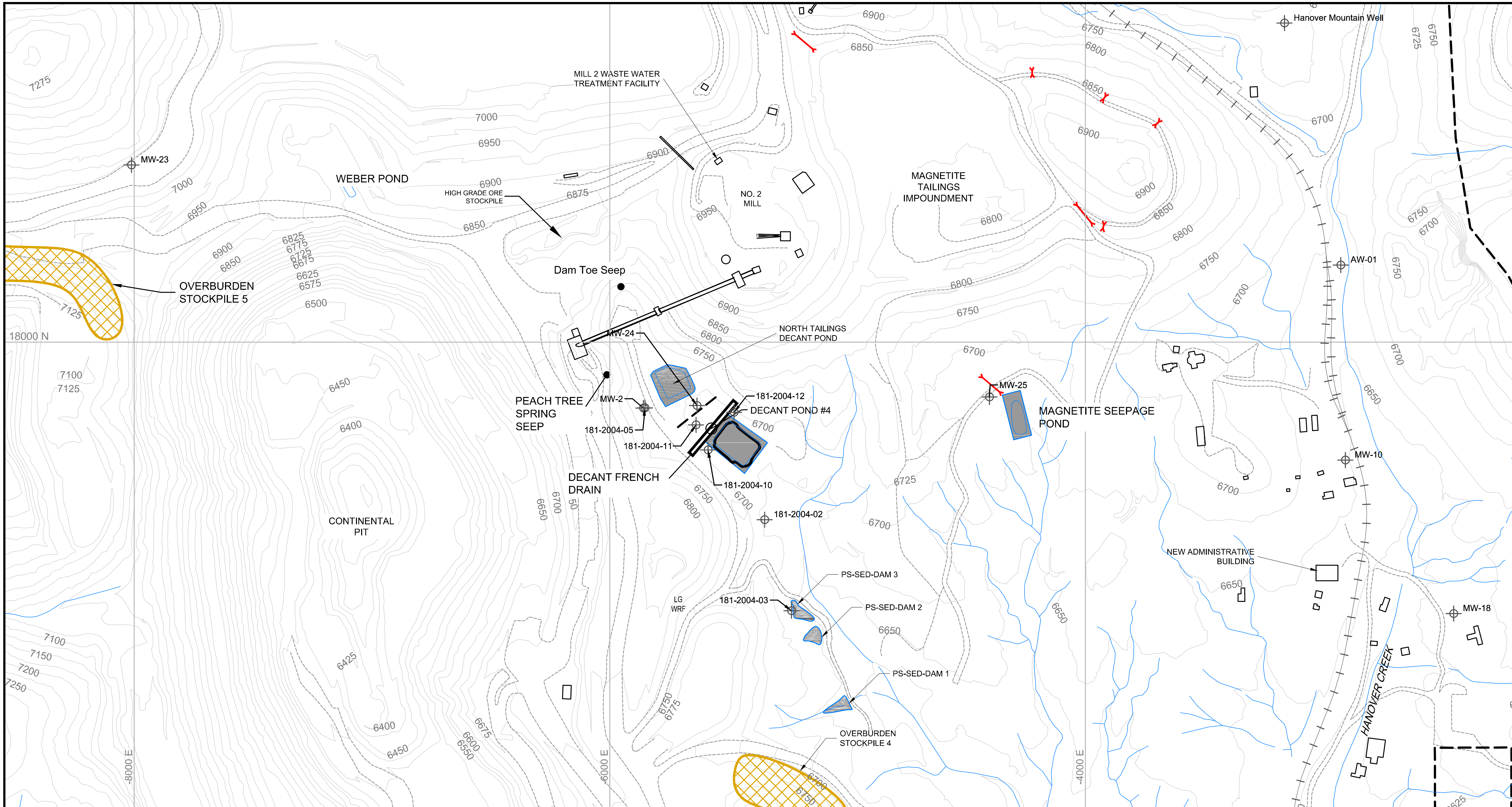

LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY*
- BORROW AREA
- SURFACE IMPOUNDMENTS
- CULVERT
- FACILITIES
- EXISTING TOPOGRAPHIC CONTOURS (25' INTERVAL)
- DRAINAGES
- MONITORING WELL
- SEEP

*(UNDER MMD REVIEW, SEE APPENDIX B.4)

REFERENCE: TOPOGRAPHY BY COOPER AERIAL SURVEYS CO., TUCSON ARIZONA, DATE: DECEMBER 15, 2013.

0 400
SCALE IN FEET

COORDINATE SYSTEM CHINO LOCAL MINE

FIGURE □
UPPER POISON SPRING AND HANOVER CREE□ AREA□CONTINENTAL MINE

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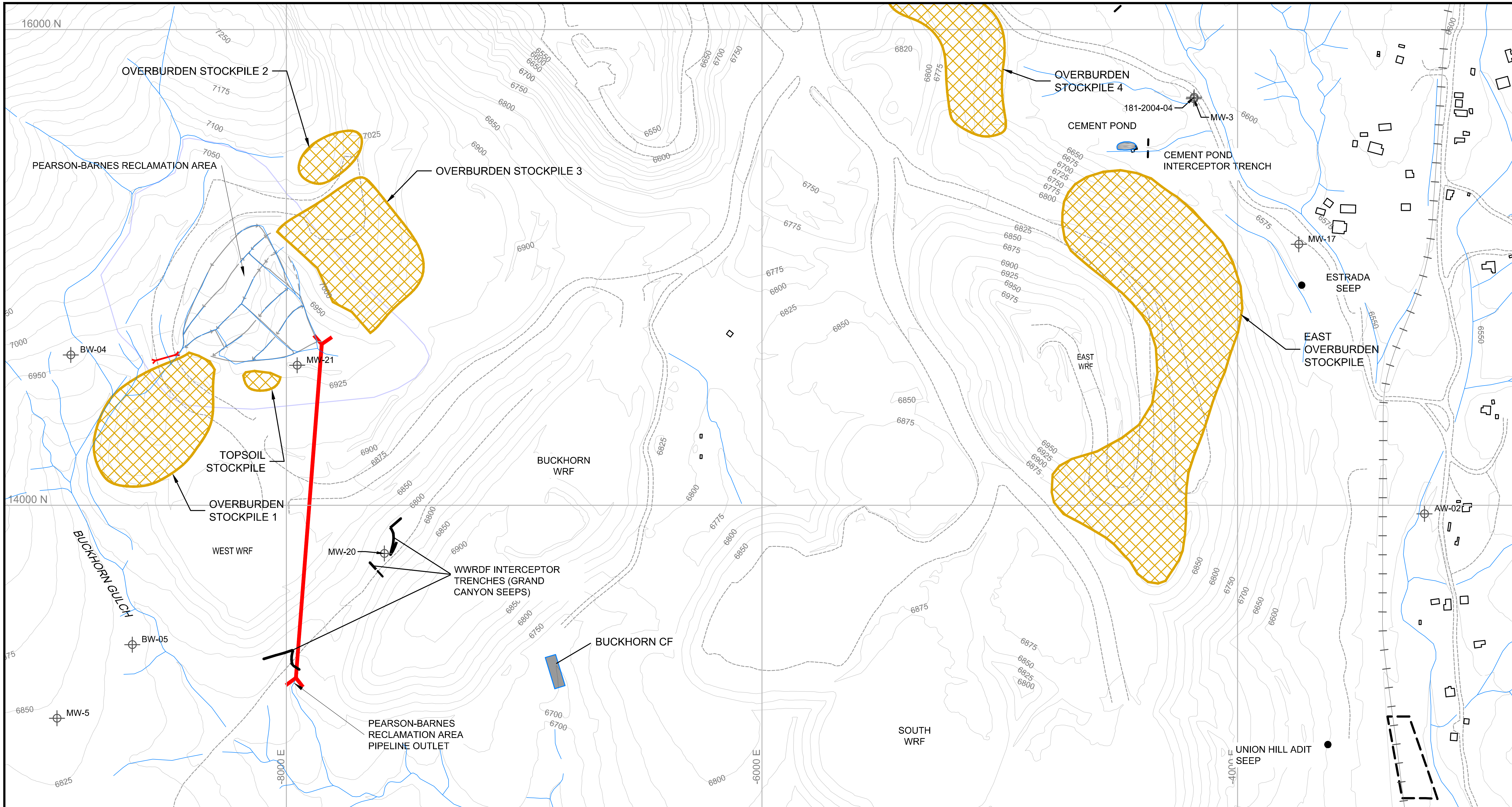

12/10/2014 R:\Cobre\2014_CCP\Calculations\AutoCad\CCP Figures\Startup CCP\Figures-Phoeni \20141113-Fig.8.Lower.Poison.Spring.And.Upper.Buckhorn.And.Hanover.Creek.Area.dwg

LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY*
- BORROW AREA
- SURFACE IMPOUNDMENTS
- CULVERT
- FACILITIES
- EXISTING TOPOGRAPHIC CONTOURS (25' INTERVAL)
- DRAINAGES
- MONITORING WELL
- SEEP

*(UNDER MMD REVIEW, SEE APPENDIX B.4)

REFERENCE: TOPOGRAPHY BY COOPER AERIAL SURVEYS CO., TUCSON ARIZONA, DATE: DECEMBER 15, 2013.

0 400
SCALE IN FEET

COORDINATE SYSTEM
CHINO LOCAL MINE

FIGURE □
UPPER □UC□ HORN GULCH AND HANOVER CREE□ AREA□CONTINENTAL MINE

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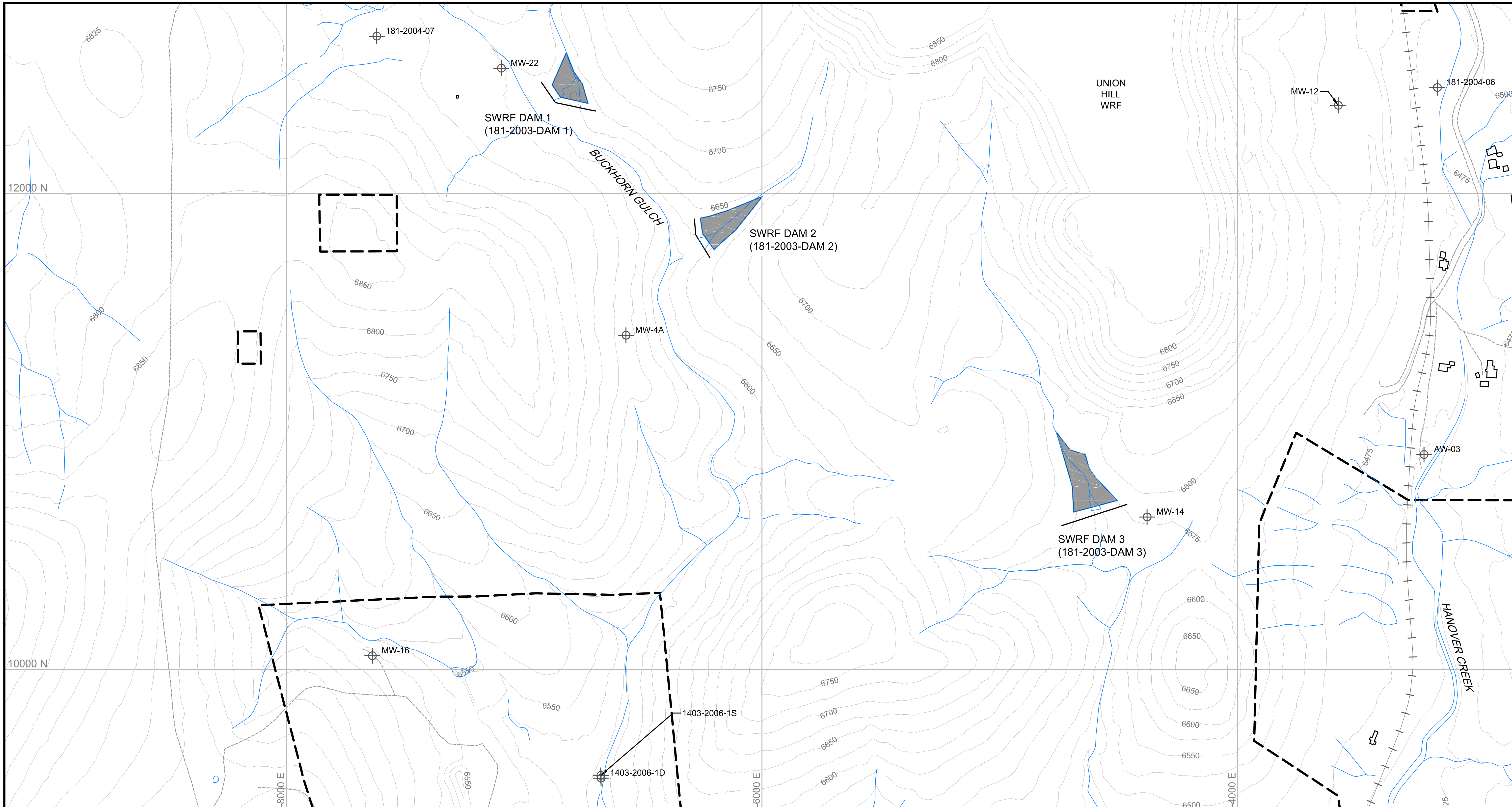

LEGEND / NOTES

- ROADWAY OR TRAIL
- RAILROAD
- PROPOSED MMD PERMIT BOUNDARY
- SURFACE IMPOUNDMENTS
- FACILITIES
- EXISTING TOPOGRAPHIC CONTOURS (25' INTERVAL)
- DRAINAGES
- MONITORING WELL

*(UNDER MMD REVIEW, SEE APPENDIX B.4)

REFERENCE: TOPOGRAPHY BY COOPER AERIAL SURVEYS CO., TUCSON ARIZONA, DATE: DECEMBER 15, 2013.

0 400
SCALE IN FEET

COORDINATE SYSTEM
CHINO LOCAL MINE

N

FIGURE □
MIDDLE □UC□ HORN GULCH AND HANOVER CREE□ AREA□CONTINENTAL MINE

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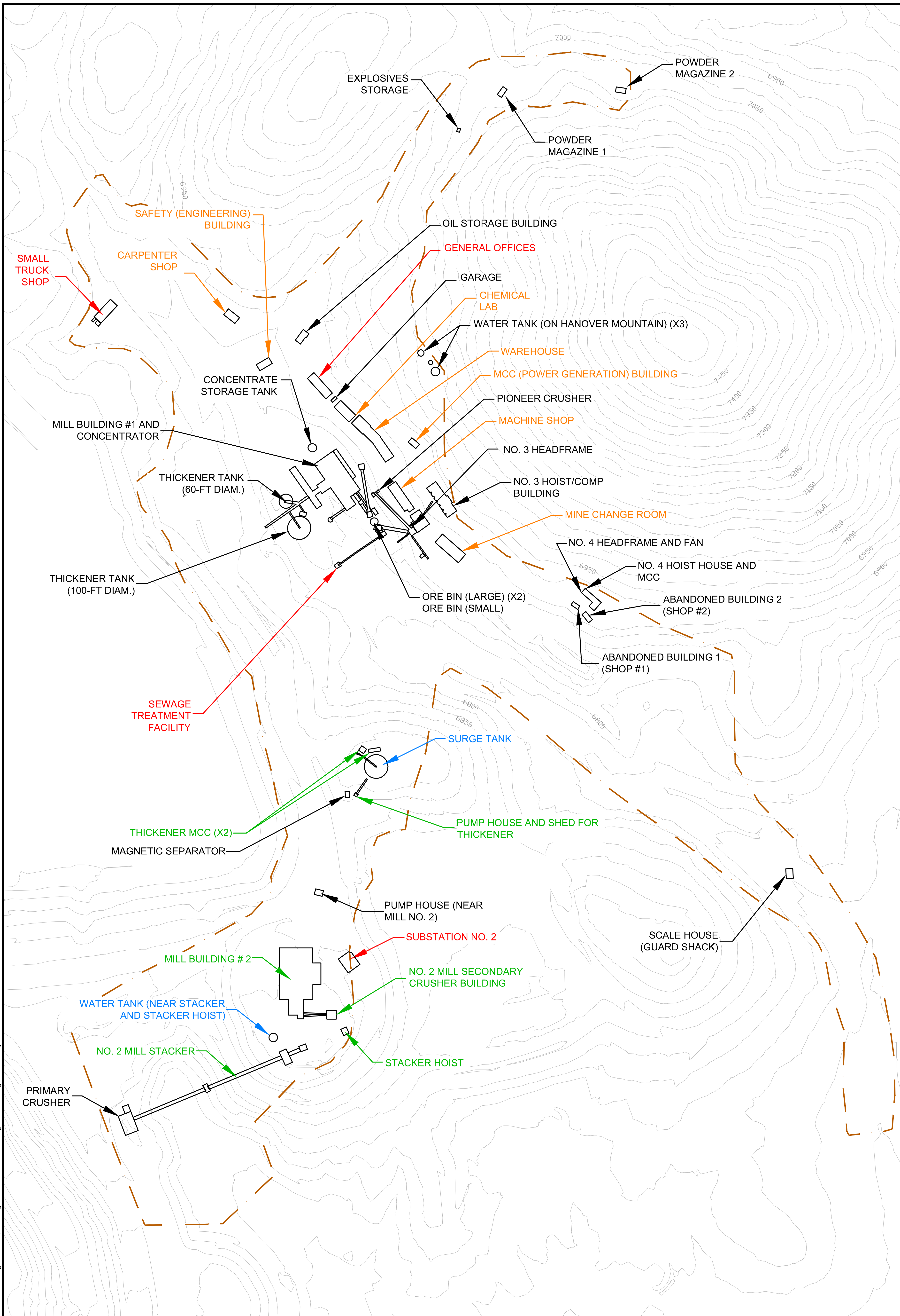

LEGEND / NOTES

BUILDING NAME (black)	DEMOLISH / REMOVED PRIOR TO EOY 2019	BUILDING NAME (blue)	INDUSTRIAL PMLU
BUILDING NAME (green)	DEMOLISH AT RECLAMATION	BUILDING NAME (orange)	IN PREVIOUS CCP INDUSTRIAL PMLU / DEMOLISHED PRIOR EOY 2019
BUILDING NAME (red)	REPLACED BY EOY 2019 INDUSTRIAL PMLU	— — ·	INDUSTRIAL PMLU BOUNDARY

EXISTING TOPOGRAPHIC CONTOURS (25' INTERVAL)

SCALE IN FEET
0 400

COORDINATE SYSTEM
CHINO LOCAL MINE

N

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FIGURE 9
CONTINENTAL MINE INDUSTRIAL POST MINING LAND USE

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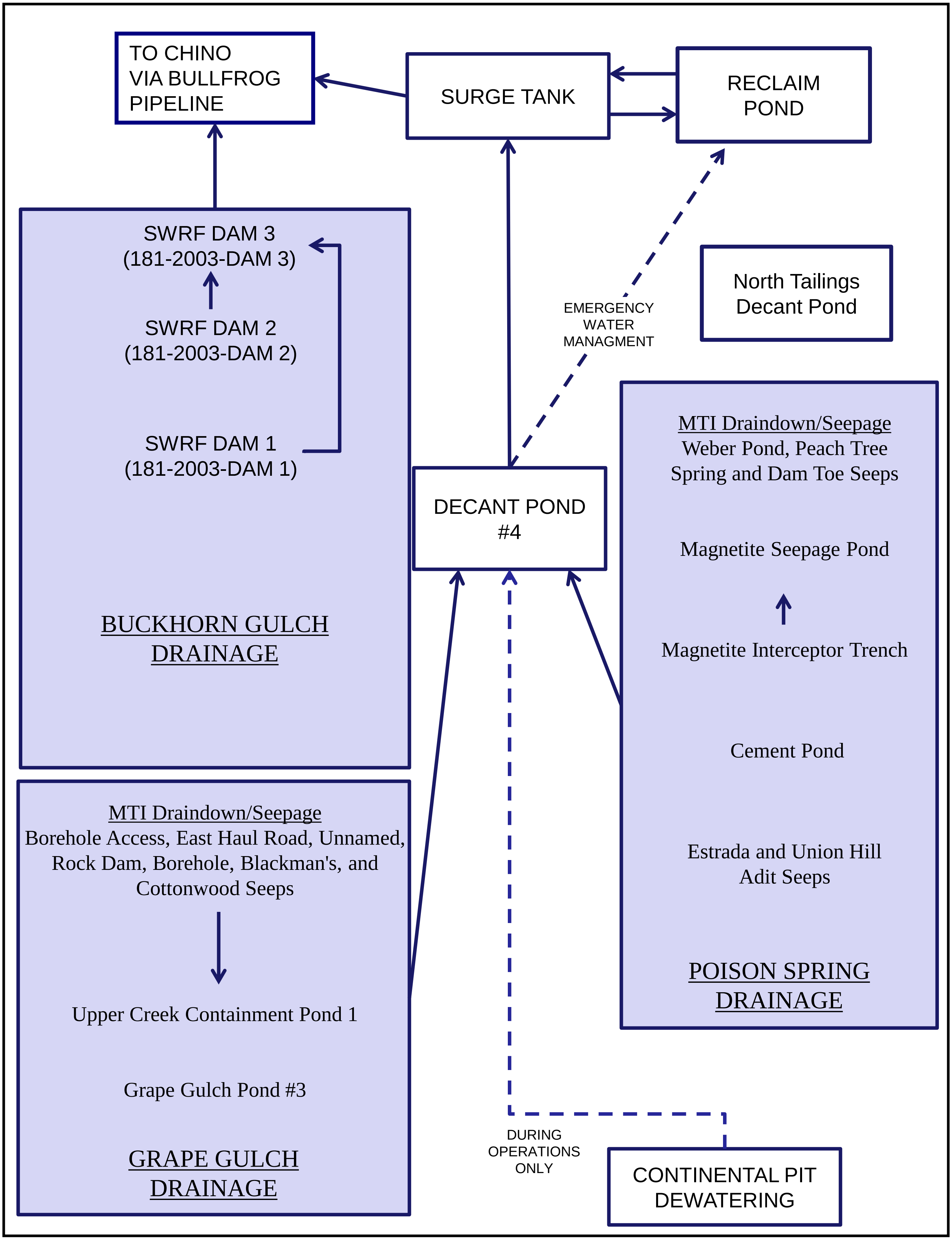

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PROJECT: 200189	TASK: 01	**FIGURE 10** **CONTINENTAL MINE WATER MANAGEMENT FLOW DIAGRAM**	PREPARED FOR: FREEPORT-McMoRAN
PREPARED BY: TELESTO SOLUTIONS INCORPORATED			

Date: 12/10/2014 User: dolson

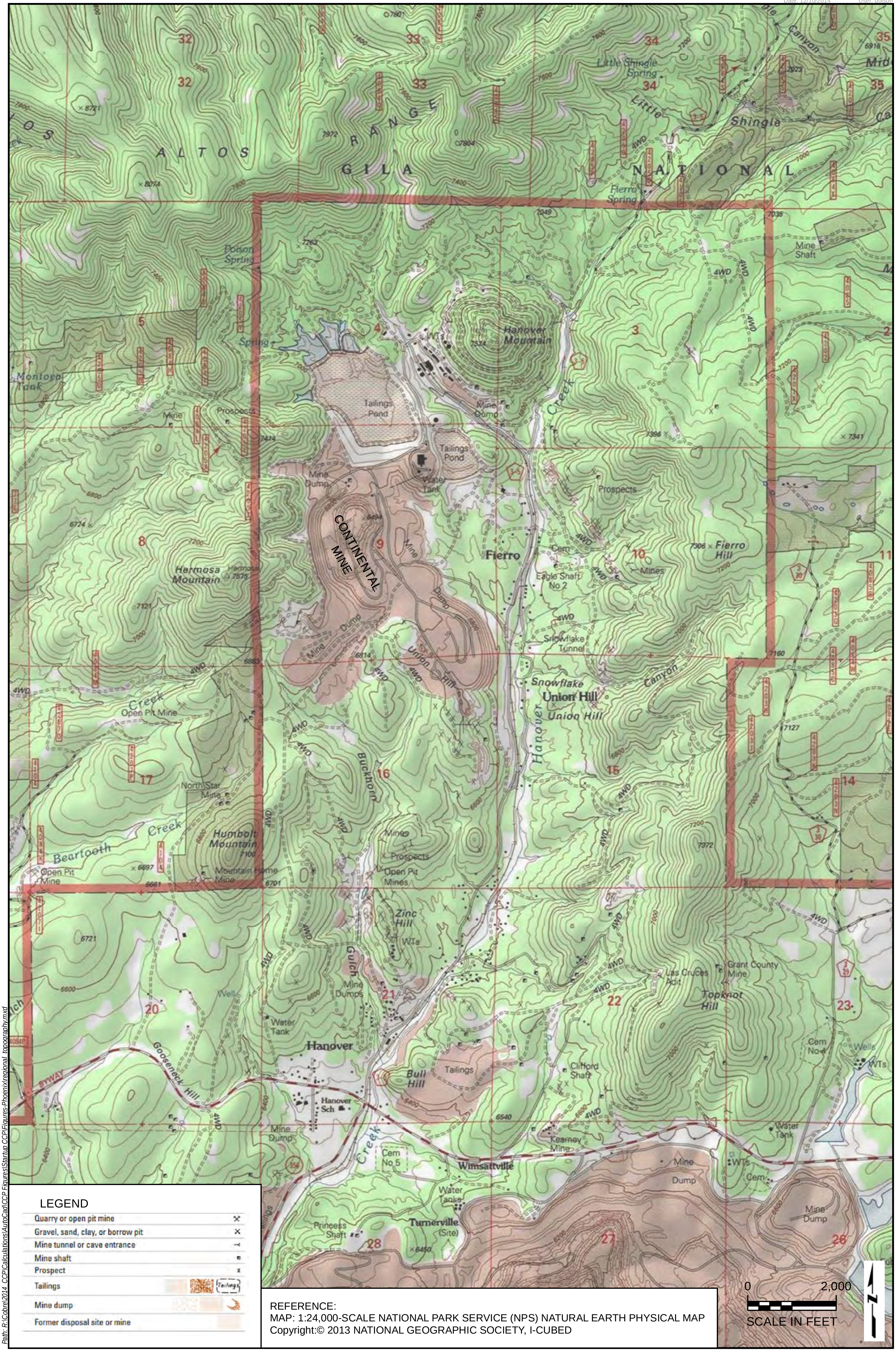

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FIGURE 11
GENERALIZED REGIONAL TOPOGRAPHIC MAP

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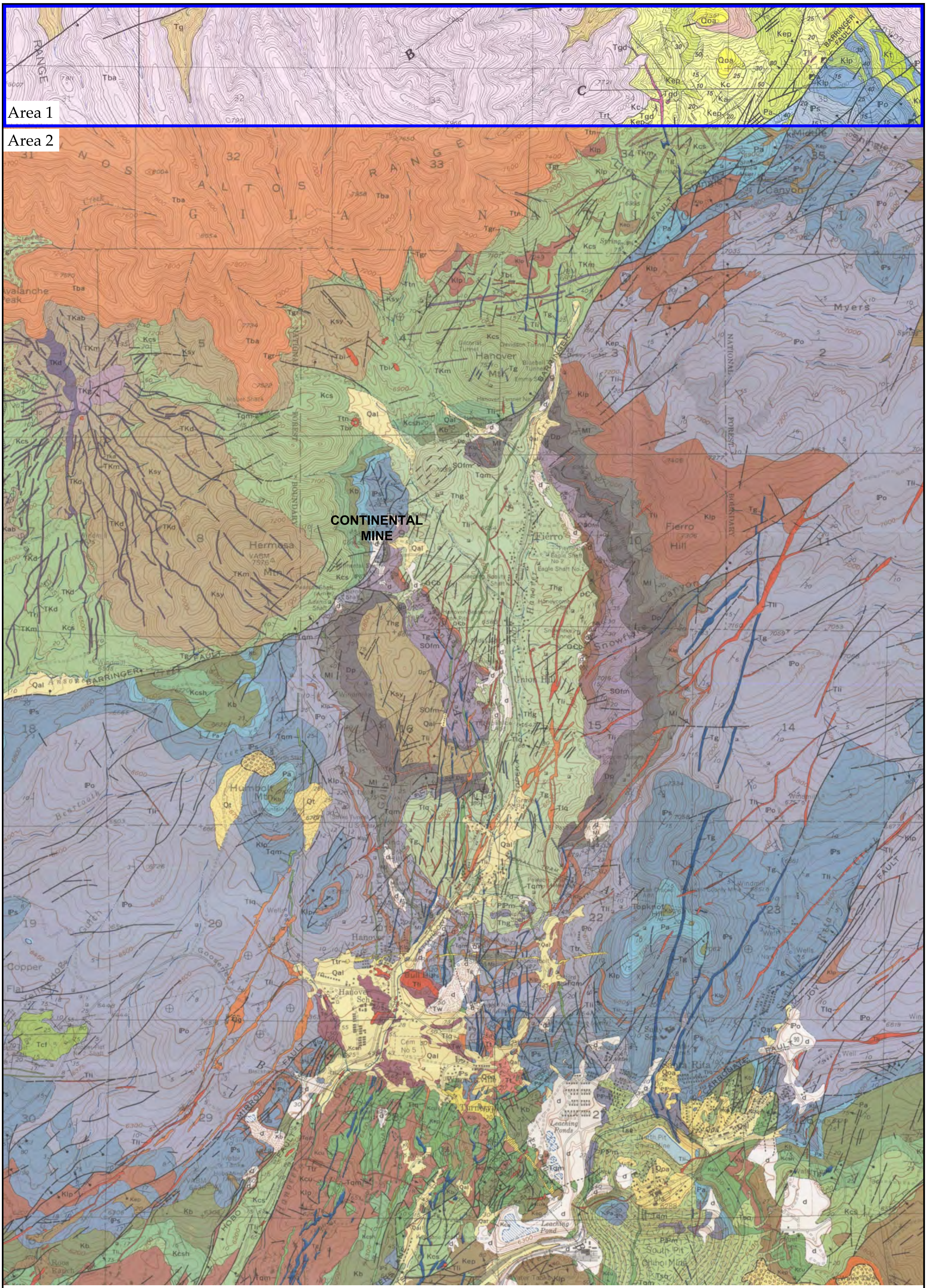


GEOLOGY LEGEND: See Figure 12-B For Area 1
See Figure 12-C For Area 2

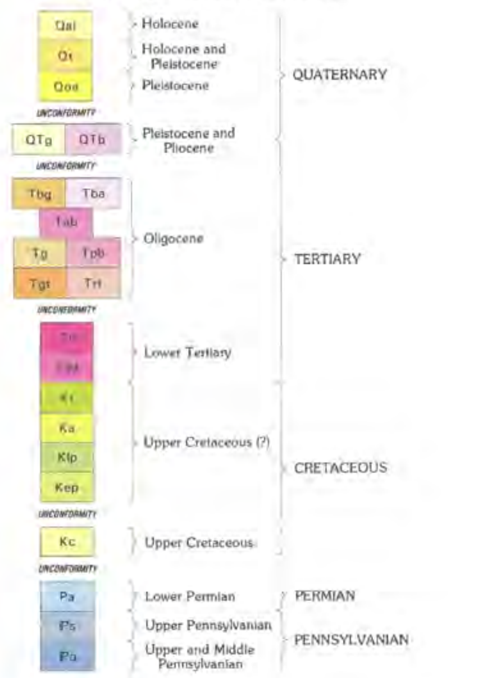
N
W E
S

FREEPORT-MCMORAN

FIGURE 12–A
GENERALIZED GEOLOGY

Scale: As Noted	Date: 7-21-2014	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: ANR	

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene)**—Sand, silt, clay, and lenses of gravel in Sapillo Creek and Mimbres River valley; locally includes talus deposits as much as 50 ft thick

Qt **Talus deposits (Holocene and Pleistocene)**—Slope debris, cones, and sheets composed of boulders and large blocks of limestone, sandstone, conglomerate, basalt, and rhyolite tuff in a sand, gravel, and silt matrix

Qoa **Older alluvium deposits (Pleistocene)**—Unconsolidated fanglomerate of subrounded to angular boulders, cobbles, and pebbles of all older rock in the area in a pebble, sand, and silt matrix

QTg **Gila Conglomerate (Pleistocene and Pliocene)**—Coarse conglomerate and fanglomerate. Boulders, cobbles, and pebbles of andesite, quartz diorite porphyry, and quartz diorite with minor quartzite, limestone, and shale enclosed by angular to subangular sand and small pebbles cemented locally by argillaceous and calcareous matrix. Forms western margin of trough of coarse detritus deposited along Mimbres River valley and Sapillo Creek. Largest boulders as much as 3 ft in diameter; fragments average 3 to 6 in. in diameter.

Cliffs of consolidated fanglomerates in Allie Canyon grade from highly indurated rock, in contact with older rocks, to poorly consolidated rock east of the confluence of Allie Canyon and the Mimbres Valley. Interstices of indurated fanglomerates filled with fine-grained calcareous and argillaceous cement.

Lenses of bedded conglomeratic arkose, exposed southwest of G.O.S. ranch, 70–80 percent angular to subangular quartz and 20–30 percent feldspar and pumice fragments. Poorly defined lenticular layers of well-rounded cobbles and pebbles grade laterally and vertically within bedded arkose. Bedding of fanglomerate more distinct eastward; quantity and size of fragments decrease with concurrent increase in quantity of sand

QTb **Basalt flows (Pleistocene and Pliocene)**—Dark-greenish-gray basalt flows interbedded with Gila Conglomerate; made up of plagioclase, olivine, and pyroxene. Thin sections of two specimens show basalt to be about 60 percent labradorite microlites (0.2–0.8 mm in length) and about 40 percent olivine and pyroxene. Olivine is extensively altered to iddingsite; pyroxene partly altered to bastite. Plagioclase unaltered or only slightly altered to fine, flaky, unidentified clay mineral; magnetite granules sparsely disseminated throughout basalt

Tbg **Conglomerate unit (Oligocene)**—Subrounded pebbles, cobbles, and a few boulders of basalt and rhyolite in light-brownish-gray volcanic sand matrix; crudely bedded and crossbedded. Interbedded with basaltic-andesite flows (Tba) in western and central parts of quadrangle. Interlayered arkoses are thin bedded and consist of sand and silt-sized grains of dark-gray basalt and light-gray rhyolite and pumice. Unit deposited during period of repeated displacement of basaltic-andesite flows. South of Deadman Canyon fault, conglomerate has been repeatedly displaced to various levels and periodically eroded before deposition of basaltic-andesite flows. Unit ranges from 50 to as much as 300 ft thick. In most areas, fault blocks were not tilted by repeated fault movement; however, at head of Skates Canyon, faulted blocks of conglomerate are tilted as much as 30°

Tba **Basaltic-andesite flows (Oligocene)**—Medium-dark-gray to dark-brownish-black, porphyritic flows with a few conspicuous phenocrysts of green olivine, light-gray plagioclase, and light-green pyroxene in an aphanitic groundmass. Major constituents of the groundmass, in order of abundance: labradorite microlites from 0.1 to 0.4 mm in length, granular clusters of pyroxene from 0.1 to 0.3 mm across, fibrous iddingsite less than 0.1 mm in length, fine granules of magnetite. Texture of groundmass ranges from trachytic to intergranular. Hypocrystalline textures are associated with scoriaceous and vesicular horizons. Phenocrysts of olivine, pyroxene, and plagioclase make up 5–15 percent of rock. Most abundant phenocrysts are dark-green equant crystals of olivine that range from 0.2 to 2 mm across and make up 1–10 percent of the rock. Olivine is iron-rich fayalite with parallel extinction and a −2V of 80°, and it is mostly altered to iddingsite that occurs as veinlets in fracture planes of crystals, and as reaction rims around unaltered cores, and complete pseudomorphs. Thin selvages of magnetite and granular pyroxene coat a few olivine crystal faces. Clinopyroxene, or rarely twinned orthopyroxene makes up about 1–3 percent of the rocks, occurs as euhedral to subhedral prisms averaging about 0.5 mm across, are unaltered, except for mild chloritization. Clusters of pyroxene grains less than 0.1 mm across are disseminated throughout groundmass. Flows are interbedded with conglomerate, fanglomerate, and arkose. Tops of flows marked either by thin layers of flow breccia or vesicular and scoriaceous zones. The basaltic andesite rests unconformably on fanglomerate, conglomerate, and basalt in west and southwest parts of quadrangle and on an erosional surface cut on older sedimentary and intrusive rocks near southern boundary. Flows are as much as 800 ft in thickness

Tab **Augite basalt flows (Oligocene)**—Dark-gray, vesicular and amygdaloidal porphyro-aphanitic rock consisting of about 10 percent phenocrysts of augite, hypersthene, hornblende, and a few feldspar crystals in an aphanitic groundmass. Augite is unaltered, except a few grains show thin coatings of magnetite. Hypersthene is mostly altered to pseudomorphs of bastite. Alteration of hornblende ranges from slightly chloritized grains to pseudomorphs of leucoxene and iron oxide. Labradorite phenocrysts are unaltered, but are strongly corroded by the aphanitic groundmass. The groundmass ranges from hypocrystalline to glass and consists of microlites of labradorite mostly less than 0.3 mm in length. Granular magnetite is disseminated in groundmass and the vesicles are partly coated by cryptocrystalline quartz and clear chalcedony. Flows rest unconformably upon an erosion surface cut on older sedimentary and intrusive rocks, and are truncated by the present erosion surface

Tg **Conglomerate deposits (Oligocene)**—Conglomerate and arkosic sands interbedded with Tba, Tpb, Tgt, and Trt volcanic rocks. Exposed on steep slopes along north slopes of Allie Canyon and northward to Cottonwood Canyon, and along upper slopes at head of Bear, Deadman, Allie, and Skates Canyons. Lithology ranges from massive semiconsolidated conglomerate in eastern part of quadrangle, through coarse-grained conglomeratic arkose, to well-bedded arkosic sands in the western and southwestern parts of quadrangle. Conglomerates consist of cobbles, pebbles, and a few boulders of subangular to subrounded igneous rocks, with minor amounts of limestone, sandstone, siltstone, and shale in a sand- and silt-sized quartz, feldspar, and pumice matrix. Arkose consists mostly of moderately well sorted angular to subangular quartz, feldspar, pumice, and minor amounts of dark mafic and basalt grains. Deposits unconformably overlain by basaltic andesite flows and unconformably overlie rhyolite tuffs, older sedimentary, and igneous rocks

Tpb **Basalt porphyry flows (Oligocene)**—Medium dark gray on fresh break, weather dark gray, and are made up of about 50 percent phenocrysts of plagioclase and mafic minerals in a fine-grained to aphanitic groundmass. Plagioclase phenocrysts make up about 40 percent of the rock and are mostly euhedral prisms 2 to 4 mm in length. Some crystals are zoned and range from andesine to labradorite, but most are labradorite. Mafic phenocrysts are about 6 percent augite, 2 percent olivine, and 1 percent hypersthene. Augite is unaltered and occurs as twinned prisms 1 to 6 mm across. Olivine almost completely altered to iddingsite. Hypersthene, partly altered to fibrous bastite, occurs as elongate prisms that show a pale-green pleochroism and −2V of 50°. The groundmass is composed mostly of microlites of labradorite about 0.3 mm in length arranged in a poorly developed, felted texture. Iron oxide and granular olivine and augite are disseminated in the groundmass. In the west-central part of quadrangle, the basalt porphyry flows are interbedded with fanglomerates of Oligocene age; elsewhere they were deposited on an erosional surface cut on fanglomerates and rhyolite tuff. Unconformably overlain in turn by basaltic andesite flows and fanglomerate. Basalt flows apparently thin northward and thicken to southwest and west. Thickness of porphyritic basalt flows ranges from 0 to about 350 ft

Tgt **Gravel unit (Oligocene)**—Light-yellowish- and brownish-gray, poorly bedded and crossbedded conglomerate and interbeds of arkosic sandstone. Conglomerates composed of well-rounded cobbles and pebbles of basalt and rhyolite in a matrix of sand and silt-sized grains of basalt and rhyolite. Sandstones are well-bedded, poorly consolidated, medium-grained arkose consisting mostly of quartz, feldspar, pumice, and a few dark-gray mafic grains. Fluviatile sandstone and conglomerate interbedded with rhyolite tuff (Trt) occur within fault block in west-central part of quadrangle

Trt **Rhyolite tuff (Oligocene)**—Composed of two cooling units of welded tuff. Upper unit is a lavender, gray, and white crystal vitric tuff, and lower cooling unit is black, maroon, brown, and pink welded crystal vitric tuff. Tuff forms cliffs and steep slopes along upper reaches of the Allie Canyon and in central part of quadrangle where it was deposited on an early Tertiary erosion surface cut on sedimentary and igneous rocks. Tertiary terrain was dominated by north-south ridge extending from central part of map area southward into Santa Rita quadrangle. Lower unit more than 550 ft thick on lowlands to north, east, and west of this ridge; tuff thins toward rising topography of early Tertiary terrain with only thin coating of welded tuff deposited along upper slopes and crest of ridge. Surface of lower unit was then trenched during brief period of erosion, and tuffaceous conglomerate was locally deposited on eroded surface. Upper unit was deposited as an ash flow ranging in thickness from a few tens of feet along the higher topography to as much as 360 ft near the head of Allie Canyon.

The upper ash flows are light-lavender, light-gray, and white crystal-vitric tuff. The basal part of the unit consists of light-lavender, dense, partly devitrified, welded tuff; this unit grades upward through light-gray, granular, partially devitrified, lightly welded tuff into an upper white, earthy, intensely devitrified unwelded tuff. The basal lavender tuff is a vitric-crystal aggregate made up of about 15 percent crystals and crystal fragments of oligoclase, 2–5 percent sanidine, about 7 percent quartz, and 2 to 3 percent biotite in a partly devitrified matrix of randomly oriented fragments of pumice and shards. Oligoclase crystals are rimmed by potassic feldspar. The outer edges of the reaction rims are made up of serrated crystals grown at right angles to the fracture faces. These serrated potassic feldspar rims grade inward through a clear zone of potassic feldspar into a core of twinned oligoclase. The biotite crystals have rims of magnetite that grade into the cores of deep-reddish-brown biotite. The matrix consists of partially devitrified pumice and shards; the welded matrix of the basal layer grades upward into devitrified unwelded matrix composed of angular cusp-shaped, Y- and X-shaped shards, and pumice fragments. The glass fragments are devitrified to a fine crystalline mesh of quartz and potassic feldspar. Some of the angular fragments and thin threads of glass are devitrified to fine combs of quartz and potassic feldspar arranged at right angles to the boundaries of the fragments. Some of the shards and glass threads have central cavities that are lined with druses of tridymite.

The basal part of the lower cooling unit is an undevitrified black, maroon, reddish-brown, and pink, glassy, intensely welded tuff that grades upward through a 10- to 20-ft-thick zone of light-red partly devitrified tuff into a strongly devitrified light-pink welded tuff that contains a few scattered subangular to rounded fragments of andesite. The upper 3–4 ft of the lower unit contain about 20 to 30 percent rounded andesite fragments. This tuff is generally massive, showing only crudely developed horizontal layering; it weathers by exfoliation to massive subrounded or rounded surfaces.

Thin sections of the basal part of the lower tuff show it to be about 40 percent oligoclase (An_{30}), 5 percent sanidine, 3 percent quartz, and 1 percent biotite crystals in a compacted mass of pumice and shards. The oligoclase fragments range from 0.5 to 1.5 mm across; few are zoned; compositions range from sodic-oligoclase to sodic-andesine. Oligoclase in the overlying pink devitrified tuff is altered to bladed rims of potassic feldspar grown at right angles to the crystal and the fracture faces of the oligoclase. Quartz occurs as corroded grains ranging from 0.3 to 2 mm across; sanidine occurs as crystal fragments, either unaltered or only slightly corroded, from 0.5 to 2.0 mm across. In the devitrified areas of the upper part of the lower tuff, biotite occurs as conspicuous golden crystals with a metallic luster, with magnetite along the cleavage planes and as rims around cores of deep-reddish-brown biotite. The altered biotite crystals have brownish-red to orange pleochroism and −2V's ranging from 5° to as much as 40°. In the lower undevitrified layer of black, brown, and maroon tuff, biotite occurs as black vitreous crystals, in thin sections, deep-olive-green crystals with low 2V's ranging from about 2° to 5°. The matrix of the crystal-vitric tuff makes up about 35 to 50 percent of the rock and is composed of shards, pumice, and fine vitric dust, ranging from sizes below the resolution of the microscope to fragments as much as 4 mm across; most fragments are 1 to 2 mm across, and consist of a potassium-bearing glass that is partially devitrified to a very fine crystalline aggregate consisting mostly of quartz and some potassic feldspar. The degree of compaction and welding diminishes upward from the basal part of the lower tuff

Tl **Quartz latite and latite porphyry (lower Tertiary)**—Occurs as northeast-trending dikes and a pluton in southern part of quadrangle. Dikes range from 0 to about 50 ft in width and are traceable for as much as 1,500 ft along strike. The pluton is about 500 ft across; crops out on northeast slope of Shingle Canyon. Wall rocks are virtually unaltered by contact metamorphism.

The quartz latite porphyry is dark gray, made up of about 60 percent euhedral feldspar, hornblende, and biotite phenocrysts in medium-grained groundmass consisting mainly of plagioclase and hornblende and some quartz and potassic feldspar.

Plagioclase phenocrysts make up about 35 percent of the rock and are zoned euhedral crystals ranging from 2 to 6 mm in length. Crystals range from oligoclase to sodic andesine and have an average composition of calcic oligoclase. About 15 percent of the rock consists of euhedral prismatic phenocrysts of green hornblende ranging from 3 to 8 mm in length; some are slightly altered to penninite. Tabular crystals of unaltered biotite compose about 5–10 percent of rock and range from 3 to 5 mm across.

The groundmass makes up about 40 percent of rock and includes oligoclase, hornblende, and subordinate amounts of quartz and potassic feldspar. Plagioclase comprises about 60 percent of groundmass and is slightly altered to fine platy sericite and clay minerals. Hornblende makes up about 30 percent of matrix; occurs as elongate prisms ranging from 0.5 to 1.5 mm in length and is altered to penninite and calcite. Approximately equal volumes of anhedral quartz and potassic feldspar constitute remaining 10 percent of groundmass; quartz is interstitial and orthoclase occurs as subhedral to anhedral crystals 0.2–0.4 mm across and it is clouded by fine micaceous clay minerals. Accessory minerals are apatite and zircon.

Two dikes of relatively quartz-poor porphyritic latite exposed on divide between Bear and Shingle Canyons; dikes range from 0 to 30 ft across and are traceable for as much as 800 ft along strike. They show indistinct porphyritic textures with phenocrysts of medium-yellowish-brown biotite and inconspicuous very light gray plagioclase set in a medium-grained, very light gray to light-yellowish-brown, argillaceous matrix.

Plagioclase, hornblende, and biotite phenocrysts make up about 30–40 percent of rock. Plagioclase phenocrysts are the most abundant and are pervaded by microscopic flaky sericite and clay minerals that are in part replaced by calcite. Biotite is completely altered to aggregates of clay minerals, sericite, chlorite, and calcite. Hornblende is altered to clots of limonite containing irregular areas of an unidentified opaque mineral. A few quartz phenocrysts are present as conspicuous frosted and corroded grains ranging from 1 to 3 mm across. Groundmass is made up principally of a mosaic of plagioclase mostly altered to calcite, clay, sericite, and minor amounts of quartz

Tgd **Granodiorite porphyry (lower Tertiary)**—A granodiorite porphyry dike crosscuts shales of the Colorado Formation in the southern part of quadrangle. Porphyry is medium gray to medium greenish gray with 3–15 mm phenocrysts of light-gray to white feldspar, dark-gray hornblende and biotite, and a few quartz grains in a medium-gray to medium-dark-gray, very fine to fine-grained groundmass. Phenocrysts make up from about 30 to 70 percent of rock; hornblende makes up from 1 to 10 percent, and feldspar makes up about 25–60 percent, and it is mostly altered to epidote, sericite, albite, and unidentified clay minerals. Green hornblende occurs both in the groundmass as fine laths and as euhedral phenocrysts and is partly to completely altered to epidote, calcite, chlorite, and aggregates of secondary biotite. Euhedral phenocrysts of biotite are altered to chlorite, epidote, and minor amounts of leucoxene, sphene, and magnetite. Accessory minerals are sphene, magnetite, and apatite. Dike ranges from 20 to 60 ft wide and is mapped from the southern boundary of the map northward for about 1,700 ft, where it passes under basaltic andesite flows

Kt **Hornblende trachyte porphyry (Upper Cretaceous?)**—Occurs as a dike 90 ft wide that can be traced for about 300 ft along strike, where it becomes a sill 50–200 ft thick in the Oswaldo Formation. Limestones above and below sill are virtually unaffected by contact metamorphism.

The hornblende trachyte porphyry is intensely altered to brownish-yellow to brownish-gray rocks with numerous elongate prismatic phenocrysts of hornblende and dull-white feldspar set in fine-grained granular groundmass. Hornblende phenocrysts, a few millimeters in width and from 1 to 2.5 cm in length, make up about 15 percent, and zoned plagioclase phenocrysts 2–3 mm long, with an average composition of oligoclase (An_{30}), make up about 10–15 percent of rock. Phenocrysts and matrix are propylitized and altered to epidote, sericite, chlorite, biotite, calcite, and minor amounts of clinozoisite. Hornblende is completely altered to pseudomorphs consisting of cores of epidote, chlorite, and calcite and reaction rims of yellowish-brown biotite. Phenocrysts of oligoclase are altered principally to minute flakes of sericite. The porphyry contains about 1–3 percent quartz as anhedral granular aggregates in groundmass. Groundmass makes up about 75 percent of rock and consists principally of potassic feldspar, plagioclase, and quartz. Potassic feldspar is altered to fine platy sericite, reddish-brown biotite, and fine granular calcite. Accessory minerals are zircon, apatite, and magnetite.

The chilled border zone of sill is 1–3 ft thick, and is gray aphanitic porphyry less intensely altered than the interior. Epidote and biotite are nearly absent, and hornblende phenocrysts are altered to pseudomorphs of penninite, leucoxene, and calcite

Ka **Augite-hornblende diorite porphyry (Upper Cretaceous?)**—A pluton of augite-hornblende diorite porphyry crops out at head of Shingle Canyon in southern part of quadrangle. Upper contact of pluton strikes northwest, dips southwest, and is mostly concordant with beds of the Colorado Formation. Pluton is cut off on northeast by Mimbres fault; lower limit is not exposed. Pluton apparently thickens southwestward and attains a maximum exposed thickness of about 400 ft at its termination on the Barringer fault. Borders of the pluton are chilled against overlying shale beds, which are altered to dark-gray banded silicate hornfels. A faulted northwestern extension of the pluton splits into a dike and a sill; dike trends north and is cut off by Mimbres fault, and sill continues northwestward and is covered by volcanic rocks.

The pluton is a brownish-gray porphyry containing prominent phenocrysts of green augite, milky-white feldspar, and elongated prisms of greenish-brown hornblende in a medium-grained groundmass. Rock is made up of about 15 percent augite, 15 percent plagioclase, and 5 percent hornblende phenocrysts embedded in a groundmass of andesine, microlite, quartz, and augite. Augite phenocrysts are twinned and range from about 0.2 to 3 mm in width. Most crystals are uralitized and altered to aggregates of epidote, penninite, and calcite. Some augite crystals are rimmed by uralite with cores of epidote, penninite, and calcite. Andesine phenocrysts range in size from 0.1 to about 2 mm in width and are partly altered to sericite or fine micaceous clay minerals. Brown hornblende phenocrysts are altered mostly to penninite and minor amounts of epidote and calcite. Groundmass consists of felted andesine microlites ranging from about 0.05 to 0.1 mm in length, granular augite, and anhedral quartz. Augite is strongly epidotized and andesine microlites are pervaded by fine micaceous sericite and clay minerals. Accessory minerals are sparsely disseminated through groundmass and include slender prisms of apatite, anhedral zircon, and iron oxide

Klp **Hornblende-quartz porphyry (Upper Cretaceous?)**—Hornblende-quartz diorite porphyry occurs as sills and laccoliths in the Abo, Syrena, and Oswaldo Formations. Principal outcrops are along north and south slopes of Allie Canyon in central part of quadrangle. Sills range from a few feet to at least 200 ft in thickness and can be traced for distances ranging from about 600 ft to 1 mi.

On fresh surfaces, hornblende-quartz diorite porphyries are light greenish gray, but weather to reddish gray. Thin sections show about 30–60 percent phenocrysts of plagioclase and hornblende in a fine-grained, crudely felted groundmass of plagioclase and quartz. Plagioclase phenocrysts make up about 35–40 percent of rock and range from 0.3 to 3.0 mm in length; a few zoned crystals range in composition from andesine to labradorite, but most are andesine (An_{45}). Plagioclase phenocrysts are slightly altered to epidote and sericite, and rarely to albite. Hornblende phenocrysts are mostly 1–2 mm in length, but a few crystals are as much as 35 mm long. Nearly all hornblende is moderately to strongly altered to epidote and chlorite, but some is altered to calcite and biotite.

Andesine microlites in groundmass are altered to epidote and minor amounts of an unidentified clay mineral. Quartz occurs as anhedral interstitial grains between andesine microlites. Accessory minerals are apatite, zircon, and sphene; apatite and zircon are unaltered; sphene is mostly altered to leucoxene

Kep **Quartz diorite porphyry (Upper Cretaceous?)**—Coarse-grained quartz diorite porphyry occurs in sills, laccoliths, and a few dikes in central and southern part of Allie Canyon quadrangle. Sills range in thickness from a few feet to as much as 900 ft.

The quartz diorite porphyry is coarse grained and greenish gray with fine- to medium-grained, porphyritic, chilled borders; consists of about 50–60 percent phenocrysts of plagioclase, hornblende, quartz, and biotite, and few orthoclase crystals as large as 75 mm across in medium- to coarse-grained matrix of plagioclase, quartz, and potassic feldspar. Chilled borders made up of 15–50 percent phenocrysts of hornblende, plagioclase, quartz, and biotite embedded in a fine- to medium-grained matrix consisting of plagioclase, potassic feldspar, and quartz. Accessory minerals include allanite, sphene, apatite, and zircon. Plagioclase phenocrysts are zoned andesine, ranging from An_{35} to An_{50}, but most crystals are andesine (An_{40}). Some andesine in coarse-grained rocks is slightly altered to epidote, chlorite, and minor amounts of calcite and sericite. Andesine in chilled borders is partly altered to penninite and sericite and minor amounts of calcite and epidote. Matrix is made up of andesine, hornblende, quartz, and some biotite and potassic feldspar, and the grain size of matrix ranges from about 0.1 to about 1.5 mm, the same size as the smaller phenocrysts

Kc **Colorado Formation, undivided (Upper Cretaceous)**—Gray, brown, and reddish-brown, thick-bedded sandstones interbedded with a few massive ledges of light-brownish-gray arkosic sandstone, with medium-gray shale partings. Exposed only in faulted blocks in southern part of quadrangle in Shingle Canyon. Basal contact not exposed and upper beds have been removed by pre-Oligocene erosion. As much as 1,000 ft thick in Shingle Canyon area

Pa **Abo Formation (Lower Permian)**—Interbedded mudstone, siltstone, limestone, and conglomerate, about 580 ft thick.

Upper sequence of siltstones intruded by a sill or laccolith of quartz diorite porphyry about 900 ft thick; siltstones above and below the porphyry are dense, reddish-orange rocks extensively silicified and contain balls and irregular replacement nodules of epidote.

Middle and lower parts of formation consist of 460 ft of reddish-brown, purple, and red mudstones with lenses of limestone conglomerate. Lower mudstone sequence is displaced by a fault and intruded by a sill of quartz diorite porphyry about 315 ft above base of formation; the fault cuts out an estimated 200 ft of mudstone. The mudstones contain numerous laminae, lenses, nodules, and ovoids of limestone and silty limestone, and locally mudstones are cut by numerous calcite veinlets. Limestone conglomerate consists of well-rounded limestone pebbles and a few subangular to subrounded fragments of dark-gray chert and shale in calcareous siltstone matrix

Magdalena Group

Ps **Syrena Formation (Upper Pennsylvanian)**—Consists of an upper sequence of reddish-brown calcareous shale and a lower sequence of shale and limestone. Lower beds of sequence consist of two 15-ft-thick sets of calcareous shale beds separated by 7-ft-thick ledge-forming beds of mottled, light-gray and tan, silty limestone. Lowermost bed of formation is either a medium-dark-gray limestone bed or a limestone conglomerate bed. A quartz diorite sill intrudes upper part of formation about 45 ft above its base; sill is overlain by about 65 ft of interbedded light-gray limestone and silty, mottled, tan and light-gray silty limestone

Po **Oswaldo Formation (Upper and Middle Pennsylvanian)**—Consists of a lower medium- to thick-bedded limestone with shale partings, a middle thick-bedded cherty limestone, and an upper tan to light-gray silty limestone; locally, uppermost bed is a limestone conglomerate. The uppermost bed of the formation is a light-blue-gray, very fine grained limestone, from 2- to 5-ft-thick, overlain by either a limestone conglomerate bed or a medium-dark-gray limestone bed at the base of the Syrena Formation. Base of formation not exposed.

Oswaldo Formation in Santa Rita quadrangle to the south ranges from 405 to as much as 440 ft thick (Jones and others, 1967). In Allie Canyon quadrangle 270 to 300 ft is exposed

Contact—Dotted where concealed

75 **Fault showing dip**—Dashed where approximately located; dotted where concealed; bar and ball on downthrown side

10 **Strike and dip of beds**

A **Abandoned shaft**

Inaccessible adit

X **Prospect pit**

MINERAL DEPOSITS

Mineral deposits occur principally in the southern part of the quadrangle and include lead-zinc veins localized by northeast-trending faults in the hanging wall block of the Barringer fault, and as a few irregular replacement bodies of manganese oxide. The width and grade of the veins diminish northeastward and the veins are everywhere so narrow and low grade that only small quantities of lead-zinc ores have been commercially produced.

The lead-zinc veins range from 0 to 1 ft in width and are as much as 100 ft long. The veins are composed of about 90 percent quartz and about 10 percent sulfides that are made up of approximately equal volumes of galena, sphalerite, and pyrite. The quartz consists of clear gray to pink crystals ranging from a few millimeters to as much as 0.5 in. in length. Numerous vugs are lined with fine druses of quartz or quartz and sulfides. Galena and sphalerite commonly crystallize together, with subsidiary amounts of pyrite, and occur as crystal aggregates disseminated throughout the central parts of the quartz veins. Pyrite is sparsely disseminated across the vein, but concentrated mostly near the edges of the vein in discontinous zones parallel to the wall of the vein. Limonite and manganese oxide (wad) are common in the oxidized parts of the veins.

The wall rocks of lead-zinc veins are shattered over widths ranging from a few inches to as much as 10 ft; pyritized and silicified, with minor sericite and clay minerals; and cut by stringers of quartz and pyrite that extend from a few inches to 2 ft laterally from the veins into the shattered walls.

Irregular bodies of manganiferous calcite are exposed in a series of open pits and a shaft in the northeast part of sec. 35, T. 16 S., R. 12 W., and occur in veins and irregular lenses that extend laterally up to 10 ft from the veins into the limestone wall rock, and are from a few feet to as much as 30 ft in length.

REFERENCE CITED

Jones, W. R., Hernon, R. M., and Moore, S. L., 1967, General geology of the Santa Rita quadrangle, Grant County, New Mexico: U.S. Geological Survey Professional Paper 555, 143 p.

FREEPORT-McMoRAN

FIGURE 12-B
GENERALIZED GEOLOGY LEGEND

Scale: As Noted	Date: 8-27-2014	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: ANR	

EXPLANATION

QUATERNARY

Recent

Qal — Younger alluvium
Sand, gravel, and soil. Mapped only where significant geologic relations are hidden

Qt — Hillside rubble and talus

Pleistocene

Qoa — Older alluvium
Gravel and sand cemented with quartz and iron oxides

UNCONFORMITY

Upper Miocene(?) and Pliocene

Tmg — Semiconsolidated gravel deposits in the Mimbres Valley
In part equivalent to Gila Conglomerate

UNCONFORMITY

TERTIARY

Miocene(?)

Tba, Tcb — Flows and tuffs
Tba, basaltic andesite flows.
Tcb, white pumiceous and massive crystal tuffs equivalent to the Caballo Blanco Rhyolite Tuff of Elston (1957) intercalated between flows of basaltic andesite south of the Chino mine

Tbi — Basaltic andesite plugs and dikes
Probable feeders of basaltic andesite flows (Tba)

Tgr — Gravel and boulder deposits
In northwest part of quadrangle

DISCONFORMITY

Tp — Pitchstone, sandstone, and rhyolite tuff
Indurated tuff at top equivalent to Box Canyon Rhyolite Tuff of Elston (1957). Pitchstone at base, locally overlain by sandstone

Tk — Kneeling Nun Rhyolite Tuff[1]
Massive welded and cemented ash flow ranging in composition from quartz latite to rhyolite

Ttn — Rhyolite tuff
Underlies basaltic andesite flows (Tba) in northern part of quadrangle; resembles Kneeling Nun Rhyolite Tuff

Tri — Felsitic rhyolite plugs and dike
Relative age not determinable; assumed to be related to extrusion of rhyolite tuffs of Miocene(?) age. Has texture of shallow intrusive

Ts — Sugarlump Tuffs[2]
Thin-bedded pumiceous rhyolite tuffs; brown sandstone containing clinoptilolite locally

Tr, Trf — Rubio Peak Formation[3]
Tr, conglomerates and gravels;
Trf, rhyodacite-quartz latite flows

DISCONFORMITY

Lower Tertiary

Tti — Rhyodacite porphyry plug and dikes
Plug underlies Bull Hill; intrudes conglomerate west of Wimsattville (Tw). Includes quartz latite dikes of Lasky (1936) with sparse phenocrystal quartz

Tt, Tlq — Quartz latite porphyry dikes and plugs
Quartz phenocrysts abundant.
Tt, Trevarro plug and apophyses;
Tlq, all other dikes and plugs of quartz latite porphyry except that of the Turnerville and Republic dike systems (Ttr) and those at Copper Flat. Not all of exactly same age

Tw — Conglomerate west of Wimsattville
Contains fragments of quartz latite porphyry (Ttr). It is intruded by quartz latite porphyry plug (Tlq) south of Oswaldo No. 1 shaft; it is also intruded by plugs and dikes of rhyodacite porphyry (Tti)

Ttr — Quartz latite porphyry of Turnerville and Republic dike systems
Line pattern indicates southeast facies of Turnerville. Possibly as old as the quartz monzonite porphyry of the Santa Rita stock (Tsq) or the granodiorite porphyry dikes (Tg)

Tqm — Quartz monzonite porphyry dikes

Tg — Granodiorite porphyry dikes
May include apophyses of Hanover-Fierro pluton and Santa Rita stock

Relative ages indeterminable; age relations to andesite breccia (TKab) unknown

Thg — Granodiorite porphyry of the Hanover-Fierro pluton and apophyses

Tsq — Quartz monzonite porphyry of the Santa Rita stock and apophyses

Tcf — Quartz latite porphyry at Copper Flat
One complex pluton and two dikes. Relative age uncertain but between hornblende quartz diorite (Klp) and main epoch of hypogene metallization; that is, before the time of intrusion of the Turnerville and Republic dike systems (Ttr)

CRETACEOUS(?) AND TERTIARY

Upper Cretaceous(?) and lower Tertiary

TKg — Orthoclase gabbro
Small plug in North Star Basin

TKm, TKd — Diorite and mafic porphyry dikes
TKd, plagioclase-hornblende diorite porphyry dikes; some are older than the andesite breccia (TKab).
TKm, predominantly pyroxene andesite to pyroxene syenite porphyry dikes and a few biotite-plagioclase porphyry dikes. Some are apophyses of orthoclase gabbro plug (TKg). Most are younger than the andesite breccia, and one, at least, is older than a granodiorite porphyry dike (Tg). Only about 10 percent of dikes in North Star Basin are shown.

TKab — Andesite breccia
Dark purplish-green indurated volcanic breccia and conglomerate containing blocks and cobbles of older rocks, but mostly of mafic porphyries and dark volcanic rocks. In North Star Basin

CRETACEOUS(?)

Upper Cretaceous(?)

Age with respect to syenodiorite porphyry (Ksy) and andesite breccia (TKab) not shown

UNCONFORMITY

Ksy — Syenodiorite porphyry
Sills and laccoliths

Kt — Trachyte porphyry
Sills and small plutons; chilled margins along hornblende quartz diorite (Klp) and quartz diorite porphyry (Kqp). Intrudes ancestral Mimbres fault

Klp — Hornblende quartz diorite
Sills, laccoliths, and few dikes, some in quartz diorite porphyry sills (Kqp). Cut by mafic porphyry dike (TKm) north of Hanover Mountain

Krp — Rhyolite porphyry
Sills. Appears to have blocked the extension of hornblende quartz diorite sill (Klp) in Groundhog mine. Age relative to quartz diorite porphyry (Kqp) indeterminable. Cut by granodiorite porphyry (Tg) and quartz monzonite porphyry (Tqm) dikes. In section C-C' only

Ka — Augite-hornblende andesite porphyry sills
Near Georgetown. Relative age indeterminable; assumed to have been intruded during time of dominance of the sill form; definitely older than rhyodacite porphyry dikes (Tti) and younger than Percha Shale

Kqp — Quartz diorite porphyry
Sills and laccoliths

CRETACEOUS

Upper Cretaceous

Kcs, Kcsh, Kcu — Colorado Formation
Kcs, sandstone member; alternating beds of sandstone, arkose, and shale. Upper part equivalent to Mesaverde Formation; thin limestone beds in base 100 feet equivalent to Greenhorn Limestone. Chain of circles is a key conglomerate bed.
Kcsh, shale member; black shale except for quartzite 20 feet thick in middle part. Equivalent of Graneros Shale.
Kcu, Colorado Formation, undivided. 0–1,000 feet thick

Kb — Beartooth Quartzite
Reddish fine-grained orthoquartzite, minor black shale and conglomerate locally. 50–140 feet thick

UNCONFORMITY

PERMIAN

Lower Permian

Pa — Abo Formation
Red shale, mudstone and limy mudstone, limestone and chert conglomerate. 0–265 feet thick

CARBONIFEROUS — PENNSYLVANIAN

Magdalena Group

Ps — Syrena Formation
Upper part argillaceous limestone, some shale; lower part limy shale and argillaceous limestone. 170–390 feet thick

Po — Oswaldo Formation
Limestone, some thin shales; sandstone lenses shown by stipple or line of dots where lens is thin. Siliceous shale 20–40 feet thick at base. 330–420 feet thick

MPm — Metasedimentary rocks
Chlorite-actinolite-epidote-garnet-diopside-magnetite alteration, cut by stringers of pyrite

DISCONFORMITY

MISSISSIPPIAN

Lower Mississippian

Ml — Lake Valley Limestone
Limestone and marly limestone. Upper part pure crinoidal limestone, some white chert nodules. 300–400 feet thick

DEVONIAN

Upper Devonian

Dp — Percha Shale
Box Member of Stevenson (1945), gray shale with calcareous nodules; Ready Pay Member of Stevenson (1945), black fissile shale. 230–315 feet thick

DISCONFORMITY

SILURIAN

Sf — Fusselman Dolomite
Gray massive cherty dolomite. 100–300 feet thick

ORDOVICIAN

Upper Ordovician

Om — Montoya Dolomite
Light-gray dolomite, in part interlayered with dark chert; sandstone 1–16 feet thick at base. 300–350 feet thick

SOfm — Fusselman and Montoya Dolomites

DISCONFORMITY

Lower Ordovician

Oe — El Paso Limestone
Light- to medium-gray, thin- to thick-bedded limestone and dolomite. 500–519 feet thick

CAMBRIAN

Upper Cambrian

OCb — Bliss Formation
Dolomitic and shaly limestone, shale, basal conglomerate locally; hematitic and glauconitic sandstone and quartzite. 140–188 feet thick

UNCONFORMITY

PRECAMBRIAN

pC — Biotite-granite gneiss

Contact
Dashed where approximately located; short dashed where indefinite; dotted where concealed

Fault, showing direction and amount of dip
Bar and ball on downthrown side. Dashed where approximately located; dotted where concealed; queried where doubtful

Reverse fault
U, upthrown side

Strike and dip of beds

Strike and dip of overturned beds

Horizontal beds

Strike of vertical or near vertical foliation

d — Mine and mill dumps

Landslide

[1] The Kneeling Nun Rhyolite Tuff was named in a thesis by Elston (1953) for the Kneeling Nun, a prominent landmark near the town of Santa Rita in the Santa Rita quadrangle. The first published mention of the name was by Kuellmer and others (1953), and the first description of the formation was given by Jicha (1954). The formation is a massive partially welded and devitrified ash flow ranging in composition from quartz latite to rhyolite, and in thickness from 200 to 600 feet. It is everywhere conformable with the underlying Sugarlump Tuffs; the upper contact is an erosional one.

[2] The Sugarlump Tuffs was named in a thesis by Elston (1953) for Sugarlump Hill, NE¼ sec. 15, T. 19 S., R. 10 W., in the Dwyer quadrangle, which adjoins the Santa Rita quadrangle to the southeast. The name was first used by Kuellmer and others (1953), and the first published description was given by Jicha (1954). The formation consists of several volcanic and clastic units: well-bedded and massive pyroclastic deposits of latitic or rhyolitic composition, volcanic conglomerates, and sandstones locally replaced by green clinoptilolite. It rests disconformably on the Rubio Peak Formation (Elston, 1957, p. 42) in the Dwyer quadrangle and on early Tertiary and older rocks in the Santa Rita quadrangle. Because it was deposited on an uneven surface, its thickness is quite variable from place to place; the maximum reported thickness is about 1,300 feet, but in the Santa Rita quadrangle the thickness ranges from 50 to about 800 feet. Owing to the lenticularity of the units no section in the Santa Rita quadrangle can be cited as typical.

[3] The Rubio Peak Formation was named in a thesis by Elston (1953) after a prominent butte at secs. 9, 10, 15, 16, T. 19 S., R. 10 W., in the Dwyer quadrangle. The first published description of the formation was given by Hernon and others (1953). The formation consists of andesite and latite flows, conglomerate, welded ash flows, volcanic conglomerate and tuffaceous sandstones. No section can be cited as typical owing to the lenticularity of the flows and other units. The formation was deposited on an irregular surface and is therefore highly variable in thickness. Elston (1957) estimated the maximum thickness in the Dwyer quadrangle to be about 5,000 feet.

On the basis of floral assemblages regarded as most probably of late Miocene or early Pliocene age collected from lake beds overlying rhyolitic tuffs believed to be correlatives of the Kneeling Nun Rhyolite Tuff, and from lake beds within beds believed to be correlatives of the upper part of the Rubio Peak Formation (Jahns and others, 1955; F. J. Kuellmer, written communication, 1960) all three formations described above are tentatively dated as Miocene(?). A major erosional disconformity separates the Rubio Peak Formation and intrusive rocks of early Tertiary age. Flows of basaltic andesite overlying the Kneeling Nun Rhyolite Tuff are older than the Gila Conglomerate of Pliocene and Pleistocene age and parts of the Santa Fe Group of middle(?) Miocene to Pleistocene(?) age.

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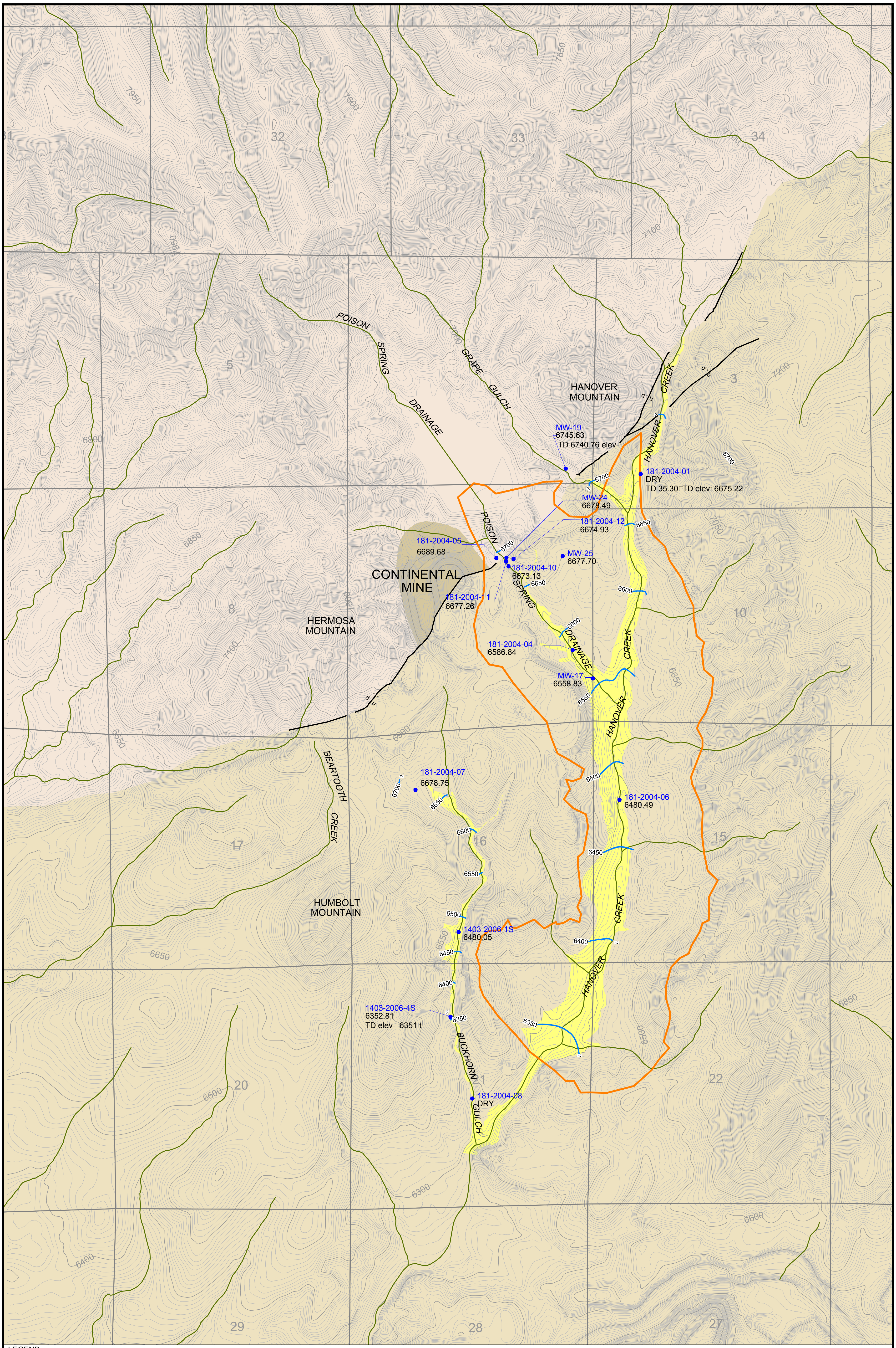
FIGURE 12-C
GENERALIZED GEOLOGY LEGEND

Scale: As Noted	Date: 8-27-2014	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: ANR	



LEGEND

- ALLUVIUM
- NORTH CRETACEOUS FLOW SYSTEM
- NORTH PALEO□OIC FLOW SYSTEM
- SOUTH PALEO□OIC FLOW SYSTEM

GROUNDWATER ELEVATION CONTOUR (FEET)

1403-2006-1S 6480.05 — MONITORING WELL IN ALLUVIUM / WEATHERED BEDROCK GROUNDWATER ELEVATION (FEET)

BARRINGER FAULT (APPROX.)

HANOVER-FIERRO STOCK BOUNDARY (APPROXIMATE)

USGS TOPOGRAPHIC CONTOURS (10' INTERVAL)

DRAINAGES

SCALE IN FEET

0 2000

PREPARED BY:

TELESTO SOLUTIONS • INCORPORATED

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FIGURE 1□

FIRST □UARTER 201□ GROUND□ATER POTENTIOMETRIC SURFACE STREAM ALLUVIUM AND UNDERLYING □EATHERED □EDROC□

PREPARED FOR:

FREEPORT-McMoRAN

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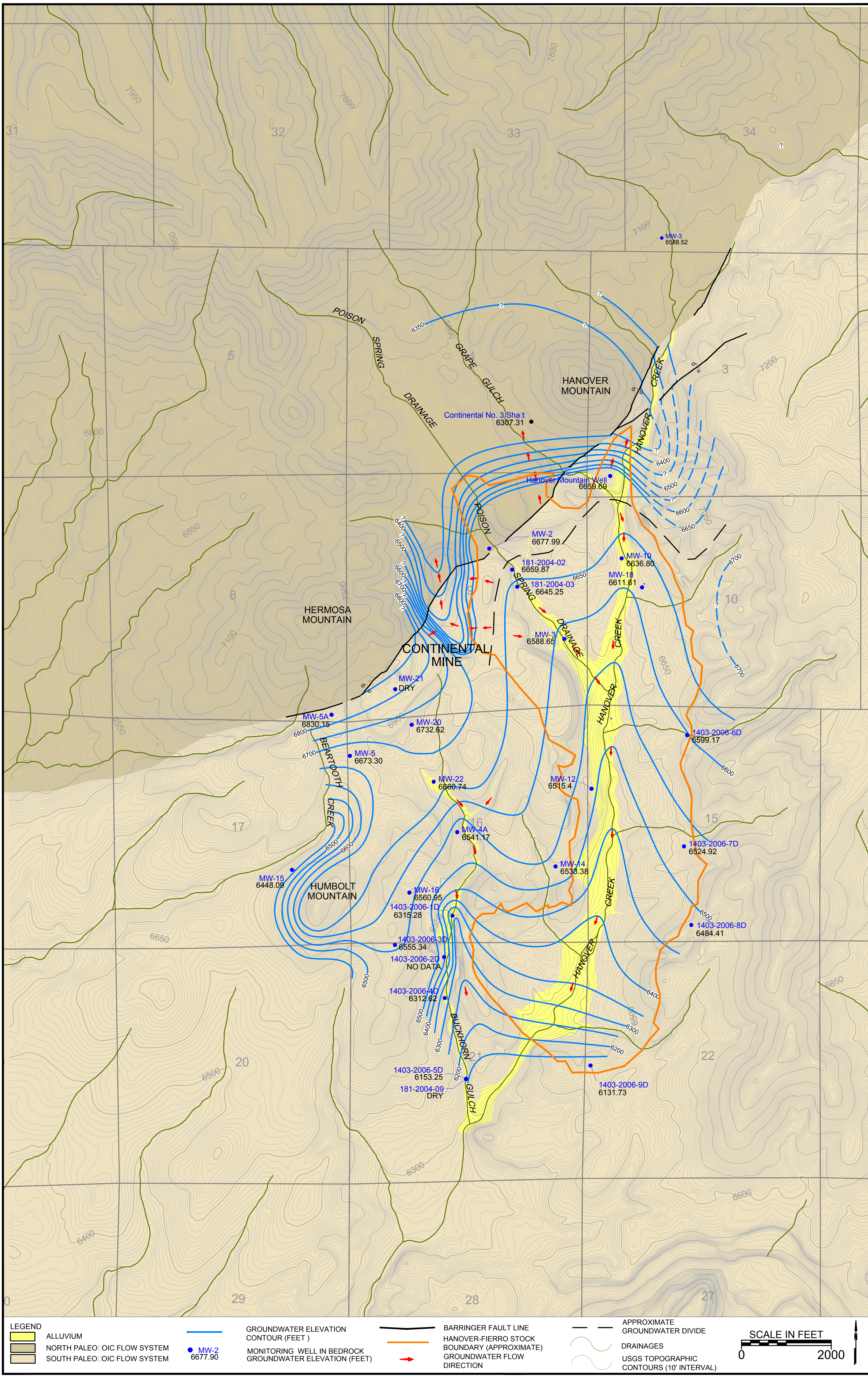

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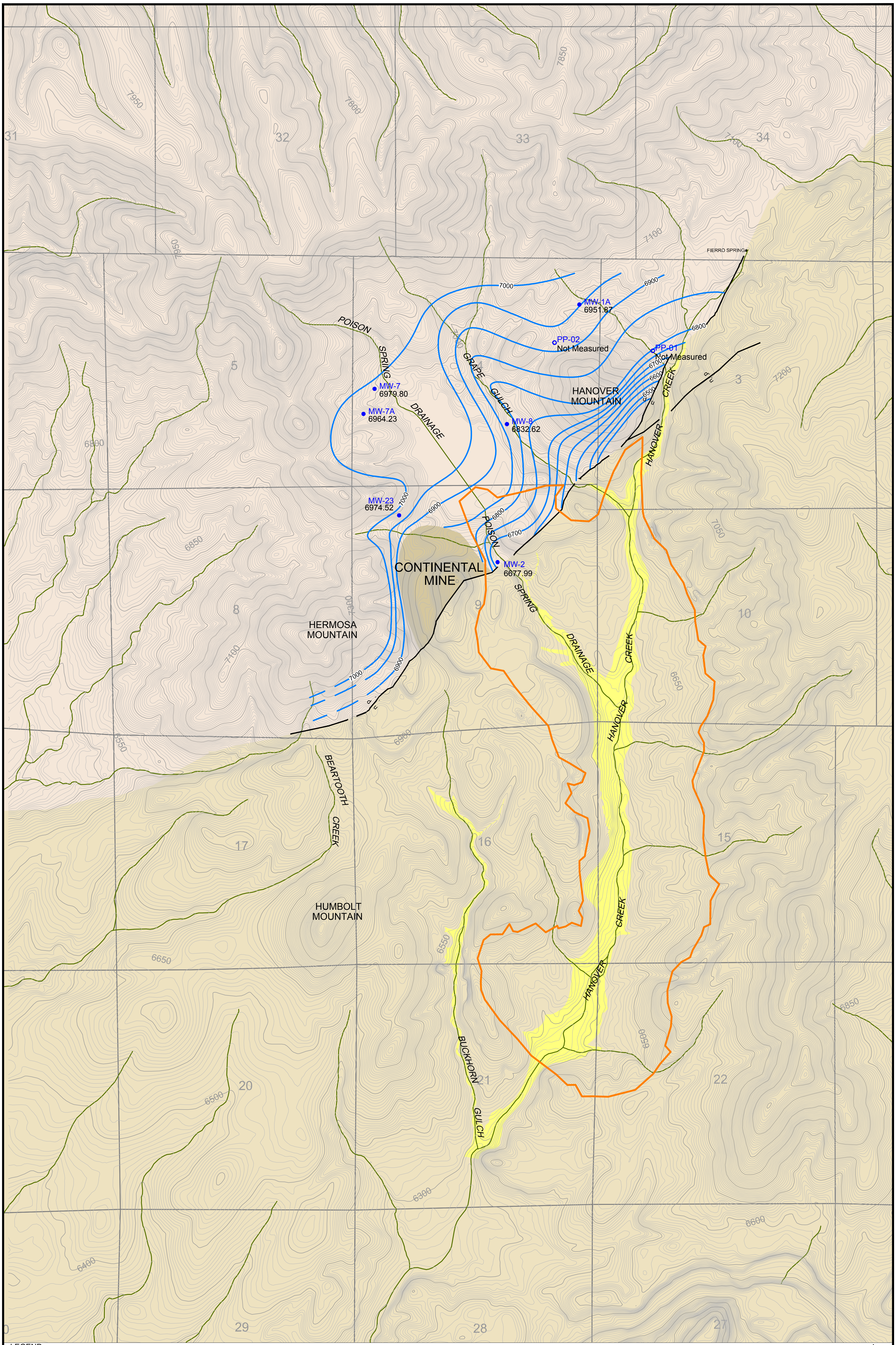
FIGURE 1[illegible]

FIRST QUARTER 2014 GROUNDWATER POTENTIOMETRIC SURFACE NORTH AND SOUTH PALEOZOIC FLOW SYSTEMS

PREPARED FOR:

FREEPORT-McMoRAN



LEGEND

- ALLUVIUM
- NORTH CRETACEOUS FLOW SYSTEM
- NORTH PALEO□OIC FLOW SYSTEM
- SOUTH PALEO□OIC FLOW SYSTEM
- GROUNDWATER ELEVATION CONTOUR (FEET)
- MW-7 6979.80 — MONITORING WELL IN BEDROCK GROUNDWATER ELEVATION (FEET)
- PP-01 — PNEUMATIC PIE□OMETER IN BEDROCK
- BARRINGER FAULT LINE
- HANOVER-FIERRO STOCK BOUNDARY (APPROXIMATE)
- USGS TOPOGRAPHIC CONTOURS (10' INTERVAL)
- DRAINAGES

SCALE IN FEET
0 2000

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PREPARED BY:

TELESTO SOLUTIONS INCORPORATED
Fort Collins, Colorado (970) 484-7704
www.telesto-inc.com

FIGURE 1□
FIRST □UARTER 201□ GROUND□ATER POTENTIOMETRIC SURFACE NORTH CRETACEOUS FLO□ SYSTEM

PREPARED FOR:

FREEPORT-MCMORAN

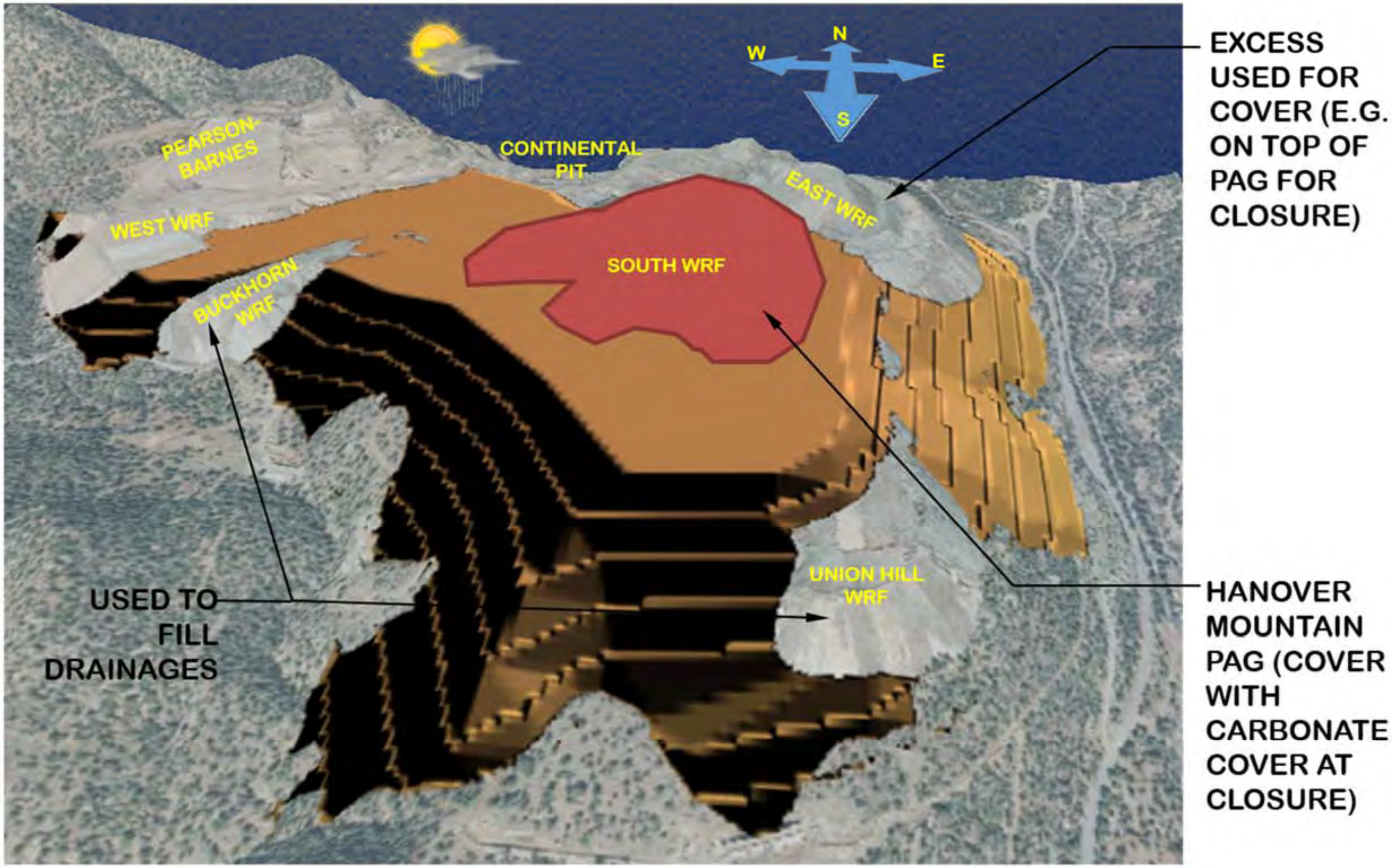


Figure 16 Hanover Mountain PAG Placement

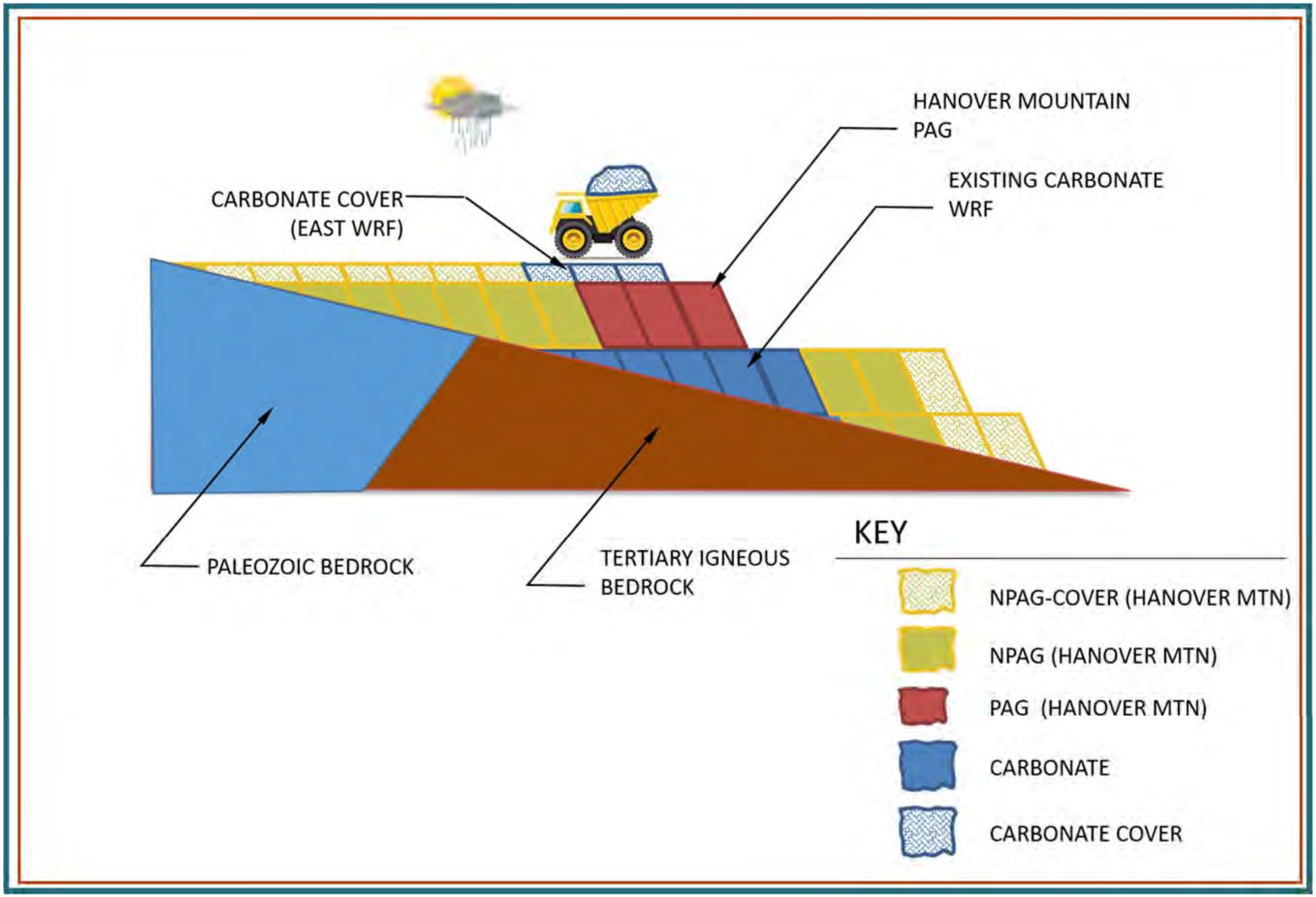
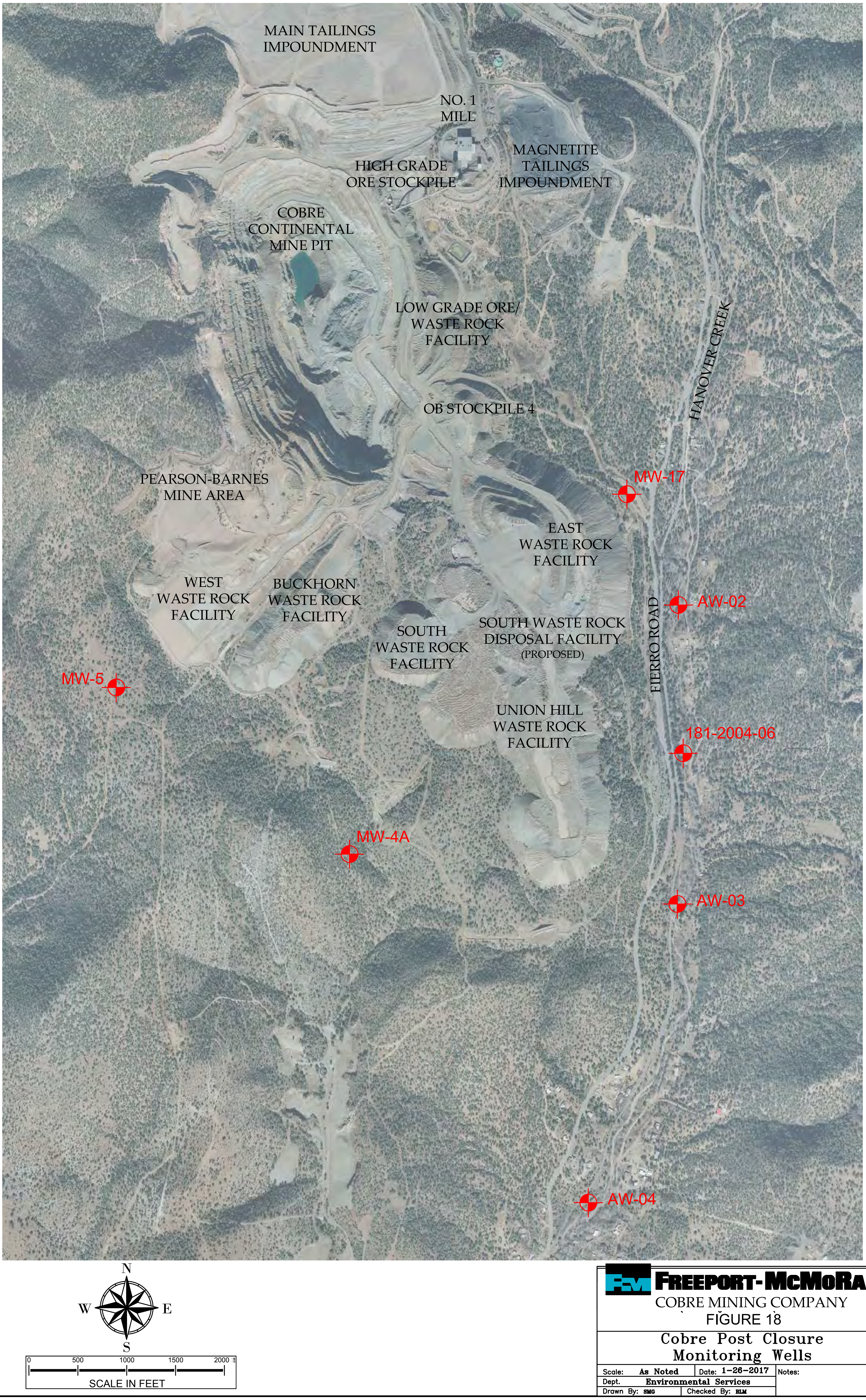


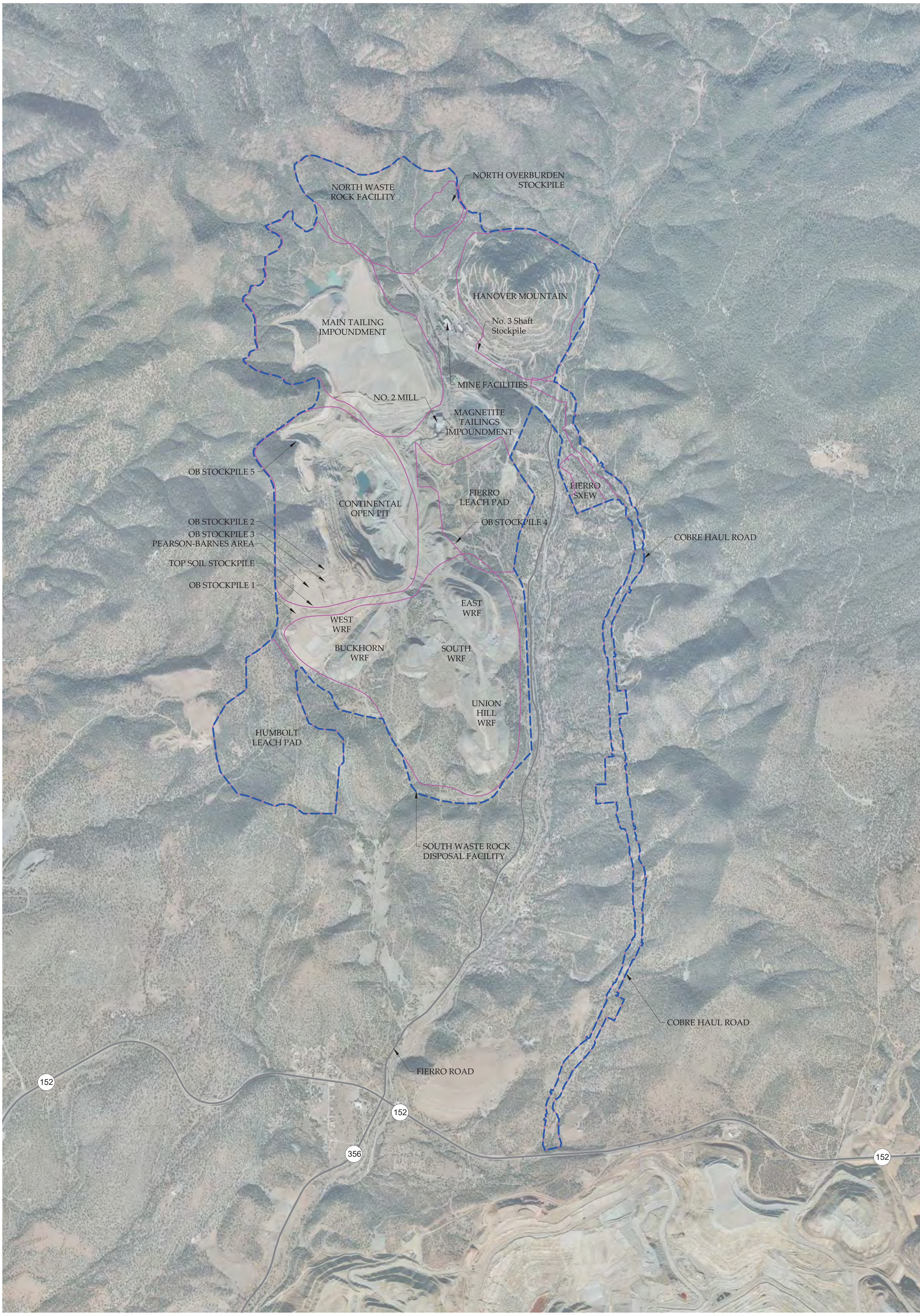
Figure 17 Cross-Section Hanover Mountain PAG Placement



FREEPORT-McMoRAN
COBRE MINING COMPANY
FIGURE 18

Cobre Post Closure Monitoring Wells

Scale: As Noted	Date: 1-26-2017	Notes:
Dept. Environmental Services		
Drawn By: SMG	Checked By: BLM	



Legend
Proposed Continental Mine Beneficiation Design Limit (Approx.1,853 Acres)
Permitted Design Limit (Approx.1,543 Acres)

N
W E
S

0 500 1000 1500 2000 ft
SCALE IN FEET

DRAFT

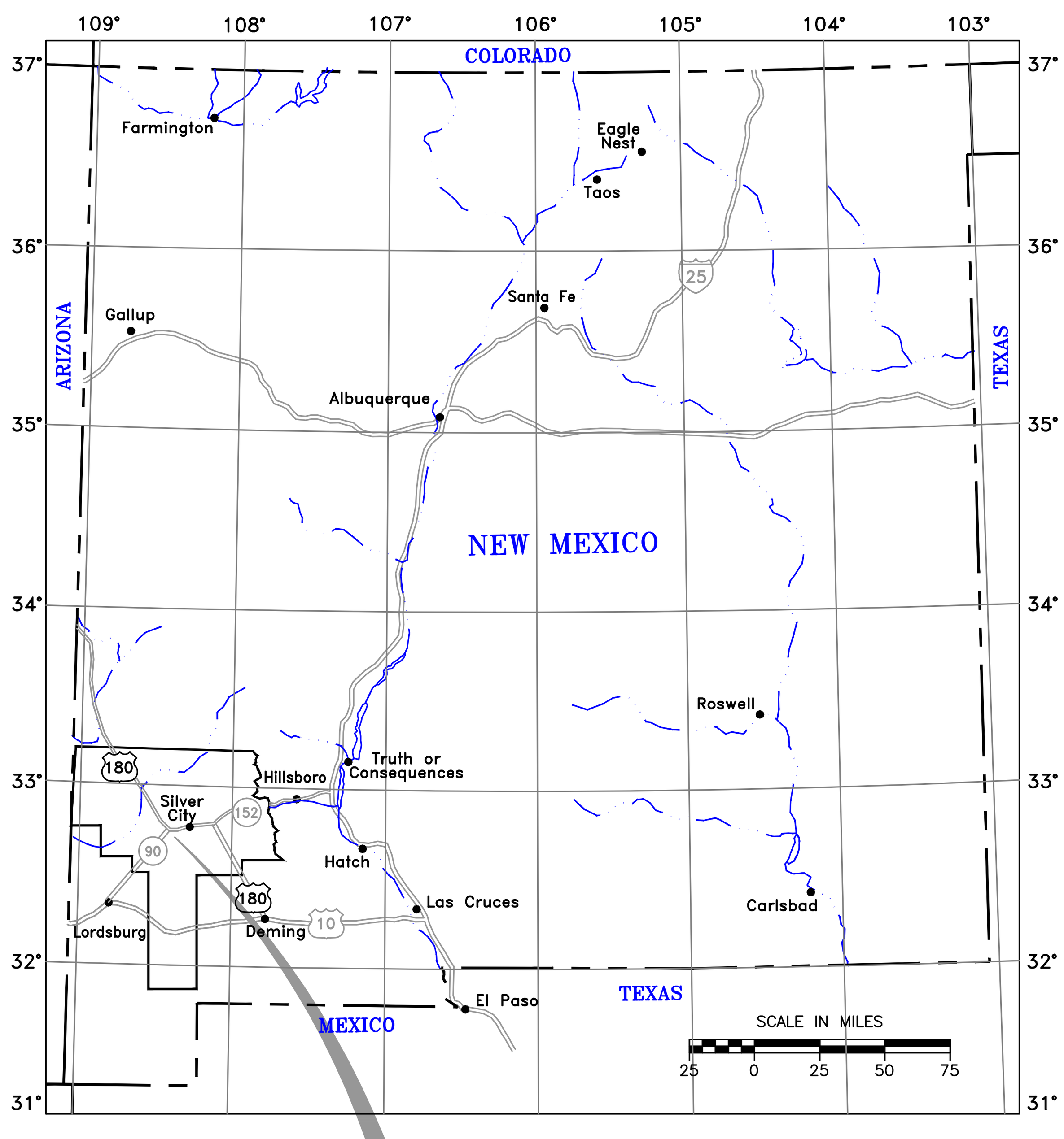
FREEPORT-McMoRAN
COBRE MINING COMPANY
FIGURE 19
PROPOSED BENEFICIATION DESIGN LIMIT

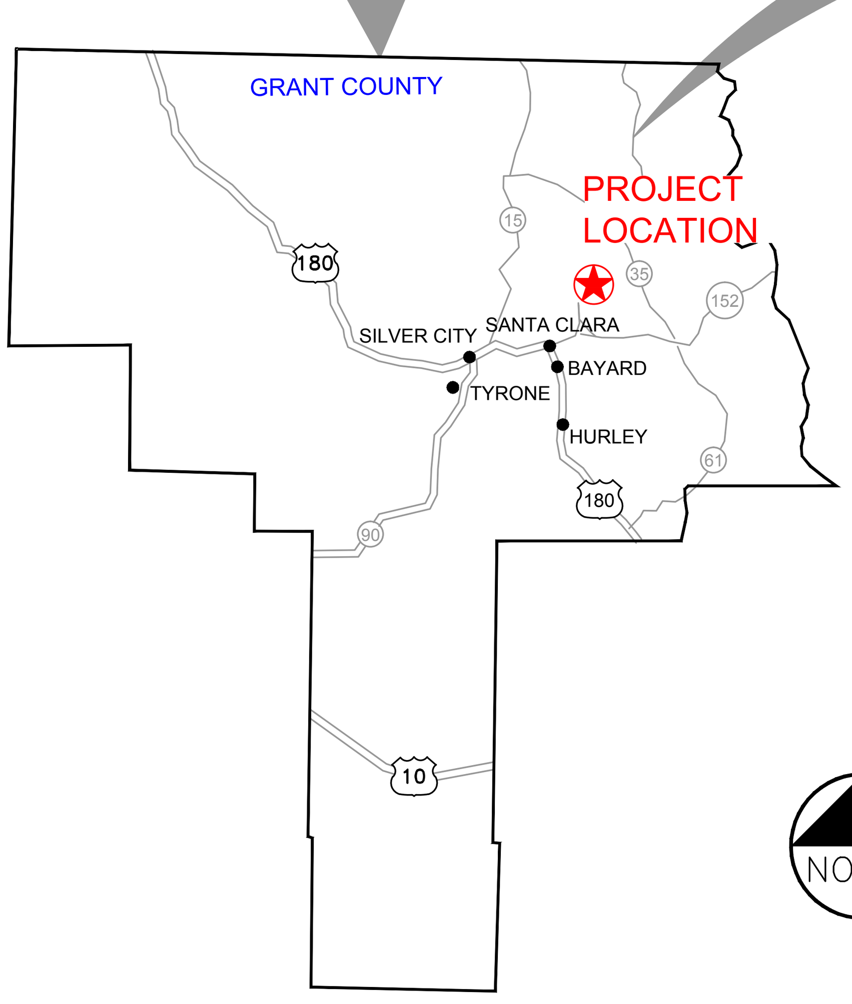
Scale:	As Noted	Date:	8-21-2017
Dept.	Environmental Services		
Drawn By:	SMG	Checked By:	RLM

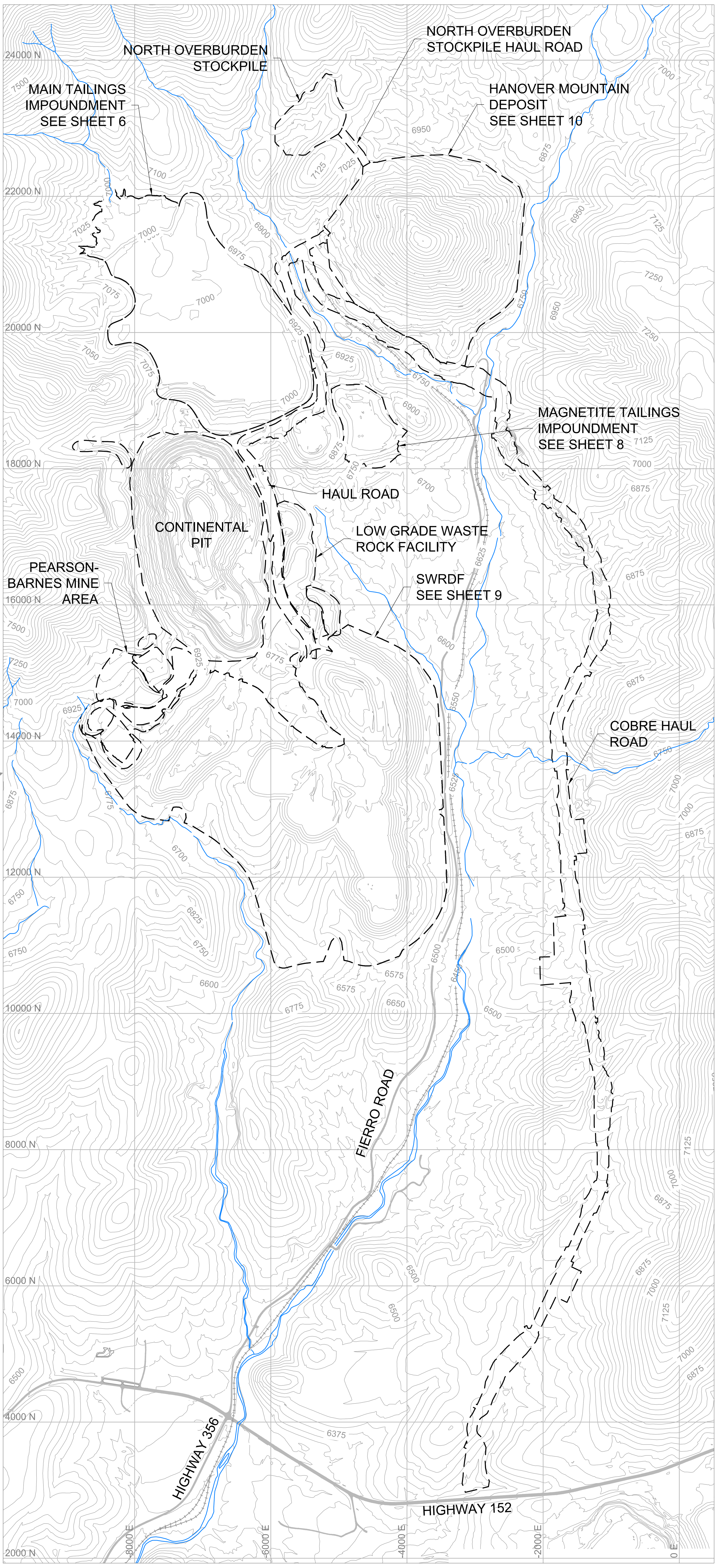
RECLAMATION

DESIGN DRAWINGS

CONTINENTAL MINE
END OF YEAR 2019
CONCEPTUAL RECLAMATION
DRA□ INGS







SHEET INDEX

Sheet Number	Sheet Title
1	COVER SHEET
2	EOY 2019 CONFIGURATION
3	EOY 2019 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 2019 MINING

COVER SHEET

SHEET NUMBER: 1
REVISION NUMBER: 1

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

NOT FOR CONSTRUCTION

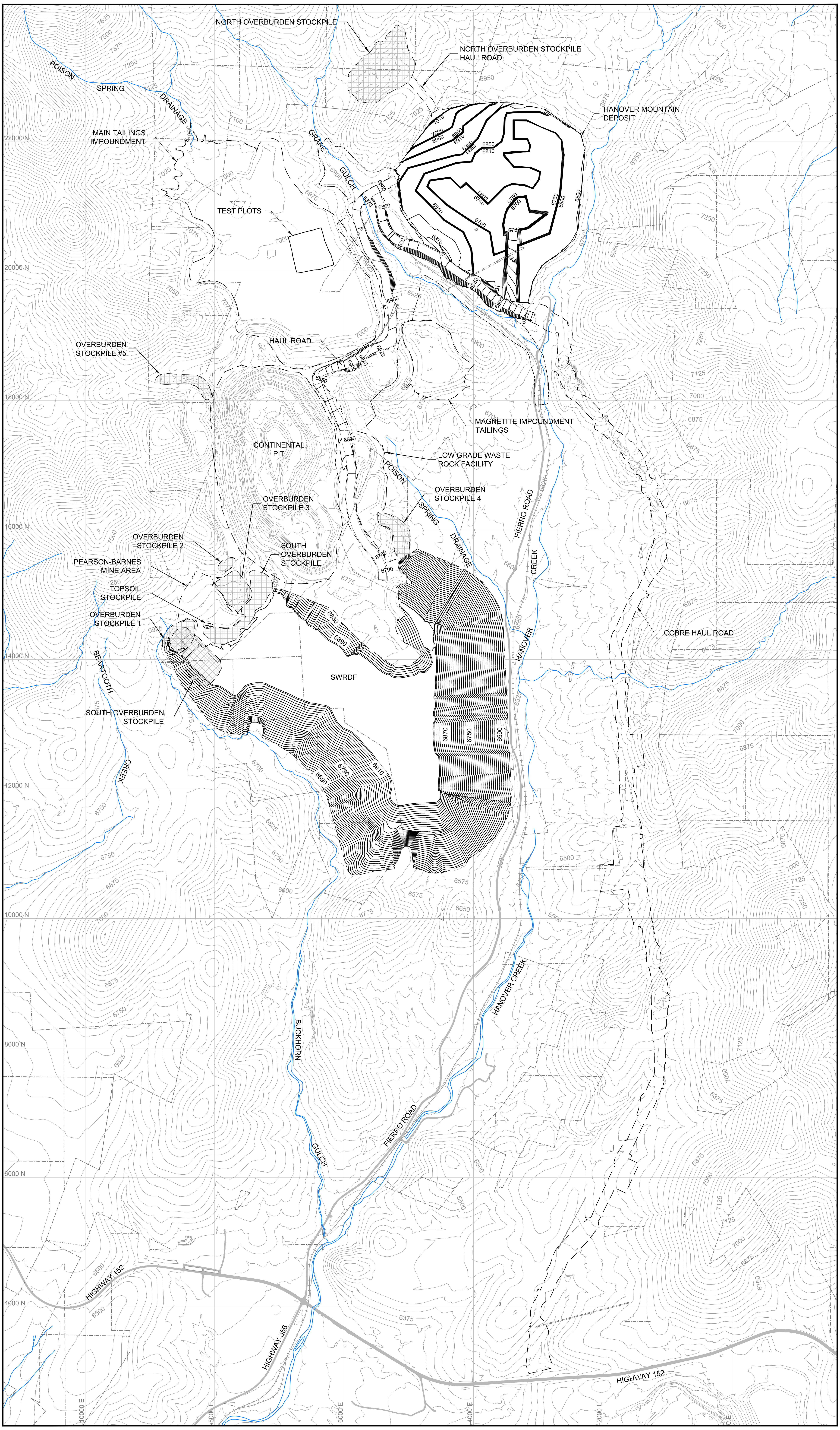
LEGEND / NOTES

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



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EOY 2019 CONFIGURATION

SHEET NUMBER: 2
REVISION NUMBER: 1

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
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REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN

NOT FOR CONSTRUCTION

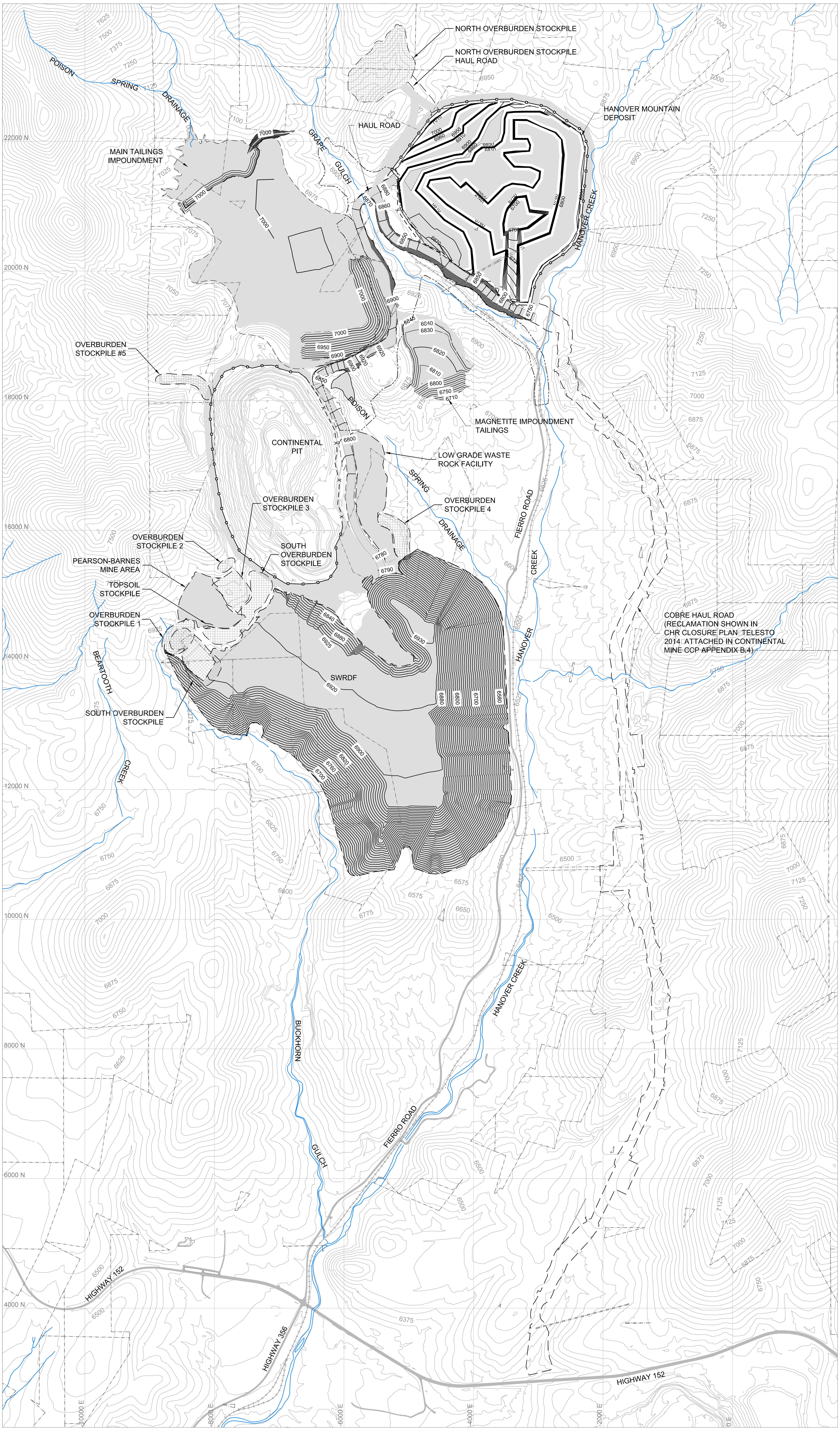
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- END OF YEAR 2019 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS
- RAILROAD
- FACILITY FOOTPRINT
- BLM ADMINISTERED LAND
- INDUSTRIAL PMLU BOUNDARY
- DRAINAGES

0 800 SCALE IN FEET

N

COORDINATE SYSTEM CHINO



NOTE:
CHANNELS AND BENCHES NOT SHOWN.

EOY 2019 RECLAIMED CONFIGUFURATION

SHEET NUMBER:	REVISION NUMBER:
3	1

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

PREPARED FOR: FREEPORT-McMoRAN

DATE	DEC. 5, 2014
PROJECT	200189
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0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN

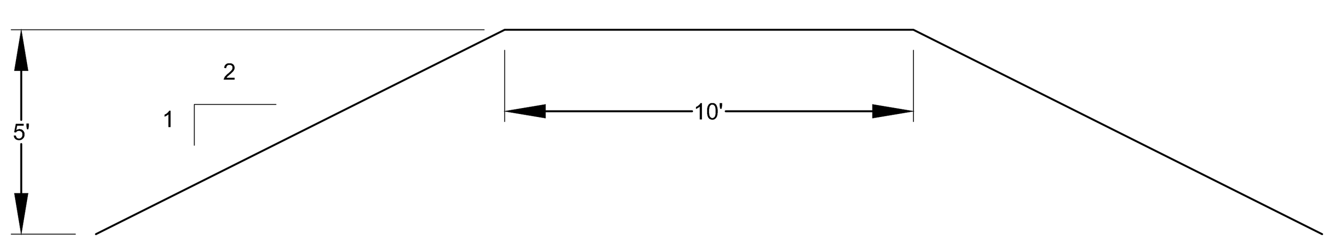
NOT FOR CONSTRUCTION

LEGEND

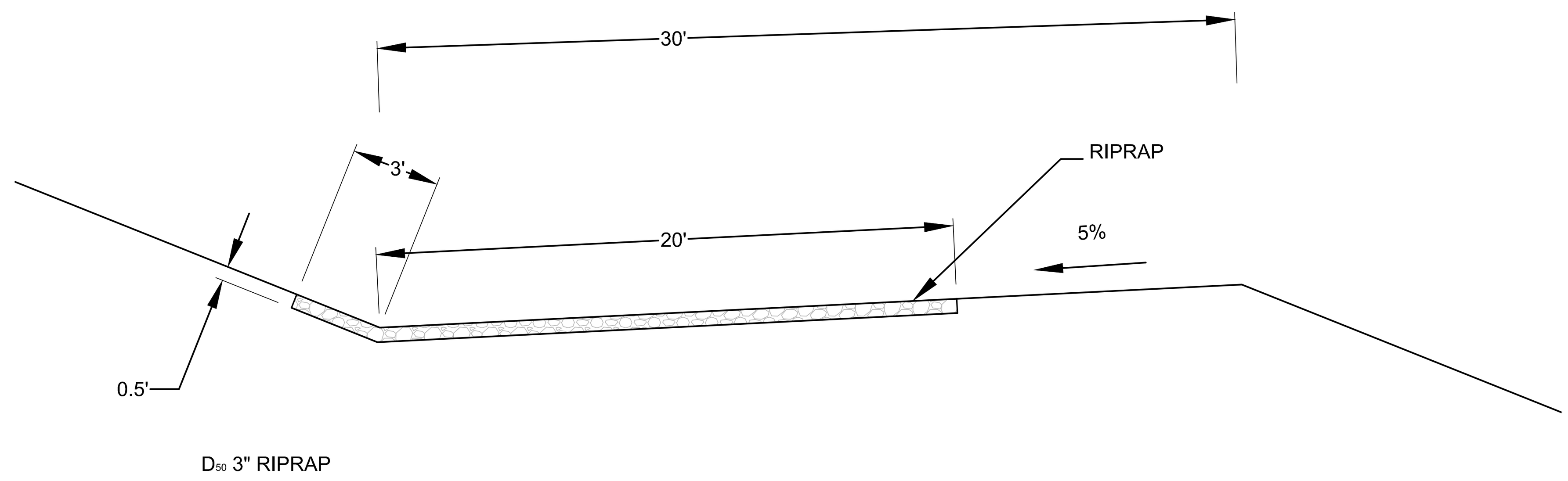
- EXISTING CONTOURS- 25' INT.
- RECLAIMED END OF YEAR 2019 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- RAILROAD
- INDUSTRIAL PMLU BOUNDARY
- FACILITY FOOTPRINT
- REVEGETATED AREA
- CHAIN LINK FENCE
- BERM
- BLM ADMINISTERED LAND
- DRAINAGES

0 800
SCALE IN FEET

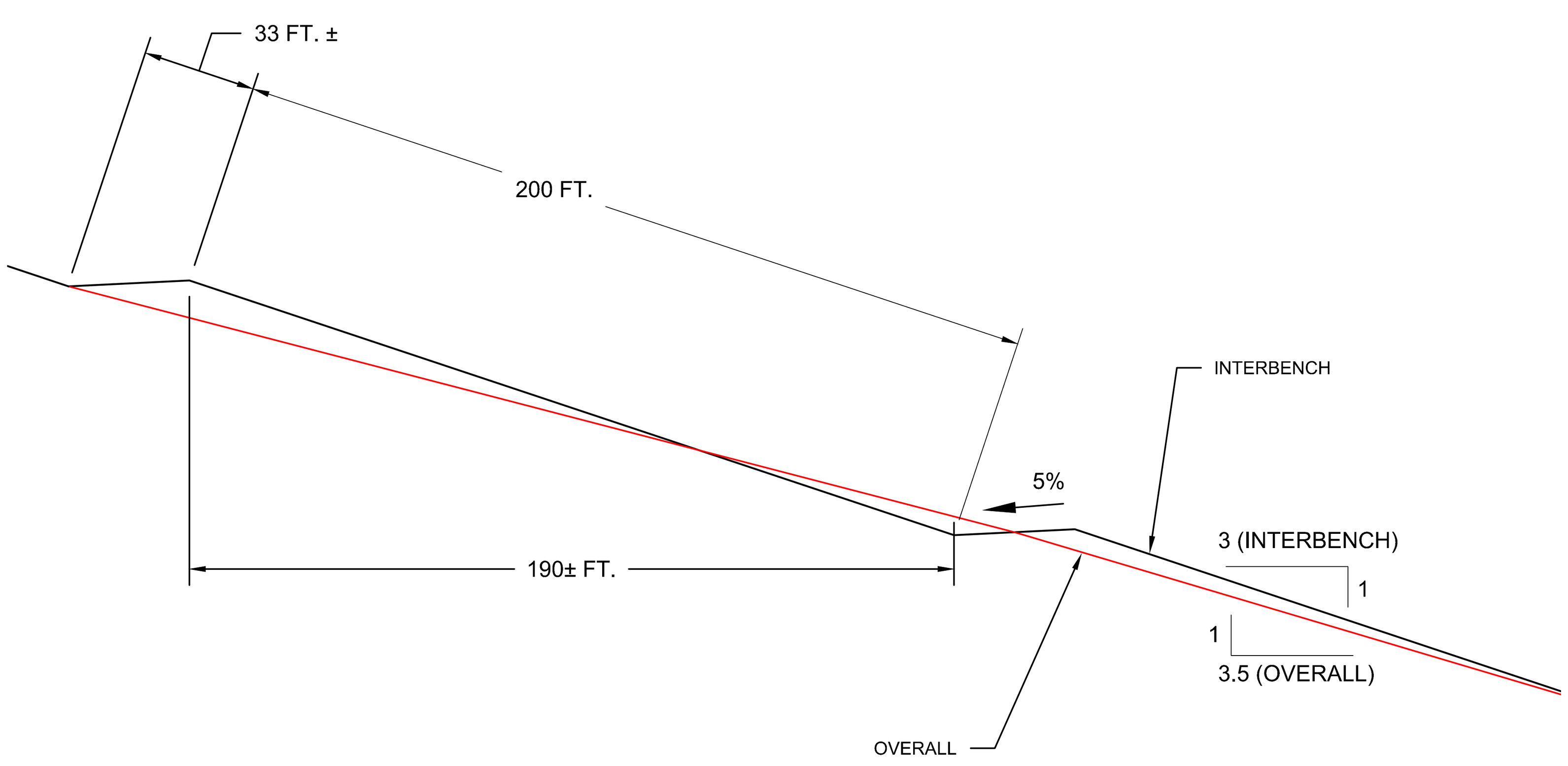
COORDINATE SYSTEM CHINO



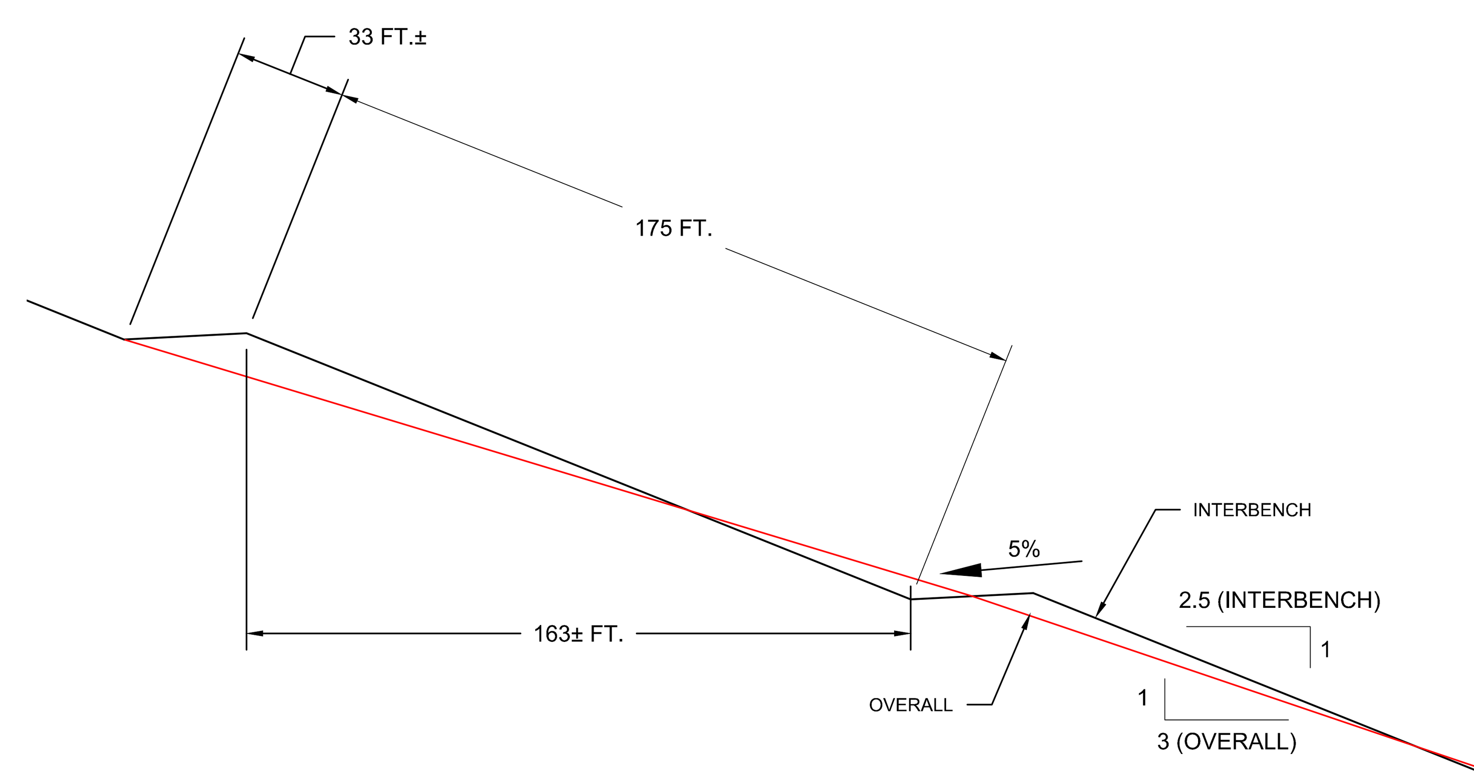
PIT BERM



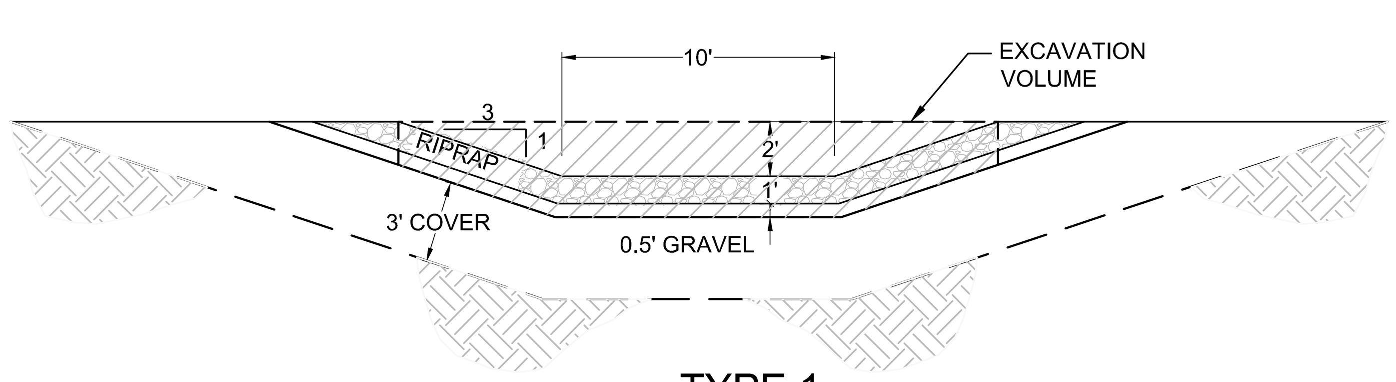
TYPICAL OUTSLOPE CHANNEL



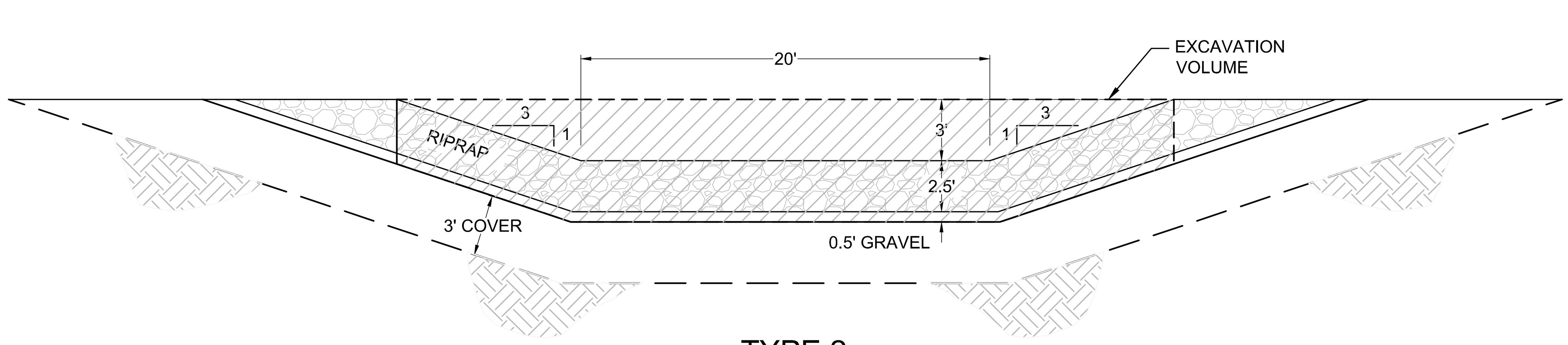
TYPICAL OUTSLOPE BENCH ON A 3:1 SLOPE



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: 4
REVISION NUMBER: 1

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PREPARED FOR: FREEPORT-MCMORAN

DATE	DEC. 5, 2014
PROJECT	200189
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REVISIONS

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0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN

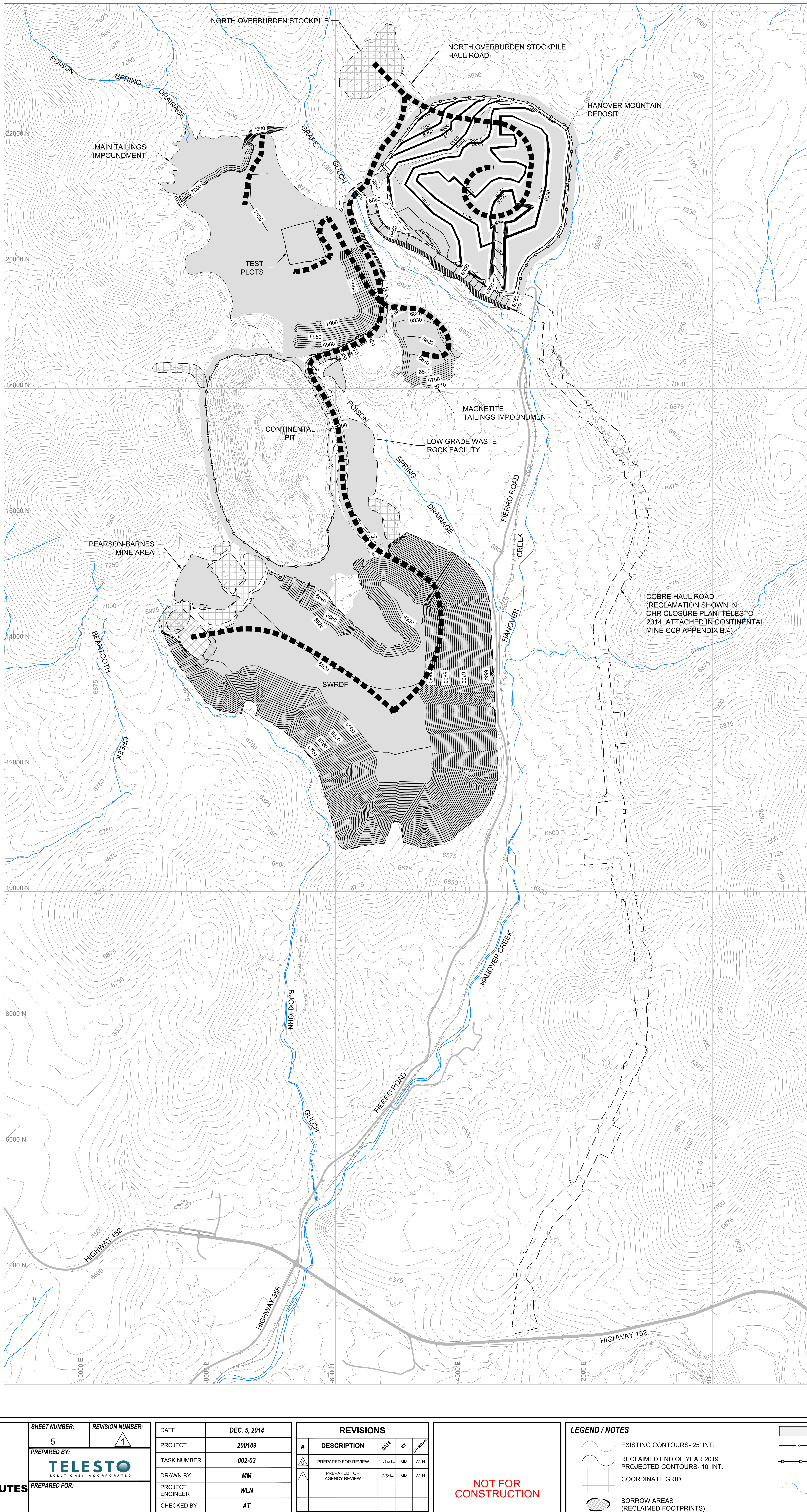
NOT FOR CONSTRUCTION

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.



COVER HAUL ROUTES

SHEET NUMBER:	REVISION NUMBER:
5	1

PREPARED BY: TELESTO SOLUTIONS INCORPORATED

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DATE	DEC. 5, 2014
PROJECT	200189
TASK NUMBER	002-03
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PROJECT ENGINEER	WLN
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REVISIONS

#	DESCRIPTION	DATE	BY	APPROVAL
0	PREPARED FOR REVIEW	11/14/14	MM	WLN
1	PREPARED FOR AGENCY REVIEW	12/5/14	MM	WLN

NOT FOR CONSTRUCTION

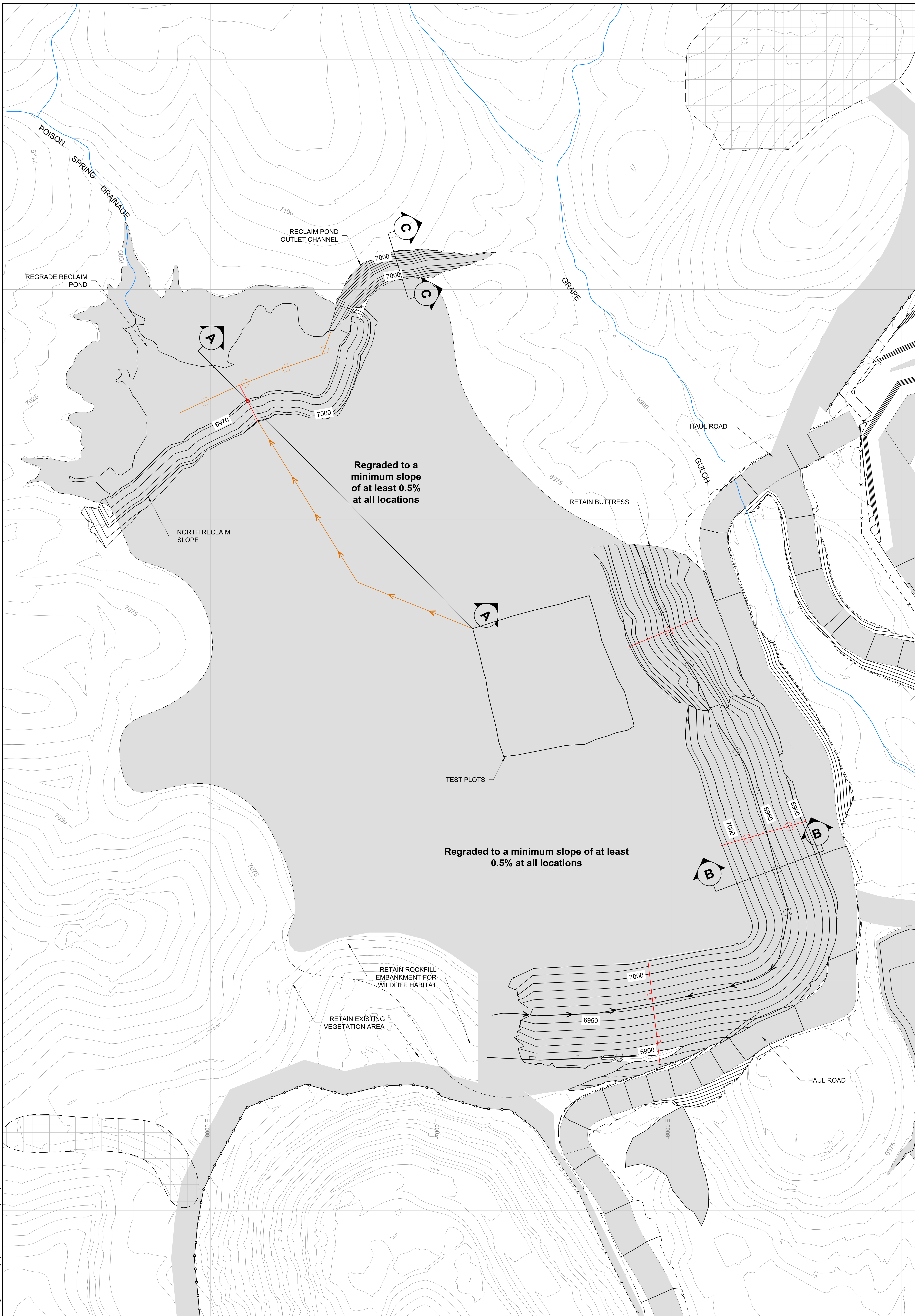
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- RECLAIMED END OF YEAR 2019 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



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MAIN TAILINGS IMPOUNDMENT RECLAIMED

SHEET NUMBER: 6

REVISION NUMBER: 1

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

NOT FOR CONSTRUCTION

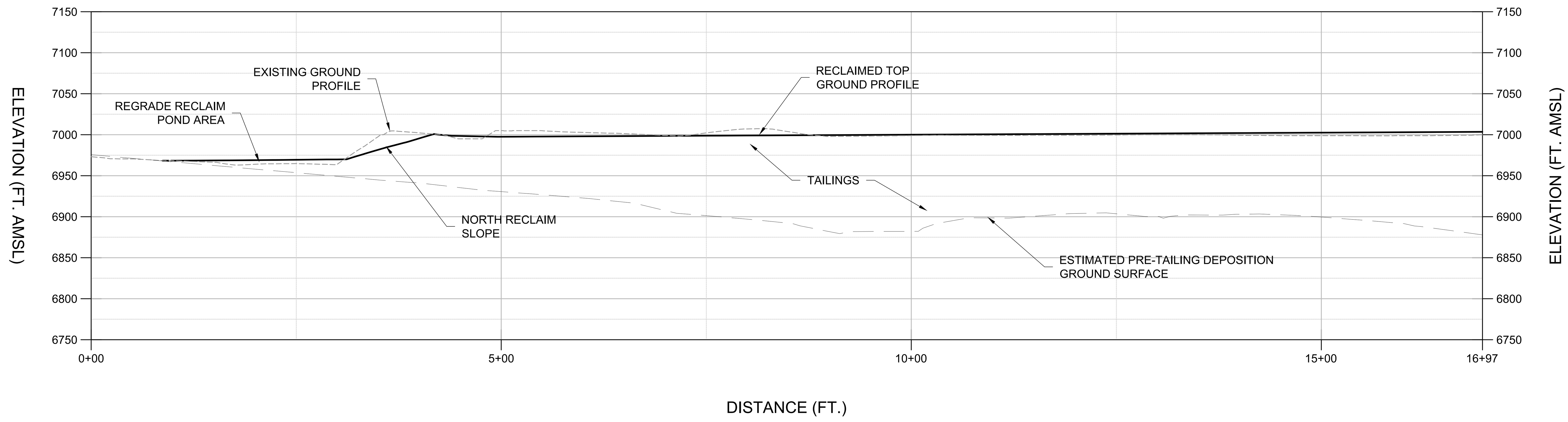
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT. (AMSL)
- RECLAIMED END OF YEAR 2019 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

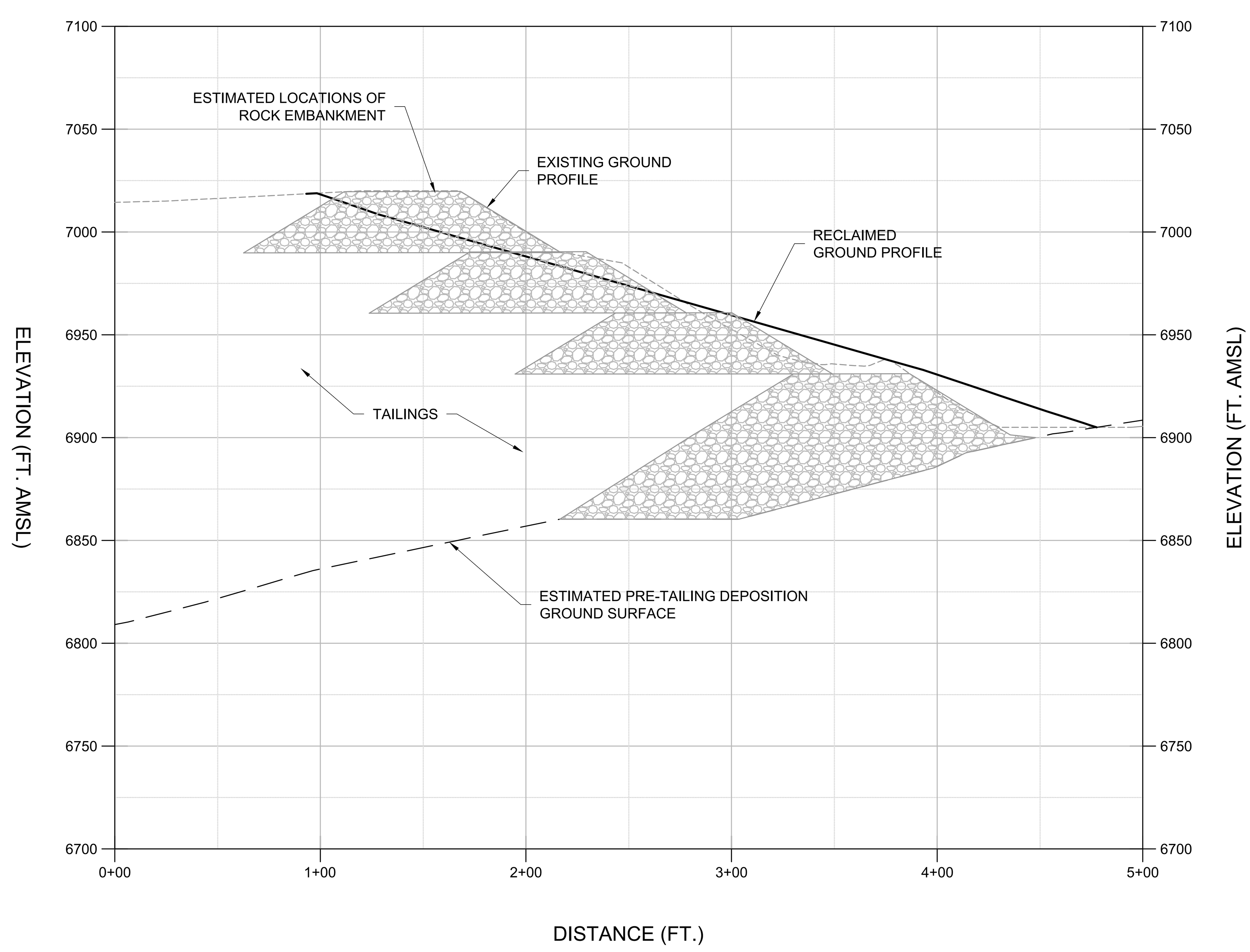
0 — 200 SCALE IN FEET

COORDINATE SYSTEM CHINO

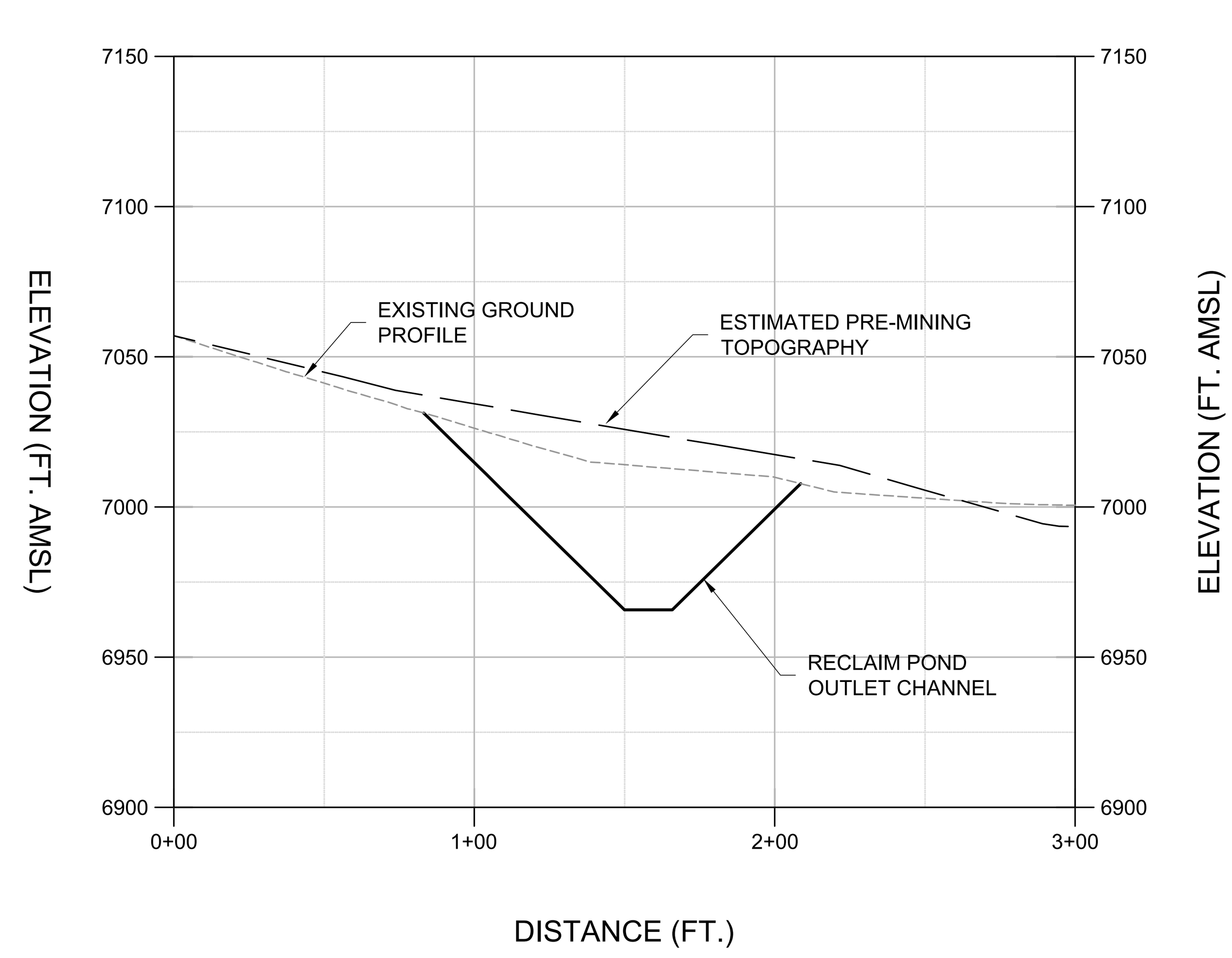
N



MAIN TAILIN□S IMPO□NDMENT
NORT□ RECLAIM SLOPE AND TOP
A SECTION A-A'
SCALE PER GRID



MAIN TAILIN□S IMPO□NDMENT
SO□T□ RECLAIM SLOPE
B SECTION B-B'
SCALE PER GRID



MAIN TAILIN□S IMPO□NDMENT
RECLAIM DRAINA□E C□ANNEL
C SECTION 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:	REVISION NUMBER:
7	1

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

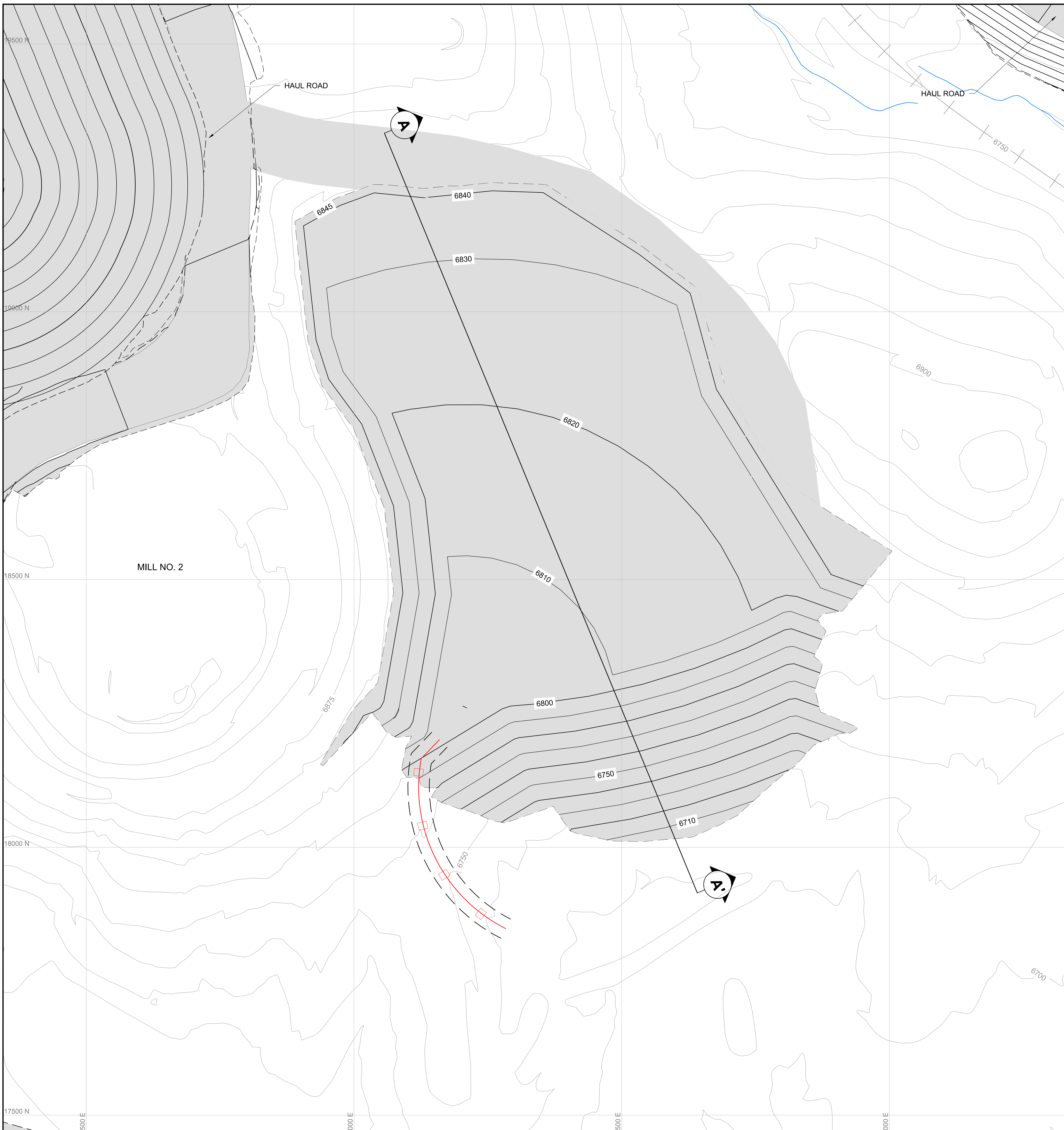
NOT FOR CONSTRUCTION

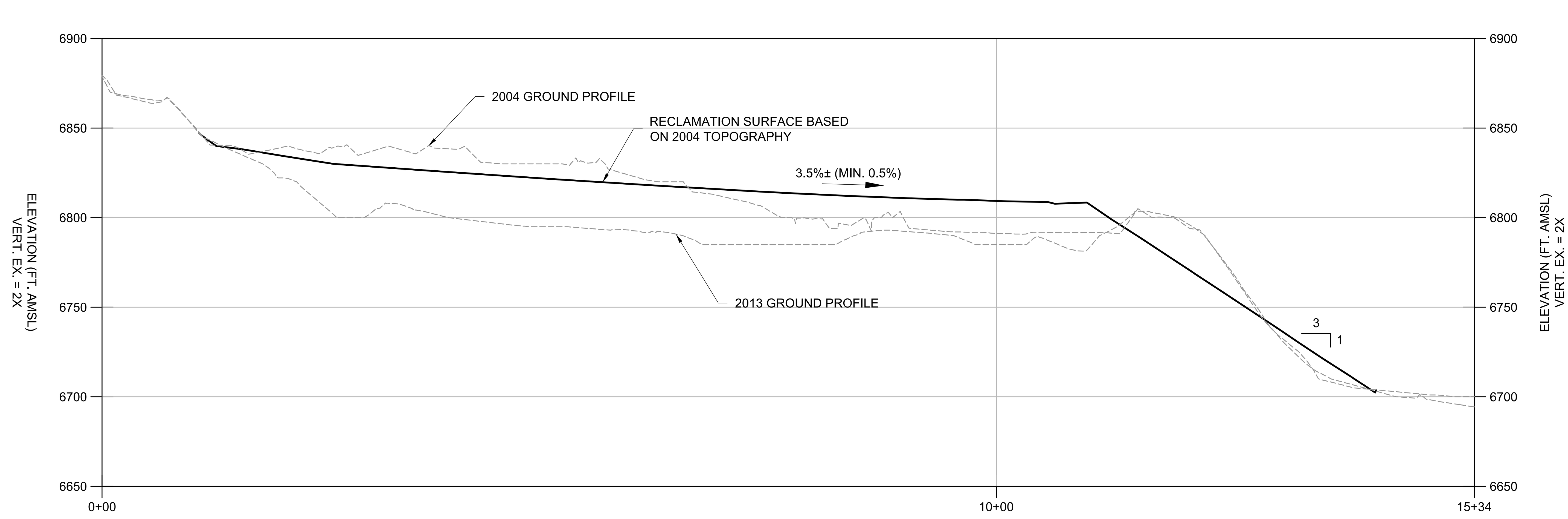
LEGEND / NOTES

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: 1

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

NOT FOR CONSTRUCTION

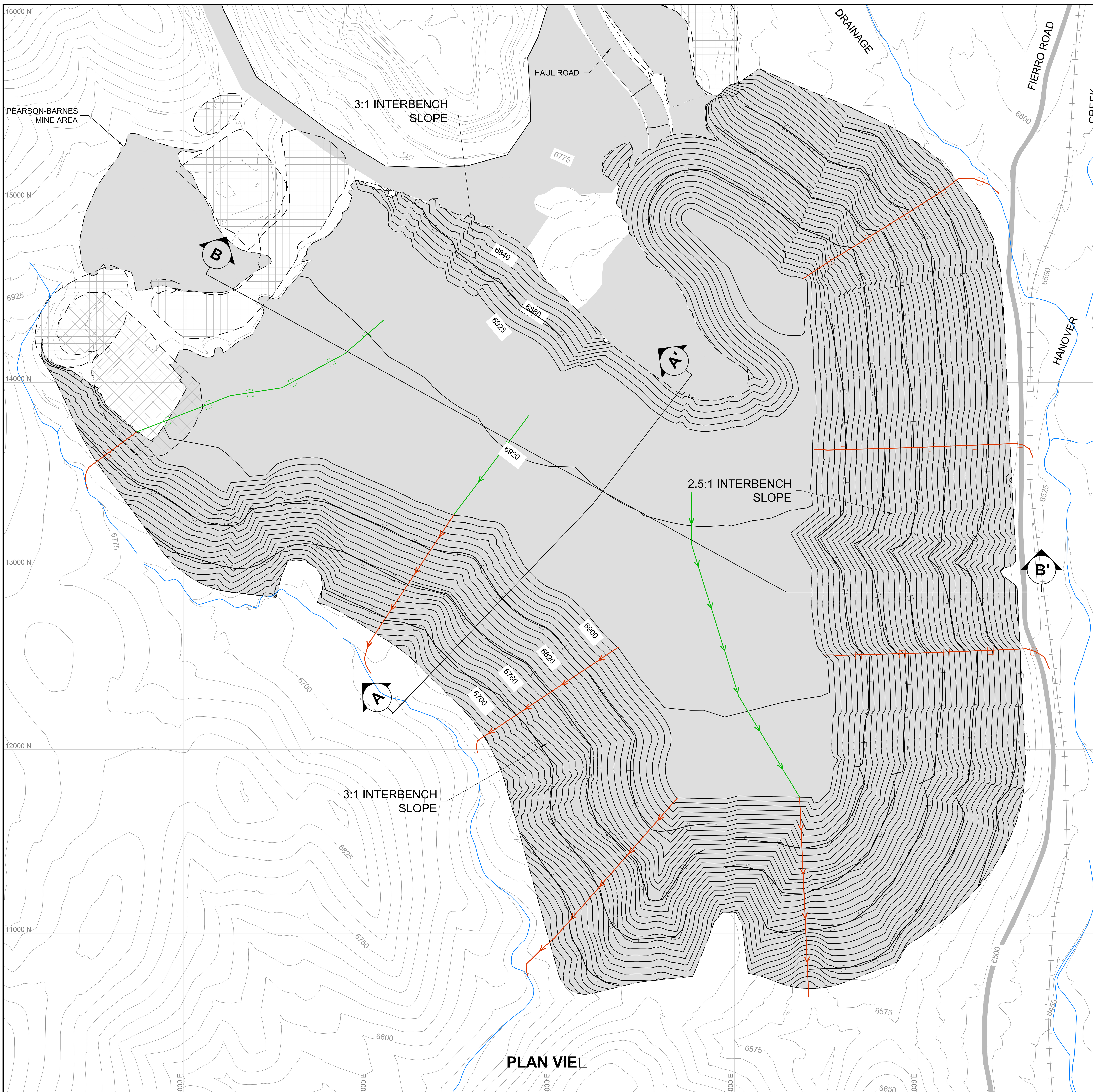
LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- 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

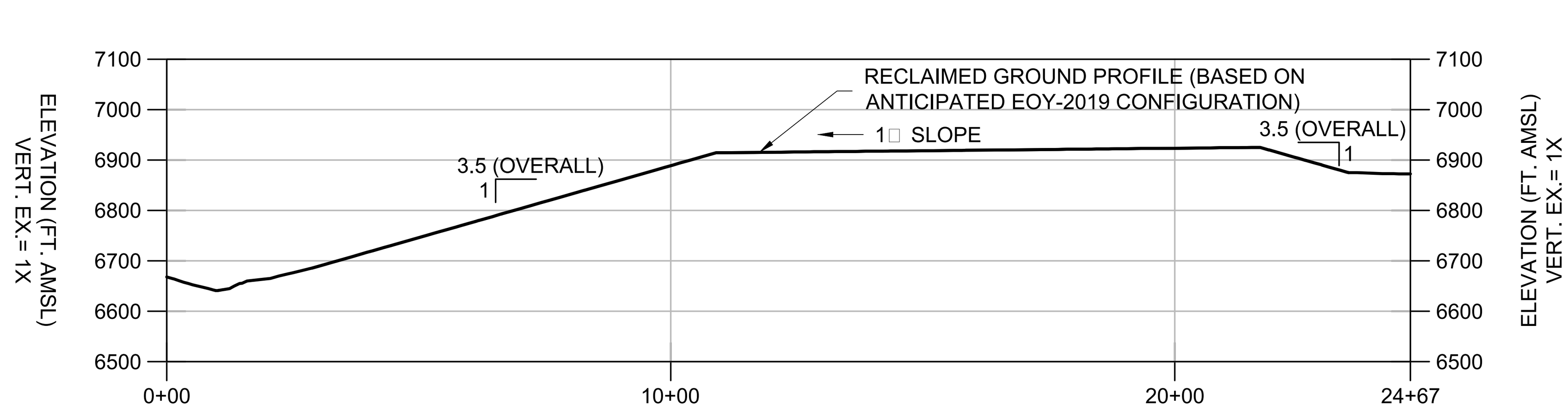
0 100 SCALE IN FEET

COORDINATE SYSTEM CHINO

N

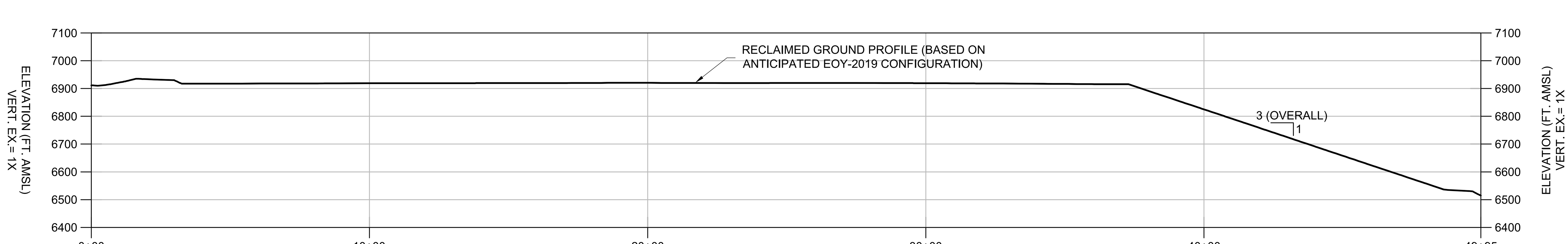


PLAN VIEW



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.

S RDF RECLAIMED

SHEET NUMBER: 9
REVISION NUMBER: 1

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

NOT FOR CONSTRUCTION

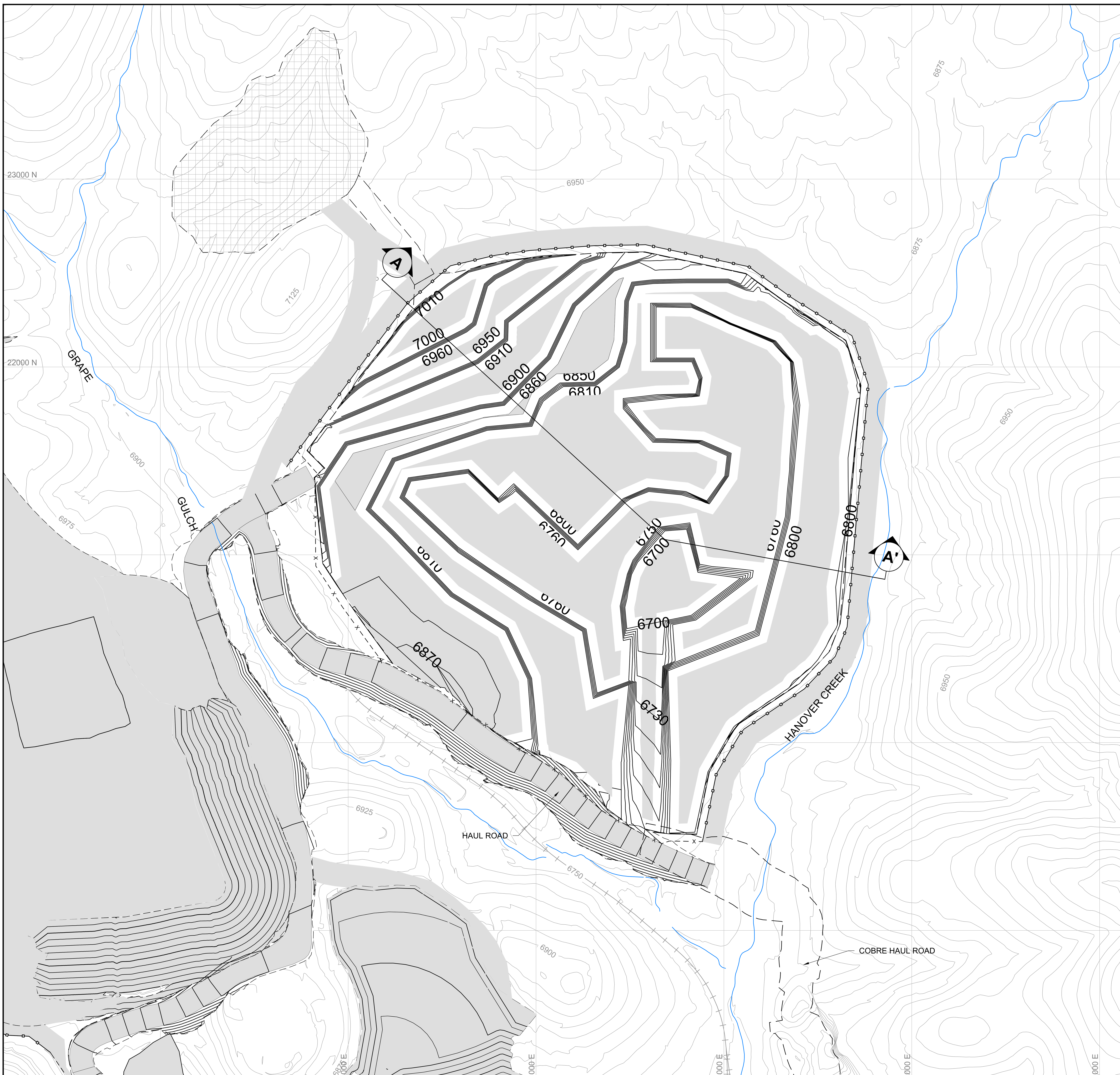
LEGEND

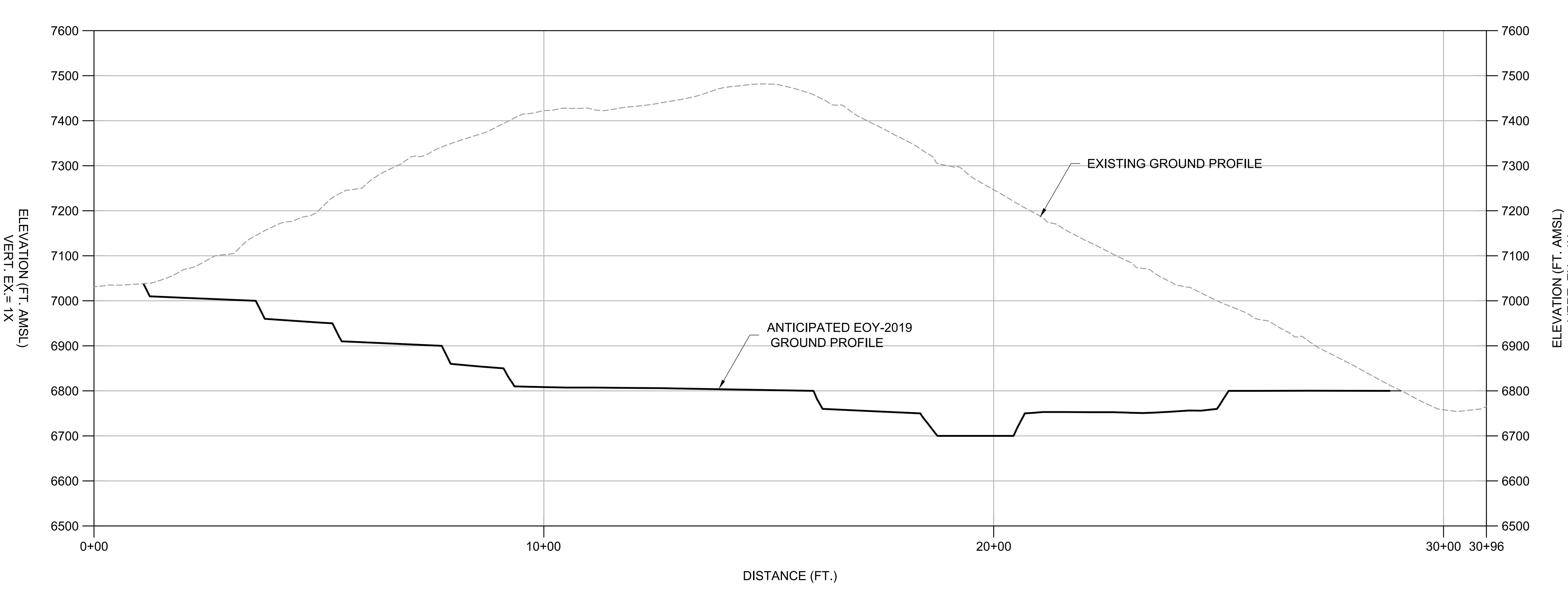
- EXISTING CONTOURS- 25' INT. (AMSL)
- RECLAIMED END OF YEAR 2019 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- CONCEPTUAL DOWNDRAIN SEE TYPE 2 CHANNEL ON SHEET 4
- RAILROAD
- FACILITY FOOTPRINT
- REVEGETATION AREA
- TYPICAL OUTSLOPE BENCH SEE TYPICAL SECTIONS 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 2019 MINING	SHEET NUMBER: 10
	REVISION NUMBER: 1
	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

NOT FOR CONSTRUCTION

LEGEND / NOTES

- EXISTING CONTOURS- 25' INT.
- RECLAIMED END OF YEAR 2019 PROJECTED CONTOURS- 10' INT.
- COORDINATE GRID
- BORROW AREAS (RECLAIMED FOOTPRINTS)
- RAILROAD
- FACILITY FOOTPRINT
- REVEGETATION AREA
- CHAIN LINK FENCE
- BERM
- DRAINAGES

0 300
SCALE IN FEET

COORDINATE SYSTEM CHINO

N

APPENDIX A

Facility Characteristic Forms

APPENDIX A

FACILITY CHARACTERISTIC FORMS

List of Tables

NOTES:

1. Borrow area reclamation costs are included in mine facility costs.
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.

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 2019
EOY 2019 Reclaimed Area—Berm and Fence Area Surrounding Pit at Closure (acres)	17.6
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch Berm and Fence Area	TBD
Berm and Fence	TBD
Capital Cost Totals	**TBD**
Capital Cost/Acre	**TBD**

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 2019
EOY 2019 Reclaimed Area (acres)	32.1
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

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 2019
EOY 2019 Reclaimed Area (acres)	180.7
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other[1]	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[1] Other includes channels, downdrains

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 2019[2]
EOY 2019 Reclaimed Area (acres)	62.5
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other[1]	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[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 2019[1]
EOY 2019 Reclaimed Area (acres)	418.8
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other[2]	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[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 2019[1]
EOY 2019 Reclaimed Area (acres)	110.7
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[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 2019
EOY 2019 Reclaimed Area (acres)[1]	5.0
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other[2]	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[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 2019
EOY 2019 Reclaimed Area (acres)	82.0
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

2014 Continental Mine Closure/Closeout Plan Update
Facility Characteristics Form

Cobre Haul Road

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 2019
EOY 2019 Reclaimed Area (acres)	94.5
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other[1]	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

[1]Other includes spanning arch demolition

[2] Cobre Haul Road Closeout Plan, dated February 2016, is attached in Appendix B.4

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 2019
EOY 2019 Reclaimed Area (acres)	11.9
Item	**Capital Cost**
Cover Material (Load, haul, spread)	TBD
Regrade	TBD
Seed & Mulch	TBD
Other	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

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 2019
EOY 2019 Reclaimed Area (acres)	TBD
Item	**Capital Cost**
Regrade	TBD
Seed & Mulch	TBD
Other	TBD
Capital Cost Totals	TBD
Capital Cost/Acre	TBD

APPENDIX B

Earthwork Cost Estimate Summary Report

APPENDICE B and C

Appendices B and C will maintain the general CCP cost estimation assumptions and methodologies utilized in the previously submitted 2014 CCP Update. However, there are some costs that will be updated to reflect minor changes that have occurred since the original 2014 CCP Update was produced. These changes are:

Long Term Water Management- The Hanover Mountain Deposit storm water management system is currently the subject of final design. Although these designs are not fully completed, the basic configuration has been refined. This refinement calls for expansion and relining of Upper Creek Containment Pond #1. We currently replace lined ponds if they are older than 30 years old. This pond was slated for replacement within the assumed 12 year management schedule, but since it will be newly relined, this replacement cost will not be included.

Reclamation - The Upper Creek Containment Pond #1 is projected to be increased in size from 1.13 acres to approximately 1.29 acres. Additional costs would be included for ripping and covering the larger pond area. Minor drainage channel work would be required to reroute storm water to Grape Gulch. The updated cost estimate will also include No.3 Stockpile regrading cost and the cost for hauling in addition 24 inches of cover for the Low Grade Ore Stockpile.

Appendices B and C will be updated and resubmitted following the approval of the technical CCP scope of work.

APPENDIX C

Water Management

Cost Estimate Summary Report

APPENDICE B and C

Appendices B and C will maintain the general CCP cost estimation assumptions and methodologies utilized in the previously submitted 2014 CCP Update. However, there are some costs that will be updated to reflect minor changes that have occurred since the original 2014 CCP Update was produced. These changes are:

Long Term Water Management- The Hanover Mountain Deposit storm water management system is currently the subject of final design. Although these designs are not fully completed, the basic configuration has been refined. This refinement calls for expansion and relining of Upper Creek Containment Pond #1. We currently replace lined ponds if they are older than 30 years old. This pond was slated for replacement within the assumed 12 year management schedule, but since it will be newly relined, this replacement cost will not be included.

Reclamation - The Upper Creek Containment Pond #1 is projected to be increased in size from 1.13 acres to approximately 1.29 acres. Additional costs would be included for ripping and covering the larger pond area. Minor drainage channel work would be required to reroute storm water to Grape Gulch. The updated cost estimate will also include No.3 Stockpile regrading cost and the cost for hauling in addition 24 inches of cover for the Low Grade Ore Stockpile.

Appendices B and C will be updated and resubmitted following the approval of the technical CCP scope of work.

APPENDIX D

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