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TYRONE MINE CLOSURE/CLOSEOUT PLAN UPDATE PHELPS DODGE TYRONE, INC., TYRONE, NEW MEXICO

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
ABA	acid-base accounting
AST	Above-Ground Storage Tank
AQB	Air Quality Bureau
AQCR	Air Quality Control Regulation
BER	Basic Engineering Report
BLM	Bureau of Land Management
BMI	Borrow Materials Investigation
BMP	Best Management Practices
CCP	Closure/Closeout Plan
CDQA	construction design quality assurance
CDQAP	Construction Design Quality Assurance Plan
CFR	Code of Federal Regulations
CQA	Construction Quality Assurance
DBS&A	Daniel B. Stephens and Associates, Inc.
DP	Discharge Permit
EC	electrical conductivity
ETS	Evaporative Treatment System
EnviroGroup	EnviroGroup Limited
ft	feet
Golder	Golder Associates, Inc.
Guidelines	Closeout Plan Guidelines
HDPE	high density polyethylene
HDS	high-density sludge
µS/cm	microSiemens per centimeter
msl	mean sea level
M3	M3 Engineering & Technology Corp.
MAP	mean annual precipitation
MMD	Mining and Minerals Division
NMED	New Mexico Environment Department
NMMA	New Mexico Mining Act
NMWQA	New Mexico Water Quality Act
NMWQCC	New Mexico Water Quality Control Commission
NSR	
O&M	Operation and Maintenance
OSE	Office of the State Engineer

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

PDTI	Phelps Dodge Tyrone, Inc.
PLS	pregnant leach solution (economic copper-bearing leach solution)
PMLU	post-mining land use
POPE	Plant Oxidation Pond Effluent
RCRA	Resource Conservation and Recovery Act
RTC	Response to Comments
Rules	New Mexico Mining Rules
SCS	Soil Conservation Service
SPCC	Spill Prevention Control and Countermeasures
SPLP	synthetic precipitation leachate procedure
SSE	self sustaining ecosystem
SX/EW	solution extraction-electrowinning
SWCZ	surface water catchment zone
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
t/tk	ton over kiloton
TDS	total dissolved solids
Tyrone	Phelps Dodge Tyrone, Inc.
EPA	U.S Environmental Protection Agency
Van Riper	Van Ripper Consulting

EXECUTIVE SUMMARY

The Tyrone Mine (Tyrone) is one of the major copper mining and processing facilities in the southwestern New Mexico. For more than a decade, Tyrone has been developing plans for the eventual reclamation of these facilities once mining and copper extraction cease. Because of the importance of reclamation, Tyrone has begun to more fully integrate closure considerations in mine planning and operational decisions. This integrated process has resulted in a “mine for closure” philosophy that is intended to promote efficiency in the closure process. Ultimately, implementation of mine for closure concepts is expected to result in the most efficient use of the resources necessary to achieve reclamation in a safe, timely, and environmentally sound manner.

The Closure/Closeout Plan (CCP) presented herein represents a 5-year update of the plan originally approved by the New Mexico Environment Department (NMED) in 2003, and Mining and Minerals Division (MMD) in 2004. This update and related financial assurance cost estimates reflect current advancements in reclamation science and engineering, contemporary site conditions, concurrent reclamation activities, and projected changes in mine facilities. This primary impetus for this CCP update is to rectify the New Mexico Mining Act financial assurance requirements with End-of-Year 2007 (EOY 2007) mine conditions and conceptual designs, and ongoing reclamation projects that are projected to be completed by the permit renewal date (April 2008). Use of the EOY 2007 configuration is consistent with the snapshot in time philosophy that was adopted by Tyrone and the Agencies (NMED and MMD) early in the closure planning process.

The Tyrone Mine is located in a hot, semi-arid region in southwestern New Mexico, with elevations in the area ranging from about 5,800 to 8,000 feet above mean sea level. The landscape around the mine is characteristic of a block-faulted terrain in the Basin and Range Province, with northwesterly trending mountains separated by broad valleys containing thick alluvial deposits. The native vegetation is locally complex ranging from scattered pine and oak forests to extensive evergreen woodlands and grasslands.

The principal mine facilities and components to be reclaimed include applicable portions of the open pits, waste rock and leach ore stockpiles, tailing impoundments, copper beneficiation facilities, mine operations facilities and ancillary infrastructure. A significant amount of reclamation activities have been conducted at the mine since 2004. This has resulted in full reclamation of the majority of the tailing impoundments, closure of the mill and concentrator area, and ongoing reclamation activities at several of the leach ore and waste rock stockpiles. Closure of stockpiles and tailing impoundments relies on a combined approach involving source control (soil covers) and complementary surface and ground water control measures and water treatment. The cover systems will be placed on mining substrates graded to allow storm water to drain while minimizing soil loss from erosion. The cover systems will be revegetated to establish a self-sustaining ecosystem and stabilize the soils. Surface water control structures will be designed to convey water in a manner that maintains the integrity of the adjoining soil covers. Ground water control measures will be operated to limit the impacts to ground water resources.

This closure/closeout plan incorporates the concept of expanding the area granted a waiver by approximately 780 acres. The purpose of this request is to include portions of pit areas that were previously inadvertently excluded in the previous waiver, expanded pit areas and also to include areas where the environmental benefit of reclamation is substantially reduced because the topography does not allow surface water to drain away from the mine. These areas include some of the interior-facing stockpile slopes.

At closure, the bulk of the mine process solutions will be eliminated by recirculation and evaporation, and the remaining solutions will be collected, treated, and prepared for final discharge. Impacted waters will be treated using a nanofiltration plant, and a high density sludge plant, that when implemented, will treat all impacted waters so as to meet New Mexico Water Quality Control Commission water quality standards. Some existing surface impoundments, tanks and other mine process water management facilities and pipelines will be used to facilitate conveyance of water to the treatment plant during post-closure, while others will be permanently closed.

Tyrone has completed numerous other studies required by DP-1341 and Mining Act Permit GR010RE and is in the process of completing a feasibility study. Information from these various studies has been considered in preparing this closure/closeout plan update.

The estimated capital cost to reclaim the principal mine facilities is about $217,033,928. This cost includes reclamation of about 2,900 acres of stockpiles, tailing impoundments, surface impoundments, and other mine areas, and construction of a water treatment system with a 2,300 gallons per minute capacity. This cost is intended to reflect the highest reclamation cost scenario assuming mine closure under the current configuration of the mine. Out-year costs are expected to be less, assuming that the mine for closure concepts are implemented as described in the CCP.

Post-closure operations, maintenance, and monitoring costs were estimated for a 100-year period following completion of the reclamation. The total cost for post-closure is subject to prediction of the appropriate economic factors (escalation and discount rate) to be applied during the 100-year post-closure period. The net present value will be calculated to determine the cost for financial assurance as part of a financial assurance proposal to be submitted at a later date.

1.0 INTRODUCTION

The Tyrone Mine (Tyrone) is an open pit copper mine located just off State Highway 90, approximately 10 miles southwest of Silver City in Grant County, New Mexico (Figure 1-1). This updated Closure/Closeout Plan (CCP) provides an update to the End of Year 2001 Through 2008 CCP (M3 Engineering & Technology Corp. [M3], 2001) and presents the current closure/closeout plan and associated reclamation cost estimates for the Tyrone Mine.

1.1 Purpose of Plan

The Tyrone Mine CCP was updated to fulfill the requirements of the following two permits:

- Supplemental Discharge Permit (DP) for Closure, DP-1341, which was issued by the New Mexico Environment Department (NMED) on April 8, 2003 (NMED, 2003a); and

- Permit Revision 01-1 to Permit GR010RE (MMD Permit), which was issued by the Director of the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department on April 12, 2004 (MMD, 2004).

Specifically, Condition 1 of DP-1341 requires Tyrone to submit to NMED an updated closure plan 180 days prior to the expiration date of the permit, which is April 8, 2008. Thus the updated CCP is due on October 11, 2007. In addition, Section 9.S of the MMD Permit stipulates that a revised closeout plan be submitted to MMD no later than five years after the permit approval, which is April 11, 2009. This CCP supersedes the End of Year 2001 through 2008 CCP (M3, 2001).

1.2 Plan Organization

This section describes the purpose and scope of the CCP Update and its overall organization. The main body of the CCP consists of the following sections:

- **Section 1.0** provides an overview of the CCP Update for the Tyrone Mine,

- **Section 2.0** describes the current environmental setting of the Tyrone Mine including geology, fauna, flora, history, existing facilities, current disturbances, and discharge permits associated with the mine,

- **Section 3.0** describes the facilities, materials characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with the Tyrone Mine,

- **Section 4.0** details the proposed post-mining land uses for the Tyrone Mine and the associated requirements for the individual areas,

- **Section 5.0** summarizes the status and pertinent results of the additional studies required in the MMD Permit GR010RE (Section 8.L) (MMD, 2004) and the conditional studies required in DP-1341 (Conditions 74 through 90) (NMED, 2003a). Additionally, a description of the status of ongoing and completed reclamation projects at the mine is provided in this section,

- **Section 6.0** describes the proposed reclamation design criteria and post-closure monitoring plans for the three major mine facility areas at Tyrone,

- **Section 7.0** summarizes the current and planned CCP activities for each of the three major mine facility areas at Tyrone,

- **Section 8.0** presents a summary of the capital cost estimate associated with the proposed reclamation and post-closure monitoring plans presented in Section 6.0, and the operating and maintenance costs associated with the proposed reclamation and post-closure monitoring plans,

- **Section 9.0** presents the proposed reclamation schedule associated with this CCP,

- **Section 10.0** is the signature page for the CCP update, and

- **Section 11.0** lists the references used in preparation of this CCP

The following appendices are also included in the CCP Update:

- **Appendix A** includes the reclamation design drawings that illustrate the updated CCP,

- **Appendix B** provides the updated facility characteristic forms,

- **Appendix C** includes the updated cost estimates for earthwork,

- **Appendix D** includes the updated cost estimate for water treatment, and

- **Appendix E** provides the most current documentation associated with each of the additional studies required in MMD Permit GR010RE (Section 8.L) (MMD, 2004) and the additional studies required in DP-1341 (Conditions 74 through 90) (NMED, 2003a).

1.3 Regulatory Authority

In 1993, the New Mexico legislature enacted the New Mexico Mining Act (NMMA) requiring that closeout plans be put in place for mines within the state. Rules to implement the requirements of the NMMA were promulgated in 1994. This plan has been prepared to comply with applicable regulations and requirements stipulated in the NMMA (NMAC Title 19, Chapter 10, Part 5), New Mexico Water Quality Act (NMWQA), and the New Mexico Water Quality Control Commission (NMWQCC) Regulations (NMAC Title 20, Chapter 6, Part 2). Additional details of the NMMA and closure planning concepts associated with the Tyrone Mine are described in the following sections.

1.3.1 The New Mexico Mining Act and Administrative Rules

The NMMA, which was enacted by the New Mexico legislature in 1993, requires that closeout plans be put in place for mines within the state. The legislature established a goal of promoting responsible utilization and reclamation of lands impacted by mining while also recognizing that mining is vital to New Mexico. Rules to implement the requirements of the NMMA were promulgated in 1994. The program is administered by the Mining and Minerals Division (MMD) of the New Mexico Department of Energy and Natural Resources.

Tyrone 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. The closeout plan is the core of an existing mine permit. The MMD’s New Mexico Mining Rules (Rules) and advisory *Closeout Plan Guidelines* (Guidelines) provide a foundation for the development of Closure/Closeout Plans. Subpart 506.A states 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.” The Guidelines recognize that each site presents a unique set of circumstances and that many of the existing mines subject to closure requirements were largely developed prior to the NMMA without plans for reclamation.

The landowner selects the post-mining land use, which must be approved by the Director of the MMD. Post-mining land uses 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. Determining future land-use is the first step in deciding how much effort, should be put into reconstructing lands disturbed by mining and in determining the amount of financial assurance required for the site.

The "default" reclamation standard is ecological, that is the closure plan must demonstrate the work to be done to reclaim the permit area "to a condition that allows for the reestablishment of a self-sustaining ecosystem on the permit area following closure, appropriate for the life zone of the surrounding areas." This reclamation standard must be achieved unless the operator can show that it conflicts with an approved post-mining land use, or can demonstrate that reclamation of an open pit or waste unit "is not technically or economically feasible or is environmentally unsound." An approved existing mine permit applies for the life of the operation.

1.3.2 Closure Planning Constructs

The primary reclamation challenges at Tyrone involve the control of water, stabilization of the mining residues to prevent off-site dispersal, and establishment of a self-sustaining ecosystem, where applicable. Tyrone intends to achieve the reclamation goals through a combined approach involving source control and revegetation complemented by surface and ground water controls and water treatment. In addition to honoring environmental commitments, Tyrone is bound to providing for the economic viability of its mining operations. Thus, the reclamation plans must be rationalized from an economic perspective.

While conceptually simple, the reclamation process is extremely complex in practice and the development of Tyrone's plan has required the coordinated efforts of a diverse group of scientists and engineers. The closure plan presented herein relies on the application of standard reclamation principles to the unique set of conditions that characterize the facilities at Tyrone. Consistent with industry practices at large open pit copper mines with long operating histories, Tyrone's plan employs selectively located vegetated soil covers and surface and subsurface water management systems to stabilize the mining wastes and control water quality. These practices are strategically combined to optimize the reclamation and provide efficient, long-term achievement of Tyrone's environmental goals. On a forward looking basis, Tyrone is evaluating and implementing practices that will facilitate the efficiency of reclamation in the future.

To aid Tyrone in selecting a plan, environmental scientists and engineers have performed extensive, site-specific investigations to develop a comprehensive understanding of the environment. Over the past decade, a broad range of specialized studies (e.g., ground water, cover design, revegetation, and water treatment) have been conducted to evaluate the environmental and economic implications of various closure alternatives (see Section 5 for a description of Conditional Studies). In addition, Tyrone has gained extensive practical experience with reclamation techniques through the concurrent reclamation activities being conducted at the Mine.

Results from these, and other, studies are being integrated through a comprehensive feasibility study to better understand the global implications of various closure alternatives. The Tyrone Feasibility Study (Condition 89) involves a collaborative process whereby representatives from Tyrone, NMED, and MMD selected closure alternatives and mechanisms for evaluation. Ultimately, the results of the feasibility study have figured prominently in the closure approach that is represented in this plan.

From a technical perspective, the overarching conclusions of the Feasibility Study are that increasing levels of source control (cover thickness) will not significantly affect ground water quality. Water quality of the seepage from the stockpiles at Tyrone is unlikely to improve significantly with time. Thus, there is no expectation for the foreseeable future that any of the alternatives will perform relatively better to decrease the size of the area where ground water currently exceeds the standards of 20.6.2.3103 NMAC. Measured ground water flow in the Mine/Stockpile Unit indicates that the open pit areas act as a hydraulic sink (primarily the Main Pit and the Gettysburg Pit) that is maintained by pumping the open pits that intersect ground water. This means that the majority of solutions contained in the stockpiles and ground water within the open pit capture zone (OPCZ) will flow toward the pit. Impacted water within the pit capture zone will be collected in the pit sumps and treated after cessation of operations. In the case where ground water impacts may occur outside the pit capture zone, stockpile seepage and impacted ground water will be contained by existing and proposed interceptor well systems and seepage collection/cutoff systems and sent to the proposed water treatment system.

The site conditions assumptions used for this CCP update are not static. Monitoring well data are regularly collected in accordance with the operational discharge permits, and the site wide abatement plan is proceeding according to 20.6.2.4106 NMAC and Condition 34 of DP-1341. The results of the site wide abatement plan may influence the CCP in the future. Tyrone believes that alternative abatement standards may be necessary for some constituents at one or more locations. The abatement standards and requirements in 20.6.2.4103(E) will allow Tyrone to propose alternative abatement standards upon a demonstration of the following:

- Compliance with the standard is not feasible by the maximum use of technology, within the economic capability of the responsible person or there is no reasonable relationship between the economic and social costs and benefits;
- The proposed alternative abatement standard is technically achievable and cost-benefit justifiable; and
- Compliance with the proposed alternative standard will not create a present or future hazard to public health or undue damage to property.

The objectives of Stage 1 of the abatement process are to define site conditions and provide the data necessary to select and design an effective abatement option. Once Stage 1 is completed the Stage 2 process will be implemented, if necessary, to propose alternative abatement standards for NMED's approval. These alternative standards would then be used to derive the evaluation of cleanup technologies used for abatement.

Tyrone's current mine plan projects that active mining will continue for many years. Active mining means the mining and hauling of ore for beneficiation on leach stockpiles. Tyrone will continue to leach the stockpiles for a number of years after it has stopped mining and hauling new ore. During this transition period Tyrone's solvent extraction/electrowinning (SX/EW) plant will continue to recover copper-bearing leach solutions (PLS) and process water from the toes of the stockpiles, while closure activities are implemented at other areas of the mine. The SX/EW plant will not close until leach stockpiles have been drained and the last of the economic PLS has been processed. Once the SX/EW plant closes Tyrone will fully implement the closure plan.

Tyrone also recognizes that the closure plan must be structured to accommodate advancements in science, engineering, and mining technology. Thus, Tyrone reserves the option to modify the closure plan to adopt developments in reclamation science or improved understanding of the site.

1.4 History of Closure/Closeout Plan Submittal

Prior to the legislative activities that led to the establishment of the Mining Act, Tyrone submitted various closure plans and implemented tailing test plots for closure as part of the operational DP requirements. The following summary focuses on activities that occurred after the implementation of the NMMA.

In 1994 Phelps Dodge Tyrone, Inc. (PDTI) submitted a mining operations site assessment and an existing mining operation permit application for the Tyrone Mine. The permit application was approved by the

MMD on July 10, 1996. The following list provides a chronology of the more recent progress leading to this updated CCP:

- PDTI submitted a preliminary CCP in December of 1997 (Daniel B. Stephens & Associates, Inc. [DBS&A], 1997c),

- PDTI applied for and was granted an extension by the New Mexico Energy, Minerals, and Naturals Resources Department's Mining and Minerals Division for closeout plan approval until December 31, 1999,

- PDTI submitted a revised CCP in April 1999 (DBS&A, 1999a); based on this revised report, PDTI secured an interim financial assurance bond with the NMED,

- In 1999 PDTI applied for and was granted an extension for closeout plan approval until December 31, 2001,

- PDTI submitted the End of Year 2001 Through Year 2008 CCP for the Tyrone Mine in May 2001 and updated the plan in July 2001 (M3, 2001),

- Supplemental Discharge Permit for Closure DP-1341 was issued by the NMED on April 8, 2003 (NMED, 2003a), and

- Permit Revision 01-1 to Permit No. GR010RE was issued by the MMD on April 12, 2004 (MMD, 2004).

PDTI appealed certain conditions of the Supplemental Discharge Permit for Closure DP-1341 to the Water Quality Control Commission. Following a public hearing, the WQCC upheld the challenged conditions of the permit. PDTI then appealed the WQCC's decision to the New Mexico Court of Appeals, which overturned the WQCC's decision and remanded the permit back to the WQCC for further consideration. At the time this updated CCP is submitted, the WQCC is holding a public hearing regarding whether the entire Tyrone Mine is a "place of withdrawal of water for present or reasonably foreseeable future use" where compliance with the WQCC ground water quality standards shall be measured or whether portions of the Tyrone Mine are not "places of withdrawal." The WQCC is considering and may establish criteria to be used in the future to determine what locations are "places of withdrawal." The outcome of this hearing will have a significant bearing on the future application of the WQCC regulations, including the WQCC ground water quality standards, at the Tyrone Mine. Throughout this document, there are references to comparisons of measured ground water quality with the standards of 20.6.2.3103 NMAC, including references to "exceedances" of WQCC ground water quality standards. Such references are intended to reflect a comparison of measured water quality at particular locations with the standards in 20.6.2.3103 NMAC and do not represent an admission that those standards apply or that compliance with the standards should be measured at those locations. PDTI reserves all rights regarding the issues pending before the WQCC pending the outcome of that hearing and any future legal proceedings regarding those issues, including the right to amend this updated CCP to reflect the outcome of the pending and any future proceedings.

1.5 Description of Updated Plan

MMD and NMED regulations require that existing mines prepare a CCP that reflects anticipated conditions at the end of active mining and post, prior to obtaining a permit, 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." The CCP is revised on a five year basis throughout the mine's active life to reflect changes in mine operations and site conditions. An operator would prepare an amended CCP at the time of closure that would reflect actual, rather than anticipated, conditions at the end of active mining.

The requirement that the amount of financial assurance be based upon third party costs protects the state from mine operators that close during the period of the permit without the financial resources to complete the closure and reclamation requirements of the permit. Financial assurance amounts calculated in this way are unlikely to reflect an operator's actual costs at closure because the operator may use its equipment, manpower resources, and buying power for commodities such as diesel and electricity.

This 5-year update to the CCP clarifies and revises the End of Year 2001 Through Year 2008 CCP (M3, 2001) with refined closure/closeout conceptual designs that account for changes in site-specific conditions and ongoing and completed reclamation projects. Like the original 2001 plan and financial assurance, this updated plan is a "snapshot in time" that reflects Tyrone's current mine plan and understanding of site conditions. Details on facility changes that have occurred since the last CCP and those projected in the subsequent planning period are provided in the CCP update. The CCP update also describes fulfillment of the permit conditions stipulated in the MMD Permit and DP-1341 (See Section 5.0).

The facility characteristics and reclamation designs presented in this CCP are referenced to those conditions at the Tyrone Mine at the end of year 2007 as well as the projected status of ongoing reclamation projects prior to the permit renewal date (April 2008). The proposed reclamation and post-closure monitoring plans for the principal mine facilities and nine operational DP areas (See Section 2.5.7) are described in Sections 6.0 and 7.0.

This updated CCP supports financial assurance cost estimates for closure/closeout based on the EOY 2007 mine plan. Use of the EOY 2007 mine plan is consistent with the snapshot in time philosophy that was adopted be Tyrone and Agencies early in the closure planning process. If mining activities were to cease between the years 2007 and 2013, planned mining-for-closure and ongoing reclamation activities are expected to result in lower financial assurance requirements than those based on the EOY 2007 conditions. Thus, the EOY 2007 plan is expected to represent the most onerous condition from a cost and reclamation perspective.

1.6 Summary of CCP Cost Estimate

For financial assurance purposes, the total cost to implement the CCP presented herein is estimated to be $549,548,984. Capital costs, operating costs, and maintenance costs for closure/closeout and post-closure/closeout care have been developed for this updated plan as outlined in Section 8.0.

The EOY 2007 scenario, used to develop the financial assurance cost estimate, reflects the most conservative cost scenario (i.e., the highest reclamation cost scenario) for closure/closeout in the time period between 2007 and 2013. This assumption is based on several considerations, but principally the following:

- Mining work after year 2007 will incorporate “mining for closure” practices to accommodate the reclamation, such as: 1) placement of mined materials on stockpiles in a manner that reduces the volume of materials that must be moved to achieve post-closure slope configurations, 2) mined materials will be placed on the upper surfaces of the stockpiles as part of mining operations to create the 0.5 to 5 percent slopes required to convey water off the top surfaces, 3) waste material mined from the West Main Pit will be used to buttress the west side of the No. 2A Stockpile in support of future reclamation activities for this facility; and 4) waste material from the Copper Mountain Pit will be placed within the San Salvador Hill Pit and/or the South Rim Pit,

- Ongoing reclamation activities at the Nos. 1, 1C, and 7A stockpiles, and within the Mangas Valley Tailing Area will reduce the financial assurance requirements in the near term, and

- Upcoming accelerated reclamation projects that are planned for completion between 2007 and 2013 will reduce the financial assurance requirements in the future.

2.0 EXISTING FACILITIES AND CONDITIONS

The following sections describe the Tyrone mining facilities and operations, ownership history, past and current land uses, environmental setting (such as topography, geology, hydrology, climate, and wildlife), and mine material characteristics. In addition, pertinent permits and operational DPs are summarized herein.

2.1 Description of Mining Facilities

For the purposes of the CCP Update, the Tyrone Mine has been separated into three geographical areas; the Mine/Stockpile Unit, the East Mine Unit, and the Mangas Valley Tailing Unit (Figure 2-1). The three areas are described as follows:

- The Mine/Stockpile Unit includes the Main, Valencia, Savanna, Gettysburg, San Salvador Hill, South Rim, and Copper Mountain Pits; the 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B (former East Main), 6C (former Gettysburg In Pit), Copper Mountain, and 7B (former Gettysburg Out Pit) leach ore stockpiles; the 1C, 2B Waste, 3B, 7A, 7C, 8C (former Upper Main), and portions of the Savanna waste rock stockpiles; the 5A (former 1D) and proposed 9A overburden stockpiles; the SX/EW Plant; PLS collection impoundments; seepage interception systems; storm water detention impoundments; maintenance and lubrication shops; process solution pumping stations; former mill and concentrator; and associated facilities (Figure 2-2).

- The East Mine Unit includes the No. 1 leach stockpile, acid unloading facility, former precipitation plant area, and historic Burro Mountain tailing impoundment (Figure 2-3).

- The Mangas Valley Tailing Unit includes the Nos. 1, 1A, 1X, 2, 3 and 3X tailing impoundments, Mangas Valley tailing repositories, and associated facilities (Figures 2-4 and 2-5).

The general layout of the mine facilities at Tyrone is presented in Figure 2-1 and Plate 1. The principal mine facilities and main mine components are discussed in Sections 2.1.1 through 2.1.11 and include:

- Open pits

- Waste rock, leach ore, and overburden stockpiles

- Mine operation facilities (e.g., warehouse, shop, and office buildings, and power plant)

- Solution extraction-electrowinning (SX/EW) plant

- Lubrication shop
- Acid-unloading facility and decommissioned precipitation plant
- Former mill and concentrator area
- Tailing impoundments
- Water management system (including wells, tanks, pipelines, process water ponds), and
- Ancillary infrastructure (roads/railway, fuel storage tanks, power lines, storm water controls)

2.1.1 Open Pits

The location of active open pit mining has shifted over time resulting in a number of distinct, but related pits. The open pits are developed in a series of 50-foot benches by blasting, excavation, and hauling. The overall slope of the pit walls has a gradient of approximately 1.3(H):1(V).

The open pit complex at Tyrone currently encompasses approximately 1,250 acres, including the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna, and San Salvador Hill pits. Mining is currently focused in the West Main area. Previously mined and now partially or completely backfilled pits include the Virginia Racket, West Racket, East Main, Gettysburg Entry, BA-O, Upper Main, and San Salvador Hill pits. The Main Pit is located near the center of the Mine/Stockpile Unit and is about 1,200 feet deep. The West Main and Valencia pits are considered by Tyrone to be part of the Main Pit. The Main, Copper Mountain, Gettysburg, and Savanna pits are currently being dewatered to maintain mining access and provide process makeup water. Where operationally feasible, Tyrone has backfilled portions of the Main Pit and the other pits to facilitate mining and reclamation. Tyrone was granted a conditional waiver from the requirements to achieve a self-sustaining ecosystem for the Main, Savanna, Gettysburg, and Copper Mountain Pits. A waiver was not granted for the San Salvador Hill and South Rim Pits as part of the current closeout plan approval.

2.1.2 Waste Rock, Leach and Overburden Stockpiles

The Tyrone Mine permit area contains a number of stockpiles located along the perimeter of the pit areas. The stockpiles generally fall into three types: 1) leach stockpiles, which are used to extract copper from low-grade ore, 2) waste rock stockpiles, which store excavated materials that have little or no recoverable copper; and 3) overburden stockpiles, which contain materials suitable for future reclamation purposes.

Combined, the stockpiles encompass approximately 2,800 acres. The leach stockpiles are used to extract copper from low-grade ore and consist of the 1, 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B (former East Main), 6C (former Gettysburg In Pit), and 7B (former Gettysburg Out Pit) stockpiles. A former leach ore stockpile leached by a previous operator, the Copper Mountain stockpile, is located along the southwest perimeter of the Copper Mountain Pit. Waste rock stockpiles include the 1C, 2B Waste, 3B, 7A, 7C, 8C (former Upper Main), and portions of the Savanna stockpile. The 5A (former 1D), Savanna, and proposed 9A stockpiles contain overburden material that may be used for cover material at closure.

2.1.3 Main Mine Facilities

The main mine operations facilities area is located along the north ends of the 3A and 5A stockpiles along the upper reach of Mangas Wash (Figure 2-6). Facilities and structures located in the main mine operations area include:

- MM-01 General Office
- MM-02 Mine Operations Office
- MM-03 Security
- MM-04 Safety Building
- MM-05 Human Resources/Training
- MM-06 Jerome Building
- MM-07 Plant Warehouse
- MM-08 Truck Shop/Machine Shop/Welding Shop
- MM-09 Electric Shop
- MM-10 Pipe Shop
- MM-11 Carpenter Shop
- MM-12 Lumber Storage
- MM-13 Shovel Repair
- MM-14 Environmental Lab
- MM-15 Chapel
- MM-16 Electrical Building & Chlorine Shack
- MM-18 Analytical Lab
- MM-19 Car Wash
- MM-20 Diesel Tank Farm
- MM-21 Electrical Power Substation
- MM-24 Fire Truck Barn
- MM-25 Ambulance Barn

2.1.4 SX/EW Plant

The SX/EW plant is located northwest of the Main Pit, between the 3B and 2A stockpiles (Figure 2-7). PLS from the leach stockpiles is sent to the SX/EW plant where the copper is extracted. After copper extraction, the remaining solution is recycled by adding acid to produce raffinate, which is then re-circulated through the leach stockpiles to collect additional copper. Facilities and structures located in the SX/EW plant area include:

- Tankhouse
- SX/EW Plant Area Shop
- Leach Crew Office
- SX/EW Warehouse
- Substation
- Raffinate Storage Tanks (2)
- Gonzales Cells
- Jamison Cells
- Organic Tanks (4)
- Mixer/Settler Tanks (8)
- Tank Farm (5)
- Water Tank
- PLS Feed Pond
- Acid Tanks (2)
- MCC Building
- Tool Room and Storage
- Chlorinator Room
- 2A West Raff Tank
- Rectifiers
- Workroom
- Pump Mixer Control Room
- Cobalt Sulfate Tank
- Reagent Tanks
- Tool Room
- Diluent Storage Tank
- Pacesetter Filters (2)
- Wash Pad, and
- Other miscellaneous (e.g., tanks and pipelines)

2.1.5 Mill and Concentrator

The mill and concentrator area is located east of the 3A stockpile (Figure 2-8). Demolition activities at the site began in August 2004, and reclamation of the mill and concentrator area was completed in early 2007. The buildings and facilities that remain in the vicinity of the Mill include:

- MC-01 Tailing Thickeners (8)
- MC-02 Reclaim Water Storage Tanks (3)
- MC-04 Reclaim Water Pump House
- MC-05 Terminal Tanks (3)
- MC-15 Mill Warehouse (Warehouse and Core Storage)
- MC-17 Radiators/Power Plant (Powerhouse)
- MC-21 Fuel Station
- MC-22 Tire Shop
- MC-24 Spigot Underflow Pump house
- MC-25 Tailing Pump house
- MC-26 Electric Power Substation, and
- MC-27 Inactive Diesel Storage Tanks (2)

The buildings and facilities presented below were demolished, removed, and the site buried according to an approved building removal plan. Further details on the mill and concentrator reclamation project are provided in Section 5.2.

- MC-06 Flotation Units (3)
- MC-07 Secondary Crusher
- MC-08 Mill Pumphouse
- MC-09 SX/EW Change room
- MC-10 Intermediate Ore Storage
- MC-11 Primary Crusher
- MC-12 Process Water Tanks
- MC-13 Concentrator-Filter Plant & Dryer
- MC-14 Lime Storage
- MC-16 Warehouse/Concentrate Unloading
- MC-19 Concentrator Building
- MC-20 Reagent Building

2.1.6 Lubrication Shop

The lubrication shop (Lube Shop) area is located east/southeast of the Main Pit area, between the 1B and 5A stockpiles (Figure 2-9). A cemetery is located east of the lube shop. Other facilities in this area include the Southwest Energy building and electrical substation. A storm water collection pond (Lube Shop Pond) is located north and northwest of the Southwest Energy building. Explosives and blasting supplies are stored at secured, isolated facilities in this area, including the prill tanks, which contain powdered ammonium nitrate, and the powder magazines, which contain primers, blasting caps, cord, and delays.

2.1.7 Acid-Unloading Facility and Decommissioned Precipitation Plant

The acid unloading facility and decommissioned precipitation plant are located southeast of the main mine facilities area, west of and adjacent to Highway 90 in the upper reach of Brick Kiln Gulch (Figure 2-10). In the past, the area was used to produce copper precipitate, but the precipitation plant was decommissioned in 1996. Presently, the area is used to unload train cars of sulfuric acid used in the leaching process. Ancillary facilities in the area include the railroad tracks, a small permitted solid-waste landfill, and various pump stations for process water and storm water handling.

2.1.8 Tailing Impoundments

The inactive tailing impoundments at the Tyrone Mine consist of the historic Burro Mountain Tailing Impoundment located in the East Mine Unit and six tailing impoundments in the Mangas Valley Tailing Unit. In addition, several small tailing repositories occur in the Mangas Valley between the No. 3 tailing impoundment and Highway 180.

The Burro Mountain tailing impoundment received tailing from the Burro Chief Mill that operated from 1913 to 1921. Final reclamation of the Burro Mountain tailing began in the July 2004 and was completed in February 2005.

The Mangas Valley Tailings Area contains the currently inactive 1, 1A, 1X, 2, 3X, and 3 tailing impoundments (Figure 2-4). The tailing impoundments cover about 2,300 acres, and contain approximately 304 million tons of tailing. The associated facilities in the Mangas Valley Tailings Area include the 1X Seepage Interception System, tailing decant return water ponds, the mine’s domestic wastewater ponds, tailing launder, and approximately 72 storm water catchments. Many of these facilities have been reclaimed, or are currently in the process of being reclaimed in accordance with DP-1341, MMD Permit GR010RE, and the DP-27 Settlement Agreement. Reclamation of the tailing impoundments began in 2004 with the initial grading of the No. 3X tailing impoundment. Reclamation of the 3 and 3X tailing impoundments was completed in 2006. The majority of the reclamation has been completed at the No. 2 tailing impoundment as well. The 1 Series tailing impoundments (1, 1A, 1X tailing impoundments) are currently in various stages of reclamation and the 1 and 1A tailing impoundments are projected to be completed by April 2008. Further details on the current status of reclamation within the Mangas Valley Tailing Unit are provided in Section 5.2.

In October 1980, about 2.5 million cubic yards of tailing escaped from the No. 3 tailing impoundment following a breach in the northwestern corner of the impoundment. The fugitive tailing from this event were consolidated into repositories adjacent to the No. 3 tailing impoundment and various downstream locations (Figure 2-5). These areas were initially covered and reclaimed in 1980-1981. In 2004, Tyrone reconfigured, covered, and revegetated the repositories (Section 5.2.1). Plans for reclamation of two repositories located on US Forest Service land (USFS North-1 and USFS South-1) are currently under review. Reclamation of these two remaining repositories is projected to be completed by April 2008.

2.1.9 Water Management System and Ponds

Figure 2-11 presents a generalized schematic of the water supply and use cycle at the mine. Various surface impoundments are used during current operations for temporary storage of both impacted and non-impacted process waters, surface waters, and seep water. Surface impoundments at Tyrone were originally identified in Table 5.6 of the End of Year 2001 through 2008 CCP (M3, 2001). Subsequently, an updated surface impoundment list was provided in the Condition 87 Surface Impoundment Study Work Plan (DBS&A, 2006b). The locations of the existing surface impoundments at Tyrone are shown on Figures 2-12 and 2-13. Table 2-1 summarizes the type and operational status of the surface impoundments. The locations of the closed/reclaimed surface impoundments can be found in the Surface Impoundment Study Work Plan (DBS&A, 2006b).

2.1.10 Other Ancillary Facilities, Structures, Systems

In addition to the major mine components identified above, there are a number of key ancillary facilities dispersed across the mine or that cross facility boundaries that support the operations at Tyrone. Some of the more important ancillary facilities that require consideration at closure are listed below:

- Haul and access roads,
- No. 1 fuel dock, No. 2 fuel dock, tire shop area,
- Electrical power transmission lines and substations,

- Storm water structures for drainage, diversion, and sediment control,
- Fencing and security systems, and
- Miscellaneous pipelines.

2.2 History of Mining at Tyrone

Native Americans mined turquoise near the old town of Tyrone prior to the coming of the Spaniards. While it is likely that the site was mined by the Spaniards prior to 1870, it appears that significant mining in the area did not begin until the late 1870s when turquoise was rediscovered in pits near Tyrone. Through the turn of the 20th century, a number of companies mined turquoise, other copper minerals, and fluorspar in the Tyrone Mine area. Prior to 1910, a number of extensive underground copper orebodies were developed on the St. Louis, Burro Chief, Copper Mountain, and Sampson claims.

In 1904, Phelps Dodge obtained an interest in the Burro Mountain Copper Company, which owned the above claims, with an option to purchase the remainder. By 1913, Phelps Dodge owned virtually all mines in the district. Upon consolidation of the claims, Phelps Dodge developed the mines for a large-scale underground operation. Mining was generally confined to areas of high-grade chalcocite mineralization, averaging at least 2 to 3 percent copper. At the end of World War I, in 1921, the underground mines shut down partly due to a drop in copper prices and a lack of high-grade ore. Operations occurred intermittently between 1921 and 1929 and between 1941 and 1950.

From 1950 to 1959, Phelps Dodge conducted an intensive drilling program, covering about 3 square miles, to delineate the large low-grade ore body that is now the Tyrone Mine. In 1967, Phelps Dodge began waste stripping operations for the open pit areas and installed a concentrator and mine support facilities. The concentrator began operating in 1969 and continued, except for occasional brief suspensions, until 1992. Limited stockpile leaching operations began in 1972, coincident with the opening of the precipitation plant. In 1984, the SX/EW plant came on-line and additional leaching operations were started. Over the life of the mine, Tyrone has extracted copper using conventional concentration methods (crushing, grinding, and froth-flotation) and two different solution extraction processes (precipitation and SX/EW).

2.3 Past and Current Land Uses

Surface lands in and adjacent to the mine have historically been used for mining, livestock grazing, timber and fuel wood harvesting, recreation, and wildlife habitat. Ponderosa pine was logged in the Big Burro Mountains south of the Tyrone Mine, and fuel wood has been cut from woodlands in this area for at least a century. Recreation in the area includes camping, picnicking, hunting, off-road vehicle use, hiking, horseback riding, and bicycling.

Current surrounding land uses include private residences, grazing, mining, and recreation. Grazing is the predominant land use surrounding the mine.

2.4 Environmental Setting

The following sections present various aspects of the mine site, including its topography, geology, climate, hydrology, soils and vegetation, wildlife, and material characteristics.

2.4.1 Topography

The Tyrone Mine area straddles the Continental Divide between the Big Burro and Little Burro Mountains. The mine is located on the northeastern slopes of the southern end of the Big Burro Mountains, a northwest-southeast trending range approximately 22 miles long and 4 to 12 miles wide. The Little Burro Mountains are situated northeast of the Big Burro Mountains and are separated from the Big Burro Mountains by the mine and the Mangas Valley (Figure 2-14 and 2-15). The Mangas Valley and the Little Burro Mountains are located within a structurally controlled regional topographic feature that trends northwest to southeast. The Little Burro Mountains have a steep southwestern front and gentle northeastern slopes.

The topography in the vicinity of the Tyrone Mine reflects the relatively gentle northeastern slopes of the Big Burro Mountains (Figure 2-14 and 2-15). Burro Peak, on the Continental Divide, rises to an elevation of 8,035 feet above mean sea level (msl). The trace of the Continental Divide is to the northeast through the Tyrone Mine, crossing the Mangas Valley at an elevation of 5,825 feet above msl. The Divide separates Mangas Wash from the southeasterly-draining Brick Kiln Gulch and Oak Grove Wash. The Continental Divide crosses the Little Burro Mountains northwest of Tyrone Peak at a maximum elevation of 6,439 feet above msl.

2.4.2 Geology

The geology of the Tyrone copper deposit and surrounding area has been summarized by DuHamel and others (1993), Kolessar (1982), and Paige (1922), and geologic maps were prepared by Hedlund (1978a, 1978b, 1978c, 1978d). Data from these sources, as well as from Tyrone operation and exploration activities, were used to develop the geologic map of the pre-mining surface and mine permit area shown in Figure 2-16.

It should be noted that the fault systems illustrated in Figure 2-16 are based on results of detailed geologic mapping conducted by Tyrone geologists. Consequently, the fault systems differ somewhat from those presented in previous reports. One of the most notable differences is the division of the Burro Chief fault into two separate faults: the West Main Fault, which trends 45 degrees northeast, and the Burro Chief fault, which splays off the West Main at an orientation of 15 degrees northeast.

The Tyrone copper deposit is considered to be a porphyry copper deposit. The Tyrone deposit is generally confined to a triangular area at the southeast end of the Big Burro Mountains and is bounded by the Burro Chief and West Main Fault systems on the west, the Sprouse-Copeland Fault on the east, and the San Salvador fault system on the south.

Rock Units

The rocks that crop out in the Big Burro Mountains, the Mangas Valley, and the Little Burro Mountains range in age from Precambrian to Quaternary and are shown in generalized cross sections in Figure 2-17. The Big Burro Mountains are dominantly composed of the Precambrian Burro Mountain granite; this batholith was subsequently intruded by the Tyrone stock nearly 56 million years ago. The Tyrone laccolith consists of a Tertiary quartz monzonite that is composed of four stages of porphyry intrusions, each of which differs in composition, texture, and age.

Exposures of Cretaceous rocks are limited to the Little Burro Mountains. The Cretaceous units are predominantly sedimentary rocks that include the Beartooth quartzite and the Colorado Formation. The Beartooth quartzite is a thin-bedded to massive fine-grained sandstone that unconformably overlies Precambrian granite. The Colorado Formation is a sandy shale that conformably overlies the Beartooth quartzite. Cretaceous and Tertiary volcanic rocks, primarily andesites and rhyolites, overlie the Cretaceous sedimentary units.

The youngest rocks in the area are of late Tertiary and Quaternary age and consist mostly of consolidated and weakly lithified sands, gravels, and conglomerates. The Gila Conglomerate Formation, the oldest of the younger sedimentary rocks, is a semiconsolidated unit that was deposited as basin fill and fan sediments derived from late Tertiary and earlier uplifts. The youngest sedimentary units are unconsolidated and were deposited unconformably on Gila Conglomerate and as valley fill along present-day drainages.

Geologic Structures

The main geologic structures in the Big Burro Mountains, the Mangas Valley, and the Little Burro Mountains are northeast- and northwest-trending faults. The main regional faults include, but are not limited to: the Sprouse-Copeland, Austin-Amazon, West Main, Burro Chief, Southern Star, and Mangas Fault systems (Figures 2-18 and 2-19). The traces of two of these regional faults, the Mangas Fault and the Sprouse-Copeland Fault, are shown in Figures 2-16 and 2-17. The Mangas Fault strikes northwest-southeast with a dip of about 60 degrees southwest forming a prominent scarp on the Little Burro Mountains. Along the fault trace, Gila Conglomerate and bolson fill deposits have been juxtaposed against the older rocks of the Little Burro Mountains. Near Oak Grove Wash, the Sprouse-Copeland Fault strikes north along the eastern boundary of the Mine/Stockpile Unit and is nearly vertical, with displacement on the order of hundreds of feet. This fault has juxtaposed the Gila Conglomerate, downthrown to the east, and the Precambrian Burro Mountain granite.

The Mangas Fault is a normal fault that separates the Little Burro Mountains from the Big Burro Mountains. Rotation of the down-dropped block has tilted the Tyrone orebody about 8 degrees toward the plane of the fault. This rotation has also preserved a wedge of the Gila Conglomerate and possibly Cretaceous rocks in the down-dropped block. The Gila Conglomerate section in the down-dropped block is thickest on the northeastern side of the Mangas Valley and thins to a few feet thick on the southwest side.

Within the Mine/Stockpile Unit, numerous intrusions or vein swarms have contributed to the development of a complex jointing and fracture network. Fractures and joints typically lack the displacement associated with faults and are of a much smaller scale, ranging from inches to tens of feet. The orientations of the vein swarms probably influenced the pattern of ground water flow during supergene enrichment.

As part of its ongoing exploration and ore control efforts, Tyrone continues to refine the understanding of individual faults and fault systems at the Tyrone Mine. Work in the area immediately northeast of the Copper Mountain pit area has provided a new interpretation of the fault systems. Detailed mapping in this area reveals that the predominant rock is the Tertiary quartz monzonite. This rock type is very competent and relatively resistant to blasting. The fracture density in the area has also recently been measured in connection with mine operations located just north of the Copper Mountain pit area. The results of these measurements show that the majority of the fractures in the area are filled with supergene kaolinite and are expected to have relatively low hydraulic conductivity. The fracture orientations and characteristics are consistent with similar studies reported elsewhere.

2.4.3 Climate

The Tyrone Mine is located in a semiarid region in southwestern New Mexico, with elevations ranging from about 5,100 to 8,000 feet above mean sea level (ft msl). The climate at Tyrone is warm and dry, with mean annual precipitation of about 400 mm (16 inches) and a mean annual temperature near 10^{o}C (50^{o}F). Precipitation falls mainly as rain, but snow may occur from November to March. Most of the precipitation in the area falls during July through October in the form of rain during short, intense, thunderstorms. About 60 percent of the precipitation falls during the summer months. Precipitation is characterized mostly by small magnitude events ranging from less than 2.5 to 6.4 mm (0.1 to 0.25 inches) per day. Larger magnitude rainfall events (greater than one inch) also occur in the summer months, but at a much lower frequency. For example, the probability of exceeding one-inch of rainfall in a 24-hour period is less than one percent. Monthly precipitation is generally less than an inch per month from November through June, peaks in July, August, and September with between 2 and 3 inches per month, and generally falls to about 1 inch in October. Evaporative demand in this region is high and annual evaporation far exceeds annual precipitation.

Seven weather stations are located at the Tyrone Mine each with varying periods of record. Of those stations, the Tyrone Mine General Office station has the longest period of record (i.e., 1954 to the present), while shorter records (2 to 10 years) are available for the other Tyrone Mine stations.

Longer term records (more than 40 years) are available from five weather stations located near the mine. The five stations with the longest periods of record are:

- The Tyrone Mine General Office station, located at the mine at an elevation of 5,960 ft msl,
- The White Signal station, located approximately 7 miles south at an elevation of 6,066 ft msl,

- The Santa Rita station, located approximately 20 miles east-northeast at an elevation of 6,312 ft msl,
- The Hurley station, located approximately 15 miles east at an elevation of 5,700 ft msl, and
- The Fort Bayard station, located approximately 20 miles northeast at an elevation of 6,149 ft msl.

These stations are considered fairly representative of the range of climate conditions at Tyrone. Long-term climatic records (spanning more than 100 years) are available for Fort Bayard, while shorter periods of record are available for the Tyrone Mine General Office, White Signal, Santa Rita, and Hurley stations. Long-term data on wind speed and direction, relative humidity, cloud cover, and solar radiation are not available for Fort Bayard. Weather stations installed at the Tyrone test plots in 2005 will provide a wider range of meteorological data (e.g., wind speed and direction, relative humidity, solar radiation, air temperature, and rainfall) than those previously measured at the mine.

2.4.4 Hydrology

The surface-water and ground water hydrologic setting at the Tyrone Mine are presented below.

Surface-Water Hydrology

The Tyrone Mine occupies only a portion of two large watersheds: Mangas Creek (a.k.a., Mangas Wash) and Oak Grove Creek (a.k.a., Oak Grove Wash). A key feature of the Tyrone property is that the continental divide segments the facility into the two watersheds. Mangas Wash drains to the northwest and Oak Grove Wash drains to the southeast. For purposes of discussion, the four major drainage basins in the area of Tyrone include Mangas Wash, Deadman Canyon, Brick Kiln Gulch, and Oak Grove Wash. Deadman Canyon is a tributary to Mangas Wash and was diverted by Tyrone around the 1X tailing impoundment to another unnamed tributary of Mangas Wash. Mangas Wash is ephemeral at the mine site and drains to the Gila River. Brick Kiln Gulch is a tributary to Oak Grove Wash, which is also ephemeral and drains to the San Vicente Arroyo and then to the Mimbres River.

Ground Water Hydrology

Ground water in the Tyrone Mine area is present in both regional and perched systems. A single regional aquifer, which is predominantly unconfined, exists throughout the site. In addition, perched zones have been identified in several areas.

The regional ground water flow regime in the area of the Tyrone Mine prior to surface mining was characterized by the presence of a single ground water divide, which was nearly coincident with the Continental Divide. Ground water flowed either toward the northwest into the Gila-San Francisco Underground Basin or toward the southeast into the Mimbres Valley Underground Basin. While regional ground water still flows to both basins from the mine area, surface mining and ground water pumping over the past 35 years have altered the original ground water flow regime. Ground water withdrawals and the complex hydrogeology of the Tyrone Mine area have had a profound effect on water level elevations, creating highly variable ground water flow regimes.

Regional aquifer water level elevations and associated ground water flow directions for the northern and southern portions of the mine, as compiled from data collected in 2007, are shown on Figures 2-18 and 2-19, respectively. The arrows show the general direction of regional ground water flow. However, local flow directions may differ significantly from the regional direction due to the influence of fractures and faults, aquifer anisotropy, and perturbations caused by local pumping. Figures 2-18 and 2-19 also show the major ground water divides at the site, which separate the regional aquifer into four general ground water flow areas. The single ground water divide that once separated the Gila-San Francisco and Mimbres Valley Underground Basins has been altered with the development of capture zones associated with pumping from the Main, Gettysburg, and Copper Mountain pit areas. The divides that define the capture zones are primarily within the boundaries of the Mine/Stockpile Unit. The water level elevations and associated ground water flow directions shown in Figure 2-19 indicate that the Main pit area capture zone most likely extends beyond the western and eastern boundaries of the Mine/Stockpile Unit.

In general, water quality upgradient and cross-gradient of major mine facilities is characterized by field electrical conductivity (EC) between 300 and 500 microSiemens per centimeter (μS/cm) (at 25°C) and field pH values between 7.0 and 8.0. Site-wide field EC and pH measurements show that higher EC and lower pH values occur around and within the Mine/Stockpile Unit. Additionally, elevated EC values are observed at the base of the 1X, 2, and 3X tailing impoundments and at wells 45, 46, and MVR-1 in the Mangas Valley Tailing Unit.

Perched water has been identified within alluvium-filled channels incised into the Gila Conglomerate or igneous bedrock below the Nos. 1A, 1B, 1C, 2A, 2B waste, 3A, 4C, 7A, and Copper Mountain stockpiles. At many locations adjacent to the mine, the perched zone water quality has been impacted by mine solutions. Perched water within these alluvium-filled channels is collected by existing PLS collection systems and seepage collection and interceptor systems installed along the toes of the individual stockpiles. Additional perched water zones occur beneath the major drainages at the mine and flows are generally located along the major axes of the drainages. Perched zones occur beneath Oak Grove Wash, Brick Kiln Gulch, and Deadman Canyon Drainages. Perched water occurs at depths ranging from near surface along the stockpile toes to approximately 100 feet below ground surface (bgs) beneath Oak Grove Wash. Perched zone water level elevations and associated ground water flow directions for the Deadman Canyon and Oak Grove Wash/Brick Kiln Gulch areas, as compiled from data collected in 2007, are shown on Figures 2-20 and 2-21, respectively. Background water quality for the perched zones is predominantly a calcium-bicarbonate-sulfate type water with total dissolved solids (TDS) concentrations ranging between 500 and 600 mg/L. Figure 2-22 shows the 2007 water level elevations for the perched zones adjacent to the 3A stockpile.

2.4.5 Soils and Vegetation

The soils in Grant County were previously mapped by the Forest Service and Soil Conservation Service (Parnham, 1983). Site-specific soil and vegetation surveys were conducted at Tyrone in 1997 as part of the closure/closeout studies (DBS&A 1997c). The distribution of soils at the Tyrone Mine is controlled by the climate, geology, age of the land surfaces, and physiography of the area. The vegetation is indicative of the regional climate modified by soil and topographic factors. The distribution of the existing vegetation is locally complex and reflects the influence of both environmental gradients and land management practices. The vegetation in the permit area is not unique relative to the surrounding area and represents a minor fraction of plant communities that are locally and regionally extensive. No threatened or endangered plant species are recognized as occurring in the permit area.

Four soil-vegetation associations have been identified within the mine permit area as shown on Figure 2-23. These include the: (1) alluvial grassland association; (2) piedmont scrub savanna association; (3) mountain slope scrub savanna association; and (4) mountain slope mixed evergreen woodland association. The individual associations are described below.

Alluvial Grassland Association

The dominant soils in the alluvial grassland association include coarse-loamy and sandy families of Haplustolls. The soils are very deep, nonsaline, nonsodic, and coarse-textured and were formed in thick, stratified alluvial deposits composed predominantly of mixed igneous rocks. This association includes two consociations that occupy the nearly level to gently sloping floodplains and alluvial terraces of the major drainages in the permit area. The vegetation in this map unit is representative of an alluvial grassland with a minor riparian component.

The potential plant community at the site would probably be dominated by warm season grama grasses *(Bouteloua spp.)* with a minor shrub component of soaptree yucca *(Yucca elata)* and honey mesquite *(Prosopis glandulosa).* Important cool season grasses likely include lovegrasses *(Era grostis spp.),* junegrass *(Koeleria cristata),* muttongrass *(Poa fendleriana),* New Mexico needlegrass *(Stipa neomexicana),* and bottlebrush squirreltail *(Sitanion hystrix).* Desert willow *(Chilopsis Iinearis)* was presumably the dominant tree in the riparian corridor along the active floodplain.

The existing vegetation is dominated by a variety of annual and perennial grasses and forbs. Sideoats grama *(Bouteloua curtipendula)* and purple three-awn *(Aristida purpurea)* are the dominant perennial grasses, while honey mesquite, Apache plume *(Fallugia paradoxa),* and California bricklebush *(Brickellia californica)* are important shrubs. Mat muhly *(Muhlenbergia torreyi),* cholla *(Opuntia spp)* and Russian thistle *(Salsola kali)* are locally prevalent in disturbed areas. Desert willow is primarily restricted to the Wind Canyon drainage upstream of its confluence with Mangas Wash.

Piedmont Scrub Savanna Association

The soils in the piedmont scrub savanna association are included in loamy-skeletal, clayey-skeletal, and fine families of Aridic Haplustalfs. The soils are very deep, nonsaline, nonsodic, medium- to fine-textured, and calcareous in the lower solum and substratum. These soils were formed in residuum composed of regionally derived Gila Conglomerate and local fan terrace deposits from the Little Burro Mountains. This association includes three consociations that occur on the gently sloping to steep pediments and fan terrace remnants north and east of the mine pits and stockpiles.

The scrub savanna vegetative community at the Tyrone Mine is characteristic of the transition between an open grassland and mixed evergreen woodland. The potential plant community was probably dominated by mixed graina and associated grasses with a moderate component of honey mesquite and gray oak *(Quercus grisea).* Pinyon pine *(Pinus edulis)* one-seed *(Juniperus monosperma)* and alligator juniper *(J. deppeana),* and Emory oak *(Q. emoryi)* were probably important minor elements in the community.

Currently, the dominant perennial grasses are sideoats grama, hairy grama *(B. hirsuta)* rough bentgrass *(Agrostis scabra),* and tobosa *(Hilaria mutica)* Honey mesquite, gray oak, beargrass *(Nolina microcarpa),* broom snakeweed *(Gutierrezia sarothrrae),* and catclaw mimosa *(Mimosa biuncifera)* constitute the primary shrub species. Pinyon pine, one-seed and alligator juniper, and Emory oak are important woody species on slopes with north- and east-facing aspects.

Mountain Slope Scrub Savanna

The soils in the mountain slope scrub savanna association are comprised largely of loamy-skeletal Haplustalfs. The soils are shallow, medium-textured, and contain relatively high amounts of coarse fragments. These soils formed in residuum and colluvium from quartzite and mixed igneous rocks. This association includes a single consociation that is restricted to the steep and very steep western slope of the Little Burro Mountains.

The vegetation in this map unit represents the kinds of vegetation found on high-gradient west-facing slopes. The potential plant community was probably dominated by mixed grama grasses with a moderate component of beargrass, gray oak, mountain mahogany *(Cercocarpus montanus),* and sotol *(Dasyflrion wheeleri).* One-seed and alligator juniper were probably important minor elements in the community.

Because of the steep slopes, the vegetation in this association has probably been only minimally influenced by management. The existing vegetation is characterized by a relatively open shrub canopy. Rough bentgrass, sideoats grama, and blue grama *(B. gracilis)* are the dominant perennial understory grasses. The overstory is dominated by Emory and gray oak, beargrass, sotol, and one-seed juniper, with a minor representation of honey mesquite and pinyon pine.

Mountain Slope Mixed Evergreen Woodland

The soils in the mountain slope mixed evergreen woodland association are mostly loamy-skeletal Haplustolls. These soils are shallow, noncalcareous, and medium- to coarse-textured with moderate to high amounts of coarse fragments. These soils formed in residuum and colluvium from competent igneous rocks composed of quartz monzonite and granite. Minor areas of bedrock are exposed at the surface in this map unit. This association corresponds to a single consociation map unit that occupies the strongly sloping to very steep backslopes and ridges of the Big Burro Mountains.

Vegetation within the mountain slope mixed evergreen woodland association represents the lower elevation ranges of this community regionally. The potential plant community in this zone was probably dominated by a relatively open stand of pinyon pine and evergreen oaks with one-seed and alligator juniper occurring as locally important representatives. Mixed grama and associated grasses probably dominated the sparsely vegetated understory with mountain mahogany, point-leaf manzanita *(Arctostaphylos pun gens),* and squawberry *(Rhus trilobata)* occurring as important shrub components. Ponderosa pine *(Pinus ponderosa)* and Gambel oak *(Quercus gambelii)* are locally important subordinates in this community that may dominate in minor sheltered topographic positions. The riparian corridor associated with the upper reaches of Deadman Canyon is included in this association; thus, Fremont cottonwood *(Populus fremontii)* may occur as an incidental species.

2.4.6 Wildlife

The habitat near the Tyrone Mine supports a diversity of wildlife species. Previous studies in the Tyrone Mine Area have recorded at least 18 mammals, 79 bird species, and 5 reptiles (DBS&A 1997c; Metric Corporation 1993 and 1996; and Dames & Moore 1994). Metric Corporation (1993 and 1996) conducted surveys to identify federal and state threatened, endangered, and special status wildlife species in the Tyrone Mine area, although no threatened, endangered, or special status wildlife species were detected.

The habitat around the mine is composed predominantly of pinon-juniper woodland with a substantial oak component. Within this major habitat type are patches of riparian vegetation, ponderosa pine woodland, and rock outcrop. Large grassland areas are absent from the project area, but several grass species are prevalent providing ground cover within the woodland and in forest openings. The mine stockpiles are currently characterized by sparsely vegetated seral communities of volunteer vegetation. The reclaimed area will be dominated by grasses, forbs, and shrubs, and will increase the diversity of the area.

The main goals for reclamation at the Tyrone Mine are to stabilize the tailing impoundments and stockpile areas from erosion, reduce water entry into the underlying wastes, and support the development of a self-sustaining ecosystem. The entire area of tailing and selected areas of the mine and stockpiles will be covered with suitable soils and seeded with native and adapted grasses, shrubs, and forbs. During the bond-release period, the vegetation on the reclaimed areas is expected to represent a grass-shrub plant community. Initially, the contrast in vegetation between the reclaimed lands and surrounding undisturbed lands will provide edge habitat. Over time, the vegetation on the reclaimed areas will become more complex, both structurally and compositionally, which may increase habitat diversity for wildlife.

In the near-term, wildlife features will be constructed of locally available materials (e.g., rock or slash) on the tailing and stockpile reclamation areas to provide additional cover and vertical diversity for wildlife. These wildlife features may provide cover and nest sites for wildlife in the reclaimed areas.

2.4.7 Material Characteristics

Geologic materials found at the Tyrone mine site have been characterized with respect to their chemical composition and physical properties. The characteristics of the mineral assemblages identified at Tyrone as well as the stockpiles, tailing impoundments, and potential cover materials are described below.

Mineral Assemblages

The Tyrone ore, waste rock, and overburden have been thoroughly characterized for standard acid-base accounting (ABA) (Sobek,1978), synthetic precipitation leachate procedure (SPLP), whole rock constituent concentrations, soil pH, mineralogy, and kinetic testing of sulfide oxidation using humidity ells (DBS&A 1997a and 1997b; SARB, 1999) according to procedures recommended by the NMED (1996). Tyrone has developed a mineralogic classification that groups copper-and iron-bearing minerals into distinct mineral assemblages. The mineral assemblage approach was developed to characterize ore deposits because of the implications mineralogy has for metallurgical, mining, and environmental issues. The major mineral assemblages in the Tyrone area are listed below:

- MA-0 Gila Conglomerate
- MA-1 Leached capping
- MA-2 Oxide copper
- MA-3 Mixed oxide and chalcocite
- MA-4 Chalcocite and pyrite
- MA-5 Mixed chalcocite and chalcopyrite
- MA-6 Chalcopyrite and pyrite
- MA-7 Mixed oxide and chalcopyrite, and
- MA-8 Native copper and cuprite
- MA-21 Black copper oxide, and
- MA-51 Mixed chalcopyrite with chalcocite and covellite

Results of the geochemical analyses were used to further categorize the waste rock and leach ore into two broad groups, A and B, through statistical analysis of variability (DBS&A 1997a and 1997b). Group A consists primarily of sulfide-bearing mineral assemblages (MA-3, -4, and -5) having significant acid-generation potential, with an average ABA of -43.3 equivalent tons of calcium carbonate (CaCO3) per kiloton of rock (t/kt). Group B comprises leached cap and oxide mineral assemblages (MA-0, -1, -2, and -8) that are near neutral, with an average ABA of 6.7 t/kt. Whole rock composition data show that copper, iron, cobalt, lead, cadmium, and zinc are significantly more concentrated in the Group A mineral assemblages than in the Group B ones. Groups A and B cannot be differentiated with respect to aluminum, chromium, arsenic, manganese, and nickel. Most of the metals that can be differentiated according to the ABA groups are generally more mobile in the weathering environment than the non-differentiable metals.

Stockpile Material Characteristics

Tyrone mine materials characterization data has been reported in three principal reports as part of the End of Year 2001 through 2008 CCP (M3, 2001), and in three additional reports prepared to satisfy Condition 80 of DP-1341 (Greystone, 2003; and EnviroGroup, 2005b and 2005c). Information from these studies was compiled into a database containing information on approximately 740 samples of fresh rock and stockpile materials from Tyrone. This database provides a repository of information on the character of the materials at Tyrone for the purposes of closure and closeout planning. The waste rock stockpiles contain a significant proportion of materials designated as leach cap (MA-1), but also contain other mineral types, which have a wide range of ABA characteristics. These materials have been exposed to weathering for variable periods of time since the inception of open pit development in 1967. The leach stockpiles consist of leachable ore, primarily from mineral types MA-3, -4, and -5, which generally have consistently negative ABAs (DBS&A 1997a and 1997b; SARB 1999).

Comparisons of data from newly mined materials with those of older stockpiled materials conducted as part of the Condition 80 *Supplemental Materials Characterization Study* showed that the materials properties are highly variable and that the variability of stockpile material properties is similar to that of the fresh mine materials. The sulfate content in the stockpiled materials was significantly higher than that of fresh mine materials owing to the effects of pyrite oxidation and the application of raffinate on the leach stockpiles. Sulfate is stored in the stockpiles in the form of jarosite and other sulfate minerals that occur in significantly greater abundances in the stockpile materials as compared to fresh mine materials.

The leach ore stockpiles appear to be more reactive and release higher concentrations of constituents than waste rock stockpiles.

The stockpile materials at Tyrone are geochemically stable with respect to silicate matrix mineral reaction with water, air and acidity. The levels of acidity produced in the stockpiles are relatively low and most paste pH results are 4 and above. These conditions do not result in pervasive weathering and leaching of the primary minerals at Tyrone. The geologic materials were subjected to hypogene and supergene alteration as part of the ore forming processes that occurred over the course of millions of years and significant alteration from their present state in the stockpiles will take very long periods of time.

Stockpile temperature and pore gas composition measurements were conducted for approximately one year as part of the *Supplemental Materials Characterization Study*. Borehole temperatures were elevated in sulfide rich zones due to the heat of reaction generated by sulfide oxidation. Oxygen concentrations measured within the stockpiles were generally sufficient to support pyrite oxidation. Pyrite oxidation appears to be occurring at a rate such that pyrite depletion in the stockpiles will occur over time.

Tailing Material Characteristics

The long-term geochemical behavior of Tyrone’s tailing impoundments has been evaluated using drill core and mineral assemblage data. The tailing impoundments contain stratified layers of sands to clays (slimes). The degree of saturation varies between layers, but the fine-grained layers appear to be generally wetter, which may inhibit oxygen flow, acid generation, and the rate of contaminant migration within the tailing impoundments. The tailing impoundments are composed of Group A mineral assemblage material, originally derived from high-grade sulfide ore. Gangue minerals dominate the mineralogy, but sulfides are also found throughout the tailing impoundments. Tailing layers near the surface are oxidized and generally acidic. The pH becomes near neutral to alkaline with depth. The tailing impoundments have an overall acid generation potential with limited acid neutralization potential.

Borrow Materials

The characteristics and suitability of the cover materials at Tyrone have been previously evaluated in the *Borrow Materials Investigation* (BMI) (DBS&A, 1997c), *Soil and Rock Suitability Assessment* (DBS&A, 1997a), *Preliminary Materials Characterization* (DBS&A, 1997a), *Supplemental Materials Characterization* (DBS&A, 1997b), *Little Rock Mine Cover Design Report and Test Plot Work Plan* (Golder, 2004a), *Copper Mountain Pit Expansion Leached Cap and Waste Rock Management Plan* (PDTI, 2005a), and *Leached Cap Analysis and Vegetation Summary* (Golder, 2005d). The most recent evaluation of the borrow materials at Tyrone was completed in 2005 as part of Condition 79 of DP-1341 and Condition L.5 of the Revision 01-1 to MMD Permit No. GR010RE (Golder 2005e, 2006a).

Potential cover materials identified at Tyrone include native soils, recent alluvium, residual Gila Conglomerate, Gila Conglomerate in the 5A Stockpile, and leach cap overburden from the Little Rock Mine and the Copper Mountain Pit. The Gila Conglomerate and associated soils and leach cap are the principal cover materials identified for use at the Tyrone Mine. The Gila Conglomerate Formation is a mid-Miocene and mid-Pleistocene continental deposit that is widespread in southern New Mexico and Arizona. The composition of the Gila Conglomerate Formation varies locally depending on the source area lithology at the time of stripping and deposition. The Gila Conglomerate in the mine area consists largely of igneous intrusive rocks originating from the ancestral Big Burro Mountains, while the Gila Conglomerate in the Mangas Valley reflects the influence of volcanic and meta-sedimentary rocks from the Little Burro Mountains.

Physically, the fine-earth fraction (i.e., <2mm) of the Gila Conglomerate and associated soils is dominantly moderately coarse-textured and mainly represented by loamy sand and sandy loam textures. Fine-, moderately fine- and coarse-textured soils occur locally. In general, the coarse textured soils are more prevalent in and around the mine area, and the somewhat finer textured soils tend to occur on the flanks of the Little Burro Mountains east of the tailing impoundments. The soils around Tyrone typically contain about 30 to 50 percent rock fragments (>2 mm diameter) by volume. Saturation percentages for the soils generally range from 18 to 75 percent.

Chemically, the Gila Conglomerate and associated soils have few inherent limitations. The pH of the soils range from about 5.0 to 7.8 and the salinity levels are low (0.2 to 3.8 dS/m). These materials are universally nonsodic and have favorable calcium to magnesium ratios. Soluble selenium and boron levels are low. The materials range from noncalcareous to calcareous and contain 0.5 to 9.2 percent calcium carbonate equivalent. The highest levels of $CaCO_3$ are found in the subsurface of the soils in the Mangas Valley.

In the Tyrone Mine Area, leached cap (MA-1) is altered igneous intrusive rock (hypogene mineralization) that generally has low copper values and is considered waste rock from a mining perspective. The chemical and physical characteristics of this leached cap make it potentially suitable for use as a cover material. Leached cap from the Copper Mountain Pit Expansion and Little Rock Mine Areas have been extensively characterized and were tentatively approved for use as cover in some portions of the mine

(PDTI, 2005a and Golder, 2005d). Besides the Copper Mountain and Little Rock Areas, leached cap occurs in the West Main and Valencia Pit Areas and on the Savanna Stockpile.

Overall, the materials from the Copper Mountain Area and Little Rock Mine are net-neutralizing and non acid generating. Laboratory analyses indicate that the overburden from the Copper Mountain and Little Rock Areas is relatively uniform and has few apparent limitations as a plant growth media when compared to the surrounding native soils. There are no apparent chemical limitations with respect to salinity in either the overburden or the native soils and the pH and extractable nitrate concentrations occur at similar levels in both materials. The overburden is moderately coarse textured and contains moderate volumes of rock fragments. The native soils exhibited similar characteristics and are moderately coarse textured with moderate amounts of rock fragments (PDTI, 2000 and 2005a). Thus, the overburden from the Copper Mountain and Little Rock Mine Areas is considered to be a reasonable soil substitute relative to the native soils in the area.

The cover requirement for the Mine/Stockpile Unit at Tyrone is approximately 15.5 million yd^3 based on the current permit requirements. More than 20.3 million yd^3 of Gila Conglomerate and leached cap cover materials have been conservatively identified in the Mine/Stockpile Unit (Golder, 2005a). Additional materials may be available from alternative leached cap sources and from the deposits of residual Gila Conglomerate. Thus, the total volume of cover materials designated for the Mine/Stockpile Unit is more than that needed to cover these facilities.

The Gila Conglomerate Formation is thick and extensively distributed around the tailing impoundments. Sufficient volumes of suitable cover materials have been identified at each of the tailing impoundments and are part of the detailed engineering processes associated with the reclamation of these facilities. The surplus of cover material in this area has ultimately allowed for flexibility in siting borrow areas at Tyrone to account for operational considerations.

2.5 Permits and Discharge Plans

Tyrone currently conducts its mining operations pursuant to numerous state and federal regulations covering ground water, surface water, air, solid and hazardous wastes. Table 2-2 lists the closure/close-out related permits held by Tyrone for current mining activities. Information regarding those permits is summarized in the following sections.

2.5.1 Mining Act Permit

To meet requirements of the NMMA, Tyrone obtained approval of its existing mining operation permit (GR010RE) from the MMD in July 1996.

2.5.2 National Pollutant Discharge Elimination System (NPDES) Permit

Tyrone is currently operating under NPDES permit NMR05A918. Additionally, Tyrone has developed a Spill Prevention Control and Countermeasure Plan (SPCC) (Souder Miller & Associates, 2005) for its oil storage facilities as required by the Clean Water Act and has also developed a Stormwater Pollution Prevention Plan (SWPPP) with Best Management Practices (BMPs) (PDTI, 2004c) in accordance with the requirements of the U.S. EPA, NPDES, Multi-Sector General Storm Water Permit (MSG-2000) for Sector G – Metal Mining (Ore Mining and Dressing) facilities. Both of these documents are on file at Tyrone, as required by applicable regulations.

2.5.3 Water Rights

Tyrone has water rights licenses under the New Mexico Office of the State Engineer (OSE), File Nos. GSF 02260 and 3020 and File Nos. M2680, M4978, M4979, and M4980.

2.5.4 Air Quality

In December 1995, Tyrone submitted a Title V air quality permit application to meet its initial requirement as defined by the State of New Mexico operating permits programs (AQCR 770 and 771) pursuant to Title V of the Clean Air Act and Title 40 Code of Federal Regulations (CFR) 70. NMED subsequently issued Operating Permit Number P147, which was last updated in August 2005 (NMED Air Quality Bureau [AQB], 2005a). This permit authorizes the operation of the open pit copper mine and associated process activities such as drilling, blasting, loading, hauling, and unloading of ore and overburden.

Tyrone applied for and received a Part 72 permit (Permit No. 2448) for modification and operation of the SX/EW plant in January 2001. Tyrone also applied for and received a Part 72 permit (Permit No. 2448A) for modification and operation of the Tyrone Power Plant in May 2002. Additionally, in September 2005, NMED issued NSR Air Quality Permit No. 2448B (NMED AQB, 2005b). This permit authorizes Tyrone to operate a 250 ton per hour portable screening plant which screens, and stockpiles aggregate material of varying sizes in support of the Mangas Valley Tailing Dam Reclamation Project.

2.5.5 Hazardous Waste

The Tyrone Mine is currently classified as a small-quantity hazardous waste generator under the Resource Conservation and Recovery Act (RCRA). Tyrone generates hazardous waste under EPA identification number NMD035806405 in compliance with the requirements for hazardous waste generators set forth in 40 CFR 262 and the applicable portions of 40 CFR 265.

2.5.6 Operational Discharge Plans

NMWQCC regulations require a DP for any discharge of effluent or leachate that has the potential to move directly or indirectly into ground water. Tyrone operates pursuant to nine operational DPs which are listed in Table 2-3 and shown on Figures 2-2 through 2-4. The facilities located within the Mangas Valley Tailing Unit were previously covered under operational DP-27. They are now covered under the DP-27 Settlement Agreement and Stipulated Final Order (NMED, 2003b), DP-1341 (NMED, 2003a), and Revision 01-1 to MMD Permit GR010RE (MMD, 2004). A description of the operational DP areas is provided below.

Mine/Stockpile Unit

The Mine/Stockpile Unit is the most complex administrative unit at the Tyrone Mine. Its system of mine pits, stockpile areas, and production and maintenance facilities make up the majority of Tyrone’s current operations. Eight of the nine operational DPs are located within this area and are described below.

DP-166: No. 2 Leach System, SX/EX Plant, Open Pits

The DP-166 area covers a large part of the Mine/Stockpile Unit and includes the Main, Valencia, San Salvador Hill, and Copper Mountain Pits; SX/EW Plant and associated facilities; lube shop area which includes the fuel dock, explosives storage building and prill tanks; No. 2 leach system, 4A leach, 4B leach, 4C leach, and 7C and 8C waste rock stockpiles; Copper Mountain leach stockpile; unlined PLS and storm water collection pond at the base of the Copper Mountain Pit, North Racket Sump; No. 2 gunite-lined PLS collection pond located south of the Main Pit; PLS collection wells 2L3 and 2L5; five Main Pit production wells; SX/EW PLS feed pond; miscellaneous pipelines, 5E seepage collection pond; and seepage interceptor trenches and collection ponds located in Deadman Canyon.

DP-286: No. 3 Leach System

DP-286 includes the 3A stockpile and leaching system; 3B waste rock stockpile; 5A (former 1D) waste rock and overburden stockpile; eleven concrete-lined surface PLS catchments located along the toe of the 3A stockpile, No. 3 HDPE-lined PLS Pond, No. 3 HDPE-lined PLS Overflow Pond, Plant Oxidation Pond Effluent (POPE) ponds, HDPE-lined SPCC Pond, reclaimed mill and concentrator site, Old Fuel Dock No. 1, regional aquifer collection systems, existing seepage interceptor/barrier trenches located around the perimeter of the 3 stockpile, and ancillary pipelines and pumps.

DP-363: 1A Leach System

DP-363 includes the 1A leach stockpile and leaching system, HDPE-lined 1A PLS Overflow Pond, clay-lined 1A Storm Water Pond, 1A stainless steel PLS tank, two gravity-flow seepage collection trenches, two interceptor/barrier seepage collection trenches, and seepage pumpback wells.

DP-383: 1B Leach System

DP-383 includes the 1B leach stockpile and leaching system, HDPE-lined 1B PLS Overflow Pond, 1B stainless steel PLS tank, PLS collection system and associated pumps and pipelines, two interceptor/barrier trenches and seepage pumpback wells.

DP-396: 1C Waste Rock Stockpile

DP-396 includes the 1C, 7A, and South Rim Pit waste rock stockpiles, three interceptor/barrier trenches and associated shallow toe collection systems located along the toe of the 1C stockpile, six shallow HDPE-lined seepage collection trenches located along the toe of the 7A stockpile, and associated pumps and pipelines. The 1C and 7A stockpiles have been partially reclaimed as described in Section 5.2.

DP-435: 2A and 2B Leach Systems, 2B Waste Rock Stockpile, and Proposed 9A Overburden Stockpile

DP-435 includes the 2A, 2B, and 2C leach stockpiles, 2B waste rock stockpile, proposed 9A overburden stockpile; 2A West and 2A East PLS collection stations, 2A West and No. 2 raffinate booster pump stations, HDPE-lined 2A East PLS Overflow Pond, HDPE-lined Seep 5E Discharge Pond, HDPE-lined 2A Surge Pond, McCain Spring and Deadman Canyon Springs (Seeps 6 and 31), and associated tanks, pumps, and piping.

DP-455: Gettysburg Pit and Leach System

DP-455 includes the Gettysburg Pit, 6C and 7B leach stockpiles, Gettysburg Pit Collection Pond, HDPE-lined 6C-2 PLS Collection Pond and booster station, HDPE-lined 7B PLS Collection Pond and booster station, and associated tanks, pumps, and piping.

DP-670: Savanna Pit and East Main Leach System

DP-670 includes the Savanna Pit, East Main (newly named 6B) leach stockpile, HDPE-lined East Main Booster Pond, HDPE-lined Savanna Sediment Collection Pond, Savanna North Sump, and associated pumps and piping.

East Mine Unit

Operational DP-896 is the only discharge permit associated with the East Mine Unit.

DP-896: No. 1 Leach Stockpile

DP-896 includes the No. 1 leach stockpile, B Sump (former No. 1 PLS Pond), acid-unloading facility at the former precipitation plant, five seepage collection/barrier trenches and five gravity-fed shallow toe collection systems located along the toe of the No. 1 stockpile, newly constructed fiberglass above-ground storage tank (AST) and HDPE-lined Overflow Pond and associated booster station, pumps and piping.

2.5.7 Other Permits

Tyrone possesses an explosives permit from the federal Bureau of Alcohol, Tobacco and Firearms for blasting at the mine site.

3.0 TECHNICAL CONSIDERATIONS FOR RECLAMATION

The following sections describe the technical considerations for closure at Tyrone. These considerations include materials characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with facilities in the Mangas Valley Tailing Unit, Mine/Stockpile Unit, and East Mine Unit.

3.1 Mangas Valley Tailing Unit

The facilities located within the Mangas Valley Tailing Unit are regulated under the DP-27 Settlement Agreement and Stipulated Final Order (NMED, 2003b) and include the following:

- The 1 Series tailing impoundments (1, 1A, and 1X) currently under reclamation; the 1 and 1A tailing impoundments are scheduled to be completed by April 2008; and the 1X tailing impoundment is scheduled to be completed by December 2008;

- No. 2 tailing impoundment currently under reclamation and scheduled to be completed by the end of 2007;

- Nos. 3, and 3X tailing impoundments that are fully reclaimed;

- Mangas Valley tailing repositories that are fully reclaimed with the exception of two repositories located on USFS lands, which are expected to be reclaimed by April 2008 (pending USFS approvals); and

- Tailing launder and associated pipelines which have been removed/buried.

The primary facilities to be closed in the Mangas Valley Tailing Unit, located northwest of the open pit portion of the mine, include the 1 Series tailing impoundments, USFS North-1 and USFS South-1 tailing repositories, various storm water catchments, and tailing lauder corridor. As previously noted, a substantial amount of reclamation work has been conducted within the Mangas Valley Tailing Unit. Reclamation of the tailing impoundments and tailing repositories began in 2004 with the initial grading of the 3X tailing impoundment and closure of the tailing repositories. Reclamation of the 3X tailing impoundment was completed in 2006. Grading, cover placement, and seeding have been completed at the No. 2 and 3 tailing impoundments. Construction of the final downdrain at the No. 2 tailing impoundment will be completed by the end of 2007. Grading and cover placement are under way at the 1 Series tailing impoundments, which are expected to be completed in 2008. Reclamation of the No. 1 and 1A tailing impoundments will be completed by April 2008 and the 1X tailing impoundment will be regraded by this time. The USFS North-1 and USFS South-1 tailing repositories, and the tailing launder corridor are expected to be fully reclaimed by April 2008. Additionally, the majority of the storm water catchments located within the Mangas Valley Tailing Unit have been reclaimed (see Table 2-1). The general setting of the Mangas Valley Tailing Unit is shown on Plate 2. The following sections identify the facilities, material characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with the Mangas Valley Tailing Unit.

3.1.1 Material Characteristics

The Tyrone tailing impoundments are located on the flanks of the Little Burro and Big Burro Mountains in the Mangas Valley. The six tailing impoundments received tailing from the concentrator from 1969 through early 1992, when the concentrator was shut down. Tailing deposition records indicate that, in general, the 1, 2, and 3 tailing impoundments were used during the early period of mining (late 1960s through the end of the 1970s), and that the 1, 1A, 1X, 2, and 3X impoundments were used throughout the 1980s until mill closure in 1992. Since then, these facilities have been slowly draining and consolidating.

The tailing is acid generating and the principal sulfide mineral in the tailing is pyrite, although chalcopyrite and trace copper sulfides such as digenite, covellite and bornite may also occur. Nonsulfide copper minerals include copper sulfate minerals and possibly copper carbonates. Gangue minerals (quartz, magnetite, muscovite or sericite, chlorite/clays and potassium feldspar) make up the largest fraction of the tailing solids. The tailing was originally deposited in the impoundments as an alkaline slurry. Once the residual alkalinity in the tailing is consumed, the pH falls and the electrical conductivity (EC) rises. The degree to which the pyrite oxidizes appears to be a function of the moisture contents as it affects oxygen ingress in the near-surface tailing, and the relative age of the impoundment. The higher moisture contents of the slimes and silts relative to the sands, and the interlayered nature of the tailing, appear to limit the movement of oxygen into the deeper parts of the impoundments.

The upstream construction method was used for most of the Tyrone Mine tailing impoundments. The stratigraphy of the tailing impoundments is complex on a small scale, but is relatively straight-forward on a large scale. The cycloning of tailing slurry resulted in coarser materials dropping out near the embankments, while finer grained materials were transported toward the interior of the impoundments. Variations in the volume of the decant ponds, changes in the location of embankment discharge points, and variations in slurry flow paths created layers of coarser textured sands interspersed with layers of finer textured slimes. As the impoundments rose in height, the sand embankments were progressively constructed inboard of the original embankment (i.e., towards the decant ponds). Consequently, a vertical boring from the top of the final sand embankment to the base of the tailing would encounter coarse materials on top and finer materials near the base. Thick sequences of tailing overlie Gila Conglomerate, with an intervening thin veneer of alluvium that occurs primarily at low points in drainage channels now buried by tailing. The relatively low permeability of the basal interior slimes limits the rate of drainage from the impoundments. Because the majority of the drainage is controlled by the inherently low permeability of the basal slimes, covering the surface of the tailing impoundments is expected to have minimal impact on drainage, except for some areas on the sand embankments.

3.1.2 Site-Specific Hydrologic Conditions

Surface Water

The primary drainage within the Mangas Valley Tailing Unit is the Mangas Wash. Mangas Wash and its tributaries within the Mangas Valley Tailing Unit are ephemeral and flow only in response to significant precipitation events.

Ground Water

Regional ground water in the area occurs within the Tertiary Gila Conglomerate and, along the major axis of the Mangas Valley, in the Quaternary alluvium. Within the Mangas Valley area, ground water flow is focused toward the axis of the valley and ultimately travels northwest down the valley toward the Gila-San Francisco Underground Basin. The depth to ground water generally ranges from approximately 40 feet to nearly 90 feet bgs.

The background water quality for ground water in the alluvium appears to be calcium-bicarbonate type water with a TDS concentration of approximately 200 to 300 mg/L. For the ground water in the Gila Conglomerate, the background water quality is also a calcium-bicarbonate type but with slightly lower TDS concentrations.

3.1.3 Known and Potential Impacts

The facilities located within the Mangas Valley Tailing Unit have the potential to affect water, air, or soil and sediment. Potential constituents of concern that may be released to the environment by the Mangas Valley facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, ground water, air, and soil or sediment are outlined in the following sections.

Surface Water

Available surface water quality information indicates that surface water is not a significant source of existing or potential ground water contamination (DBS&A, 2003b). There are seven surface water sampling points maintained along the lower portion of Mangas Wash between the No. 2 and No. 3 tailing impoundments. Mangas Wash is ephemeral and, as a result, water quality data are limited to periods when water is actually flowing in the drainage. Dissolved constituents in surface water generally have concentrations that meet NMWQCC standards. However, elevated concentrations of sulfate, TDS, copper, and cadmium have been observed periodically at flow samplers 1, 2, and 4 (Plate 2).

Ground Water

Ground water in the Mangas Valley Tailing Unit generally meets the numerical standards of 20.6.2.3103 NMAC. Water quality data from Mangas Valley show very limited impacts in the area and the impacts that are observed may be the result of past or current tailing seepage, or may be naturally occurring due to the proximity of these wells to the Mangas Fault and uplifted igneous rocks east of the fault. Water samples collected from several wells installed in the Gila Conglomerate near the base of the No. 2 tailing impoundment and in the Quaternary alluvium along Mangas Valley below the 1X and 2 tailing impoundments are characterized by elevated sulfate and TDS concentrations. In some cases the water samples indicate the water slightly exceeds the NMWQCC ground water quality standards.

Air

No known air quality impacts have occurred in the Mangas Valley Tailing Unit area. Potential impacts to air quality are from wind blown particulate matter from the 1 Series tailing impoundments prior to cover placement on the facilities. Reclamation of the 1 Series tailing impoundments will be completed by the end of 2008.

Soil and Sediment

Tailing mapping conducted as part of the Condition 85 Tailing Transport and Deposition Impacts Investigation (Golder, 2006c) revealed that wind and water transported tailing was limited in extent and restricted primarily to the perimeter of the tailing impoundments. The wind blown tailing, including some water deposited materials, occupied about 150 acres around the perimeter of the tailing impoundments, which cumulatively cover more than 2,300 acres. These deposits were relatively thin and in many cases occurred upstream of the existing sediment containment systems. The relatively thin accumulations of tailing are not expected to impact ground water given the depth of ground water (40 to > 80 feet) in this area and attenuation capacity of the soils. The tailing deposition areas are being remediated in conjunction with the closure of the tailing impoundments.

An additional investigation of the tailing launder corridor will be conducted in 2007 in accordance with the Tailing Launder Reclamation Work Plan (Golder, 2006f). As part of this investigation, surficial tailing deposits along the corridor will be identified and an abatement plan will be developed. Surficial tailing deposits will be remediated according to the abatement plan. No other known impacts to soils and sediment have occurred in the Mangas Valley Tailing Unit.

3.2 Mine/Stockpile Unit

The facilities located within the Mine/Stockpile Unit are regulated under eight operational DPs, including:

- DP-166: No. 2 Leach System, SX/EW Plant, Open Pits;
- DP-286: No. 3 Leach System, No. 3B Waste Rock Stockpile, No. 5A Overburden Stockpile;
- DP-363: No. 1A Leach System;
- DP-383: No. 1B Leach System;
- DP-396: Nos. 1C, 7A, and South Rim Pit Waste Rock Stockpiles;
- DP-435: No. 2A and 2B Leach Systems, and 2B and 9A Waste Rock Stockpiles;
- DP-455: Gettysburg Pit and Leach System, Nos. 6C and 7B Leach Stockpiles; and
- DP-670: Savanna Pit and East Main Leach System.

The primary facilities to be closed and/or maintained in the Mine/Stockpile Unit include: 1) the 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B (former East Main), 6C (former Gettysburg In Pit), 7B (former Gettysburg Out Pit), and Copper Mountain leach stockpiles; 2) the 1C, 2B Waste, 3B, 5A (overburden) 7A, 7C, 8C, proposed 9A, and portions of the Savanna stockpiles; 3) Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna, and San Salvador Hill pits; 4) SX/EW Plant and associated facilities; 5) main mine facilities; 6) lube shop area which includes the fuel dock, explosives storage building and prill tanks; 5) various lined and unlined surface impoundments; 6) various seepage and PLS collection/interceptor systems; 7) various tanks; 8) regional and perched ground water extraction systems, and; 9) booster pump stations.

The general setting of the Mine/Stockpile Unit is shown on Plate 3. The following sections identify the facilities, material characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with the Mine/Stockpile Unit.

3.2.1 Material Characteristics

The Mine/Stockpile Unit contains four primary materials to be characterized, leach grade ore, waste rock, and PLS and raffinate solutions. The low grade ore and waste rock are hydrothermally altered intrusive igneous rocks, which have varying capacities to generate acidity. The leaching process may change the chemical conditions encountered in the stockpiles (Section 2.4.7). PLS and raffinate are characterized as a low-pH solutions containing elevated levels of metals, TDS, and sulfate. Other materials used in the PLS processing operation at the SX/EW Plant include kerosene-like organic reagents, electrolyte solutions, and sulfuric acid.

3.2.2 Site-Specific Hydrologic Conditions

Surface Water

Surface water within the Mine/Stockpile Unit flows in the five main ephemeral drainages in response to infrequent, intense rainfall events that occur primarily in the summer months. The drainages include: Deadman Canyon on the west side; Brick Kiln Gulch on the east side; Mangas Wash and Niagara Gulch on the north side; and Oak Grove Wash on the south side. Intermittent surface water also occurs at various springs, including: McCain Spring, Deadman Canyon Springs (Seeps 6 and 31), Spring 1 (TWS-7) and Seep 5 in the Deadman Canyon area; and TWS-7, a regional aquifer spring situated upgradient of all mine-related facilities. The surface water quality ranges from a relatively low-TDS, calcium-bicarbonate-sulfate type at TWS-7 to higher-TDS, calcium-sulfate type water at Seep 5.

Ground Water

Regional ground water in the Mine/Stockpile Unit occurs primarily within the igneous rocks (Tertiary quartz monzonite and Precambrian granite), and to a lesser extent within the Tertiary Gila Conglomerate. The depth to ground water below the area ranges from the ground surface at the bottom of the Main Pit to approximately 600 feet bgs on the down-thrown side of the Sprouse Copeland Fault southeast of the

Mine/Stockpile Unit. Flow in the regional aquifer is generally toward the open pits located in the central portion of the Mine/Stockpile Unit where pumping at the pits has created cones of depression. Local and regional geologic structures also exert significant influence on the flow of regional ground water in the area. For example, water level discontinuities on the order of several hundred feet are observed across both the West Main and Burro Chief Faults. The TDS concentrations in the regional aquifer generally range between approximately 200 and 5,000 mg/L.

Regional ground water beneath the southern portion of the Mine/Stockpile Unit generally flows to the north toward the open pits. East of the Sprouse-Copeland Fault, which runs along the eastern edge of DP-396, ground water occurs at greater depths (up to 600 feet bgs). Ground water east of the Sprouse-Copeland Fault does not appear to be intercepted by the open pits and likely flows eastward toward the Mimbres Valley Underground Basin. Regional water quality analyses from wells in the area indicate that regional ground water ranges from sodium-calcium-bicarbonate type to calcium-sulfate type.

Regional flow in the northwestern portion of the Mine/Stockpile Unit is east-northeast from the Big Burro Mountains towards the SX/EW plant. Regional ground water beneath the SX/EW plant eventually flows to the Main Pit, potentially aided by the Burro Chief Shaft and associated underground workings that breached the Burro Chief Fault (DBS&A, 2007). Regional ground water in the northeastern portion of the Mine/Stockpile Unit (near the No. 3A leach stockpile) occurs within the Gila Conglomerate and, to a lesser extent, in the intrusive igneous rocks. To the northeast of the No. 3A stockpile (beneath Mangas Wash), regional ground water intercepts Quaternary alluvium. A ground water divide located near the No. 3 PLS ponds controls the flow of regional ground water beneath the stockpile. Water east of the divide flows southeast toward the Main Pit and water west of the divide flows northwest into the Mangas Valley and Gila-San Francisco Underground Basin or into a regional aquifer collection system from which it is subsequently pumped to the No. 3 PLS holding pond. Water samples collected from monitor wells located to the west of the No. 3A stockpile provide representative background water quality for regional ground water in the Gila Conglomerate. These waters are characterized as a calcium-bicarbonate type with low sulfate and TDS concentrations.

Perched water has been identified within alluvium-filled channels incised into the Gila Conglomerate or igneous bedrock below the 1A, 1B, 1C, 2A, 2B waste, 3A, 4C, 7A, and Copper Mountain stockpiles. The perched zone water quality has been impacted by mine solutions. Perched water within these alluvium-filled channels is collected by existing PLS collection systems and seepage collection and interceptor systems installed along the toes of the individual stockpiles. Additional perched water zones occur beneath the major drainages at the mine and flows are generally along the major axes of the drainages.

Perched zones occur beneath the Oak Grove Wash, Brick Kiln Gulch, and Deadman Canyon drainages. Perched water occurs at depths ranging from near surface along the stockpile toes to approximately 100 feet bgs beneath Oak Grove Wash. Water quality for the perched zones is predominantly calcium-sulfate type water.

3.2.3 Known and Potential Impacts

The Mine/Stockpile Unit includes a number of areas or operations with the potential to affect water, air, or soil and sediment. These include the leach and waste stockpiles, various surface impoundments and sumps, PLS and raffinate pipelines, and haul and access roads. Potential constituents of concern that may be released to the environment from these facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, ground water, air, and soil or sediment are outlined in the following sections.

Surface Water

Tyrone monitors a total of 8 seeps (Nos. 2, 3, 4, 5, 5E, 6, 8, and 1 [TWS7] under DP-166, Deadman Canyon Spring and McCain Spring are sampled under DP-435, and water from the open pits is also sampled regularly under existing DPs. Surface water in the Deadman Canyon area has been impacted by seeps from the 2A leach, 2B waste and Copper Mountain stockpiles and, possibly, by residual fluids from the former United States Natural Resource, Inc (USNR) precipitation plants. Seven seepage collection systems (seep collection systems 2, 3, 4, 5E, 8, 9, and DC2-1) and various source control measures have been implemented (i.e., removal of the USNR leach stockpile, a precipitation plant and an associated pond, and a portion of the 2A leach stockpile material) in the Deadman Canyon area to limit surface water impacts in the area.

Storm water runoff from the 3A stockpile is directed to the PLS catchments through a series of engineered berms and ultimately flows to the PLS ponds. PLS flow from the 3A stockpile is collected in the engineered surface catchments and from there is directed through HDPE pipe to the PLS holding pond. Storm water runoff from the 1A stockpile is collected in a series of engineered berms and ultimately flows to a clay lined storm water pond just north of the PLS holding tank. PLS flow from the stockpile is collected in five catchments from which it is directed through HDPE pipe to the PLS holding tank. Berms and storm water collection ponds control storm water runoff from the remaining stockpiles located in the Mine/Stockpile Unit. Various storm water and process solution releases have occurred in the Mine/Stockpile Unit that were reported under their associated operational DPs and/or NPDES Permit

NMR05A918. Any corrective actions taken were reported to the appropriate agencies (e.g., NMED, EPA).

Ground Water

Saturated conditions exist within a number of perched zones adjacent to leach stockpiles and upgradient of PLS collection facilities. These saturated conditions are an intrinsic component of the mine-for-leach operation conducted at the Tyrone Mine Facility, and the saturating fluid is PLS, which exceeds numerous WQCC ground water quality standards. In three areas of the Mine/Stockpile Unit, impacted perched water quality has been observed downgradient of PLS collections systems. These areas are the toe of the 3A leach stockpile, the Deadman Canyon area, and the Oak Grove Wash/Brick Kiln Gulch area.

Perched zones at the 3A leach stockpile consist of narrow north- to northeast-oriented natural drainage channels that contain unconsolidated alluvial sediments and extend outward from the base of the stockpile. Investigations at the stockpile have identified perched PLS seepage in 10 of the 11 existing drainage channels or “canyons.” To reduce the effects of PLS seepage on ground water quality, a series of seepage interceptor/barrier collection systems have been installed in several of the canyons. Relatively small amounts of perched water not removed by the containment systems eventually migrates to regional ground water, which is captured by regional pumping wells in the area.

Perched water occurs in the shallow alluvium and colluvium in Deadman Canyon and its eastern tributaries that generally exceeds ground water quality standards due to mining operations conducted by either PDTI or USNR. The lateral extent of the perched water within the canyon seems to be primarily climate driven (i.e., the perched zone is deeper and wider during wet periods and thinner and narrower during dry periods). The majority of water that flows through the alluvium to the north rises to the surface in the vicinity of the entrance to the Deadman Canyon narrows (DBS&A, 2006c). The seven seepage collection systems and source control measures implemented in the Deadman Canyon area are designed to capture and remove the vast majority of perched seepage and prevent and abate potential impacts to ground water in accordance with discharge permit requirements and 20.6.2.1203 NMAC.

Impacted seepage originating from the 1A and 1B leach stockpiles and impacted seepage originating from the 1C waste rock pile have created perched zones of poor water quality beneath the upper reaches of Oak Grove Wash along the southeastern boundary of the Mine/Stockpile Unit. Impacted perched water mixed with native water exists in Upper Oak Grove Wash and extends approximately 0.25 mile from the toe of the 1A leach stockpile. Abatement activities conducted under DP-363 and DP-383 were initiated in January 1999, and have reduced the extent of impacted perched water, especially in Upper Oak Grove Wash, where seepage interceptor/barrier collection systems have been installed within the wash, at the bases of the 1A and 1B leach stockpiles, and at the 1C waste rock pile. The seepage interceptor/barrier collection systems are designed to capture and remove the vast majority of perched seepage and prevent and abate potential impacts to ground water in accordance with discharge permit requirements and 20.6.2.1203 NMAC.

Two incidents of ground water contamination by diesel fuel have occurred within the Mine/Stockpile Unit. The first incident occurred in 1994 in Canyon 1 of the 3A leach stockpile. An investigation showed that diesel fuel impacts in Canyon 1 were limited to the perched zone and that the diesel fuel had not migrated to regional ground water (DBS&A, 1994). To remove the diesel fuel and avoid further impacts, Tyrone began pumping from existing and new perched zone wells in Canyon 1. The pumping system was effective at removing the diesel fuel as well as de-watering the perched zone. Several wells in Canyon 1 are still equipped with functioning pumps; however, due to limited amounts of perched seepage in this canyon there is insufficient water for extraction. Canyon 1 wells are monitored quarterly under DP-286. The second incident occurred in 1997 near the Tyrone Power Plant. In August 1997, diesel oil was found in regional aquifer monitor wells 32 and 33, located north and northeast of the mill, respectively. Results of a follow-on field investigation identified the source of the diesel fuel as a leak from a storage tank pipeline and showed that the diesel fuel migrated principally in a perched alluvial channel that trends west-northwest of the tank farm located immediately south of the Tyrone Power Plant (DBS&A, 1999b). Additional characterization of the 1997 diesel fuel spill is being addressed under Condition 34 of DP-1341 (DBS&A, 2006d).

Water quality data reported routinely under the operational DPs show that various exceedances of WQCC standards have been observed in regional monitoring wells located within the Mine/Stockpile Unit. Leach solutions and seepage from incident precipitation has impacted regional ground water beneath limited portions of the Mine/Stockpile Unit. Because the majority of the area is covered by stockpiles and all the open pits lie within the OPCZ, much of the impacted ground water associated with stockpiles and pits in the Mine/Stockpile Unit area reports to the open pits, which are periodically dewatered for mining purposes. These pits are proposed to continue to be dewatered in this CCP.

Air

No known air quality impacts have occurred in the Mine/Stockpile Unit area. Potential impacts to air quality are from wind blown particulate matter from the leach and waste rock stockpiles and pit walls. When the mine is in operation, the wetting of access roads and haulage roads reduces dust generated from vehicular traffic. When leaching is in operation, the wetting of stockpiles with raffinate likely reduces particulate emissions. All operations at Tyrone are conducted within the requirements of the various air quality permits associated with the mine (see Section 2.5.4).

Soil and Sediment

There is the potential that soil and sediment in the storm water impoundments and process water ponds have been affected by PLS or storm water runoff that is collected. Soils and sediment within the Deadman Canyon area may also be impacted by seepage. Miscellaneous spills and releases of process solutions have also occurred from various tanks and pipelines in the Mine/Stockpile Unit. These releases have been reported to the NMED under their associated operation DPs. Corrective actions have been conducted on the releases and reported under their associated operational DPs

3.3 East Mine Unit

The facilities located within the East Mine Unit are regulated under operation DP-896. The primary facilities to be closed and/or maintained in the East Mine Unit include the No. 1 leach stockpile, B Sump (former No. 1 PLS Pond), and the acid-unloading facility at the former precipitation plant. The general setting of the East Mine Unit is shown on Plate 3. The following sections identify the facilities, material characteristics, site-specific hydrologic conditions, and the known and potential impacts to the environment associated with the East Mine Unit.

3.3.1 Material Characteristics

The East Mine Unit contains three primary materials to be characterized, leach grade ore, mill tailings, and leach solutions. The leach solutions are characterized as a low-pH solution containing elevated levels of metals, TDS, and sulfate. Raffinate is no longer applied to the No. 1 Stockpile.

The No. 1 stockpile consists of leachable ore materials, primarily from Group A material types MA-3, -4, and -5, and these materials are acidic and consistently have negative ABAs (DBS&A 1997a and 1997b; SARB, 1999). The reclaimed Burro Mountain tailing impoundment is comprised of tailing capable of producing acidity. Gangue minerals dominate the mineralogy, but sulfides are also found throughout the tailing impoundment. Prior to reclamation, the tailing layers near the surface were oxidized and generally acidic.

3.3.2 Site-Specific Hydrologic Conditions

Surface Water

Surface water within the East Mine Unit occurs in the ephemeral Brick Kiln Gulch and Oak Grove Wash drainages in response to infrequent, intense rainfall events that occur primarily in the summer months. No seeps are known to occur in the area.

Ground Water

Regional ground water in the area occurs within the Gila Conglomerate and intrusive igneous rocks. The Mangas Fault traverses the East Mine Unit and controls the regional ground water flow near the No. 1 stockpile. The depth to regional ground water ranges from less than 400 feet in the northwestern portion of the area to more than 700 feet southeast of the No. 1 stockpile on the up-thrown side of the Mangas Fault at monitor well 896-2005-01. On the downthrown side of the fault, the depth to regional ground water is approximately 600 feet in the southern portion of the area near monitor well MB-33. In general, flow in the regional aquifer is to the southeast. The TDS concentration in regional ground water in the East Mine Unit ranges between approximately 130 and 1,000 mg/L.

Perched water has been identified within five alluvium-filled channels incised into the Gila Conglomerate below the No. 1 stockpile. The perched zone water quality has been impacted by acid rock drainage from the stockpile. Perched water within these alluvium-filled channels is collected by five shallow toe collection systems and five deep seepage collection/cutoff trenches located near the toe of the stockpile. Impacted water intercepted in the seepage collection/cutoff systems is transferred to a fiberglass AST through HDPE pipelines. The collected seepage water is then transferred to the 1B PLS tank where the water is put back into the mine process water circuit. An additional perched water zone occurs beneath Brick Kiln Gulch/Oak Grove Wash; water within this zone generally flows in a direction coincident with the major axis of the drainage. Perched water occurs at depths ranging from near surface along the stockpile toe to approximately 70 feet bgs beneath Oak Grove Wash.

3.3.3 Known and Potential Impacts

The facilities located within the East Mine Unit have the potential to affect water, air, or soil and sediment. Potential constituents of concern that may be released to the environment by the East Mine Unit facilities include metals, sulfate, TDS, low-pH solutions, and hydrocarbon compounds. Known and potential releases of these constituents to surface water, water, air, and soil or sediment are outlined in the following sections.

Surface Water

In December 1997, approximately 1,000,000 gallons of PLS flowed as surface water for 4.5 miles along Brick Kiln Gulch and lower Oak Grove Wash from a process water line that ruptured just east of State Highway 90. Corrective actions undertaken by PDTI included the removal of PLS and affected soils and sediments. Additionally, various storm water discharges have occurred from the No. 1 stockpile and the Acid-Unloading facility that were reported under DP-896 and/or NPDES Permit NMR05A918. Any corrective actions taken were reported to the appropriate agencies (e.g., NMED, EPA). Constructed earthen berms and storm water control ponds (including the former No. 1 PLS Pond) currently control storm water runoff from the No. 1 stockpile.

Ground Water

Impacted perched water quality occurs beneath Brick Kiln Gulch and Oak Grove Wash. In this area, a zone of impacted water mixed with natural water currently extends approximately 2 miles downgradient from the No. 1 stockpile. Abatement activities have been successful in reducing the perched zone extent, which was approximately 3.4 miles in 1996, and stopping the continued migration of impacted water down Lower Oak Grove Wash. New seepage collection systems were installed along the toe of the No. 1 stockpile in 2006 in preparation of regrading activities on the stockpile. These systems are currently operational and are an effective means of capturing impacted waters within the alluvial channels that emanate from underneath the No. 1 stockpile. Impacted perched water is also pumped from three extraction well transects located downgradient of the confluence of Oak Grove Wash and Brick Kiln Gulch.

Monitor well MB-33, located on the south side of the Mangas Fault and southeast of the No. 1 stockpile, displays decreasing water quality trends as indicated by increasing sulfate and TDS concentrations from 150 to 593 mg/L and 466 to 1,040 mg/L, respectively. Regional water quality data from wells located east of No. 1 stockpile show concentrations of various constituents above NMWQCC ground water standards.

Well MB-34 exceeds WQCC ground water standards for iron, manganese, sulfate, and TDS. Well 896-2005-01 exceeds WQCC standards for fluoride, iron, and manganese. Results of the recently completed Condition 82 Supplemental Ground Water Study (DBS&A, 2007), indicated that the zone of saturation sampled by well MB-34 is most likely a perched zone of water above the regional aquifer.

Air

There are no known air quality impacts in the East Mine Unit area. Potential impacts to air quality are from wind blown particulate matter from the stockpile. When the mine is in operation, the wetting of access roads and haulage roads reduces dust generated from vehicular traffic. The stockpile is currently being reclaimed.

Soil and Sediment

Approximately 16,600 cubic yards of impacted soils were removed from the former C Sump pond and the area was reclaimed (covered and seeded) in 2006. An additional approximate 44,400 cubic yards of impacted material was also removed from two tributary drainages located east/southeast of the No. 1 stockpile in 2006 as part of the No. 1 stockpile reclamation project. Additional impacted sediments are present within the former No. 1 PLS Pond. The current reclamation plan for the No. 1 PLS Pond calls for the removal of 6 feet of material from the existing base of the pond, placement of clean common fill within the pond footprint, and cover placement and revegetation of the area.

Evidence of potential soil impacts associated with past operations in the Brick Kiln Gulch watershed was identified during a recent site reconnaissance. Soil staining and areas devoid of vegetation are the primary evidence that soils may have been impacted. The soils are being investigated in accordance with the Sampling and Analysis Plan for Soils and Sediment – Brick Kiln Gulch (PDTI, 2006b). Impacted soils identified as part of this investigation will be remediated as part of the ongoing No. 1 stockpile reclamation project.

4.0 POST-MINING LAND USE DESIGNATION

This section provides the post-mining land use (PMLU) for the permit area as a whole and for specific facilities at Tyrone based upon the requirements of the MMD Permit, NMMA Section 69-36-11.6, and Subparts 507.A and 507.B of the NMMA Rules (MMD, 1996). PMLUs are specified in Section 3.G. of the MMD Permit.

4.1 Post-Mining Land Use Overview

The NMMA Rules define the PMLU as "a beneficial use or multiple uses which will be established on a permit area after completion of a mining project. The PMLU may involve active management of the land. The use shall be selected by the owner of the land and approved by the Director (of MMD). The uses, which may be approved as PMLUs, may include agriculture, commercial or ecological uses that would ensure compliance with Federal, State or local laws, regulations and standards and which are feasible." The proposed PMLUs for each facility are presented in Figure 4-1 and were selected on the basis of the site characteristics and the following guidelines:

- Make the PMLU compatible with the surrounding ecosystem and land use;
- Use the existing infrastructure and land resources to the extent possible; and
- Maintain economic viability for Tyrone and the surrounding community.

The approved PMLUs for Tyrone are wildlife habitat and industrial in accordance with MMD Permit Conditions D.4, E.4, and I.1 (MMD, 2004). Tyrone was granted a conditional waiver from the MMD from achieving a post mine land use or self sustaining ecosystem (SSE) for the Main, Gettysburg, Savanna, and Copper Mountain Pits (MMD, 2004). The approved waiver areas are identified in Figure 4-1 and in the MMD Permit. Additionally, as part of this CCP, Tyrone has identified additional areas within the interior portion of the Mine/Stockpile Unit that will be requested for a waiver from achieving a PMLU or SSE (Figure 4-2). These additional areas include: 1) approximately 105 acres associated with additional mining around the Main and Copper Mountain Pits; 2) approximately 121 acres of pit wall area (comprised primarily of stockpile material at the hard rock/stockpile interface) that was inadvertently omitted from the previous waiver; 3) approximately 62 acres of future expansion of the eastern portion of the Main Pit associated with mining the residual Gila Conglomerate borrow source for cover; and 4) approximately 490 acres of stockpiles and disturbed areas adjacent to the open pits where surface water cannot feasibly flow out to the perimeter of the Mine/Stockpile Unit due to existing topographic constraints. Because surface water from these areas will not drain to the exterior of the mine without a substantial amount of regrading, runoff from these areas will be commingled with pit water, collected with the existing pit sump collections systems, and incorporated into the proposed water treatment influent circuit for treatment. Preliminary results of the Feasibility Study indicate that covering and regrading of this area is not supported from a cost-benefit perspective. Tyrone intends to provide more detail on the rational and justification for this additional waiver area pending agency review and comment on this CCP.

Wildlife habitat is the primary PMLU for the majority of the permit area, with an industrial PMLU designated for the Main Mine Facilities Area, including the SX/EW Plant Area, and several of the remaining buildings located within the Mill and Concentrator Area. The selection of the wildlife habitat PMLU is discussed in Section 4.2. Section 4.3 presents the rationale Tyrone used for designating an industrial PMLU for some of the facilities and provides details regarding the efforts to achieve the PMLU. Section 4.4 details the vegetation success guidelines that will be applied to demonstrate reclamation of the mine.

4.2 Wildlife Habitat Post-mining Land Use

Of the MMD-approved PMLUs, grazing land and wildlife habitat are the designations most consistent with the surrounding land uses and ecological potential of the Tyrone site, excluding the areas designated as industrial/commercial. Tyrone proposed the wildlife PMLU as a practical target use for the reclaimed lands at the site.

Reclamation will result in the development of an early-stage grass/shrub community that will provide a locally important increase in community-level diversity. Some infrastructure may have a post-mining wildlife use such as power poles for raptor perches, main roads for land management, and modified mine openings for use by ringtail cats, bats, and other wildlife.

Native vegetation will be established on the reclaimed areas at Tyrone resulting in increased erosion protection, direct habitat improvement, and reduced percolation of water into the underlying materials relative to current conditions. Proposed reclamation seed mixes and seeding rates for Tyrone are presented in Table 4-1. These species have broad ecological amplitudes and provide structural diversity.

The proposed seed mix was selected to provide early establishment of ground cover, erosion control, and diversity in growth forms. The species selected for Tyrone have been successfully used in mine reclamation and range improvement projects in many parts of New Mexico, including the Tyrone Mine.

The primary reclamation seed mix proposed for the wildlife habitat PMLU areas at Tyrone includes cool and warm season grasses, perennial shrubs, and forbs. Depending on availability, alternate species may be substituted for the primary species. The seed mix was designed for application prior to the summer rains. However, it has proved successful under fall seeding conditions.

Table 4-2 lists some of the major attributes of the vegetation selected for use at the Tyrone Mine. The selected vegetation will provide erosion control, promote soil development, and provide forage, seeds, and cover for small mammals and birds. The seed mix includes a number of valuable, nutritious forage and browse species that could be used by wildlife.

4.3 Industrial Post-Mining Land Use

The industrial PMLU designation of buildings and facilities are summarized in Table 4-3. This table includes buildings and facilities approved for industrial PMLU in the MMD Permit (listed in Appendix F of the MMD Permit), with the exception of certain buildings that have since been removed as part of the mill and concentrator demolition and reclamation project. NMED requires abatement of contaminated soils that are potential source areas for ground water and surface water contamination in accordance with NMAC Sections 20.6.2.1203, 20.6.2.3109.E.1, and 20.6.2.4103 in and around all facilities and structures approved by MMD to be left for an industrial PMLU or structures necessary for post-closure treatment and disposal of ground water and/or surface water. Those facilities not designated for industrial PMLU will be removed or demolished. Demolition, removal, and/or burial will be accomplished by the following:

1. Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are not included in the industrial PMLU, abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 24 inches minimum:

2. Covered footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations not included in the industrial PMLU will be revegetated in accordance with Appendix C of the MMD Permit: and

3. A structural removal plan will be submitted to the NMED at least 60 days prior to any structure removal or demolition; the plan will address any potential discharges of leachate and contaminated soils that could cause and exceedance of ground water standards.

The industrial PMLU will continue the existing type of use; however, the specific industry will change. The areas proposed for industrial PMLU have the infrastructure necessary to support a variety of future industrial uses. The buildings are currently being used and are well maintained and most of the areas have significant shop facilities and warehouse storage capacity. All the sites have access to a major state highway (Highway 90), and two of the areas have railroad access. Electrical power is available in each area. Storm water runoff from the areas is contained within the on-site surface impoundment system. Finally, ample water rights are available due to the water rights that Tyrone controls.

Tyrone will maintain erosion controls, structures, equipment, and utilities within the industrial PMLU areas until they are occupied by tenants. Tyrone proposes to cover and reseed non-paved areas within the industrial PMLU areas after mine closure. The areas identified for the industrial PMLU are currently used for industrial purposes such as warehousing, heavy equipment repairs, electrical distribution and repairs, welding, machining, plumbing, and training. Although the industrial PMLU will continue the existing type of use, the specific industry will change. Possible industrial uses that may be recruited were described in previous justifications for the industrial PMLU for these sites.

4.4 Site-Specific Revegetation Success Guidelines

Section 507.A of the NMMA rules (MMD, 1996) requires that the permit area of an existing mine be reclaimed to a condition that allows the establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding area unless it conflicts with the approved PMLU. Demonstration of the establishment of a self-sustaining ecosystem is made by comparison of the vegetation on the reclaimed areas to vegetation attributes on a reference area and/or technical standards (MMD, 1996).

The MMD recognizes that replication of the pre-mining plant communities after mining is not practical (MMD, 1996). The intent of the reference area characterization is to provide a site-specific, quantitative basis for determining revegetation success. More importantly, the reference area provides an “ecological barometer” that integrates normal climatic variations to aid in the evaluation of temporal changes or trends in the reclaimed ecosystem. Thus, the reference areas do not represent model plant communities that will be replicated in detail, but rather local indications of the ecological potential of the reclaimed plant communities.

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. A detailed description of the vegetation success guidelines is included in DBS&A (1999a). The approved guidelines for revegetation success that apply to Tyrone are discussed in sections 4.4.1 through 4.4.3.

4.4.1 Canopy Cover

Because of its broad implications for erosion control and ecologically based PMLUs, canopy cover is one of the primary criteria for determining reclamation success. Tyrone has a proportional success guideline for total canopy cover equal to 70 percent of the measured reference area value. The proportional standard was determined based on the interpretation of the community structure and ecological conditions in the reference area. The proportional standard reflects the view that the typical 12-year bond release period does not allow enough time for full maturation of the reclaimed plant community relative to the native sites. The numerical standard derived from the proportional standard will vary over time to account for temporal differences in canopy cover associated with climatic variations. Thus, the numerical standard may increase or decrease based on reference area measurements, but the proportional standard will remain fixed.

4.4.2 Shrub Density

Shrubs are important components of many reclaimed landscapes. A proportional success guideline of 60 percent (of the reference area) has been accepted by the MMD for shrub density in the reclaimed areas. As with canopy cover, the shrub density standard was determined based on the interpretation of the ecological conditions of the reference areas.

4.4.3 Plant Diversity

Species diversity is commonly thought to increase the stability of plant communities. The perceived enhancement of ecological stability is related to the buffering effect that species with different ecological amplitudes provide in response to environmental stresses. A technical, rather than proportional, standard will be proposed for plant diversity.

The plant diversity guidelines for Tyrone are based on the assumption that site stability is improved by establishing plants with different ecological amplitudes to buffer seasonal and annual fluctuations in climate. Tyrone understands that creating a monoculture on the reclaimed lands is not desirable, while at the same time, recognizing that the benefits of increased diversity diminish beyond subjective threshold levels that are defined by the reclamation objectives. Thus, the diversity guideline for Tyrone was developed from a functional perspective, whereby site stability and erosion control are primary performance objectives. In addition, these guidelines were developed in recognition of the limitations associated with the sampling and statistical evaluation of plant communities whereby minor components are often not represented in the monitoring data.

The numerical diversity guidelines for Tyrone mines are listed in Table 4-4. To summarize, the diversity guideline would be met if the reclaimed area contains at least three warm season grasses and two shrubs, with individual cover levels of at least 1 percent, and one perennial, cool season grass with a minimum cover level of 0.5 percent. For the purposes of this guideline, intermediate-season grasses such as plains lovegrass are considered the functional equivalent of the more traditionally defined cool season grasses. In addition, one non-weedy forb species should occur at a minimum cover level of at least 0.1 percent to meet the proposed diversity guideline. The forb guideline is unqualified with respect to seasonality and could include a perennial, biannual, or annual species.

Species diversity on the reclaimed areas is expected to increase with time; however, this process is likely to be slow. Successful colonization depends on the convergence of a seed source and the proper weather conditions; however, even with such an ideal convergence, inter-specific competition, predation, and dispersion mechanisms may limit the establishment of new plants on the reclaimed area. Because of the strong climatic influence on seed production and plant establishment, the rate of colonization is expected to be erratic and potentially slow for many species, with the highest rates of colonization expected to be concentrated in the reclaimed/undisturbed ecotone. Evidence of colonization will complement the numerical diversity guidelines listed in Table 4-4. No numerical guideline is proposed for colonization, which would be demonstrated by increases in the number of species recognized in the reclaimed area. Information on colonization will be collected and reported to provide evidence of the ability of the reclaimed landscape to support native plants from the surrounding communities. Secondarily, observations of colonization provide evidence of regeneration and thus help demonstrate the establishment of a self-sustaining ecosystem required in the NMMA.

The intent of the colonization standard is to provide evidence of the ability of the reclaimed landscape to support plants from the surrounding communities. In addition, observations of colonization provide evidence of regeneration and thus support the demonstration of the establishment of a self-sustaining ecosystem. No numerical standard is proposed for colonization, which will instead be demonstrated by increases in the number of species recognized in the reclaimed area. This information will be obtained from the relative cover data or documented observations along the margins of the reclaimed areas.

5.0 SCOPE AND STATUS OF CONDITIONAL STUDIES AND ONGOING RECLAMATION PROJECTS

Additional studies, reports, and plans were specified in the MMD Permit (MMD, 2004), in the Supplemental Discharge Permit for Closure DP-1341 (NMED, 2003a), and in the DP-27 Settlement Agreement (NMED, 2003b) to establish the CCP for the Tyrone Mine. In several of the cases, the required work plans for the additional studies and plans in the two permits and the DP-27 Settlement Agreement have been coordinated and integrated into single documents. The studies and plans themselves have also been integrated to meet the requirements of the permits and the DP-27 Settlement Agreement. Table 5-1 outlines the association between the conditions in the two permits and the DP-27 Settlement Agreement. A brief description of the status of the conditional studies and plans are included in the Section 5.1 along with summaries of the results as applicable. Section 5.2 provides a description of ongoing and completed reclamation projects at Tyrone.

5.1 Status of Conditional Studies and Plans

The following sections summarize the status and primary results of the conditional studies and plans specified in the MMD Permit (MMD, 2004), DP-1341 (NMED, 2003a), and in the DP-27 Settlement Agreement (NMED, 2003b). Table 5-2 provides a summary of the work plans and reports submitted in association with the conditional studies and plans. The most current versions of the studies are included in Adobe Acrobat portable document format in Appendix E. If at the time this plan is published a study has not been completed for a particular condition, then the work plan is included for reference.

5.1.1. Schedule and Work Plan for Closure of Shafts and Adits

To fulfill the requirements of Condition 29 of DP-1341 and Section 9.I.7 of the MMD Permit, Tyrone is required to *"…submit a schedule to identify all existing mining shafts and adits within the Tyrone Mine Facility."* A closure/closeout plan is also required to be submitted for the shafts, adits, and other underground mine openings 180 days prior to closure activities. A mining shafts and adits identification schedule was submitted by PDTI in October 2003 detailing the individual tasks and associated schedule needed to complete the identification of the shafts and adits within the Tyrone Mine Permit Area (PDTI, 2003h). An updated map of all known shafts and adits within the Tyrone Mine Facility was submitted by PDTI in August 2004 (PDTI, 2004g). The map and associated deliverable indicate that open pit mining has resulted in the mining out of nearly all the historic workings within the Tyrone Mine facility. The remaining underground workings include: 1) the Boone and Oquawka Group consisting of approximately

3,136 linear feet of remaining drifts and 290 vertical feet of remaining shafts; 2) the Burro Chief Group consisting of approximately 4,035 linear feet of remaining drifts and 260 vertical feet of remaining shafts; and 3) the Mohawk, Niagara Access Tunnel, 10 Stope, and 17 Stope Group consisting of approximately 9,169 linear feet of remaining drifts and 445 vertical feet of remaining shafts. Little or no safe access remains to these underground workings for closure purposes since they have been mined out or covered by existing facilities.

5.1.2. Abatement Plan(s)

To fulfill the requirements of Condition 34 of DP-1341, Tyrone is required to *"… submit an abatement plan or plans, including a schedule to investigate all surface water and ground water contamination at the Tyrone Mine Facility."* The original Stage I Abatement Plan for the Tyrone Mine Facility was submitted in July 2003 (PTDI, 2003b) and an addendum Stage I Abatement Plan Proposal, which addressed Agency comments on the original plan, was submitted in December 2006 (DBS&A, 2006c). The two plans present a proposed site investigation for the Tyrone Mine that adequately defines site conditions and provides the necessary data to select and design an effective abatement option. For the purpose of the plan, the Tyrone Mine Facility was divided into three study areas – Mangas Valley, Mine/Stockpile, and Oak Grove Wash/Brick Kiln Gulch. These areas were selected based on known areas of ground water and surface water contamination, potential sources of contamination, similarities in hydrologic features, and similarities in mine facilities. A site investigation work plan to assess the ground water surface water contamination in each of the three study areas was also included in the Stage I Abatement Plan Proposal along with a proposed schedule for completion of plan. The Stage I Abatement Plan is closely integrated with the supplemental materials characterization study, revised seepage investigation, and supplemental ground water study. A significant amount of field work and drilling was completed as part of the plan comment and approval process. The results of these studies and associated field investigations are currently being incorporated into the abatement plan.

5.1.3. Closure & Post Closure Surface Water Sampling Plan

To fulfill the requirements of Condition 48 of DP-1341, a closure and post closure surface water sampling plan for the Tyrone Mine was prepared and submitted by PDTI. The original Closure and Post Closure Surface Water Sampling Plan was submitted in September 2003 (PDTI, 2003e) and subsequently revised in October 2003 (PDTI, 2003f). The plan identifies 10 drainages to be sampled quarterly in accordance with the protocols established for the Storm Water Pollution Prevention Plan (SWPPP) for the Tyrone Mine. Additionally, the surface water sampling plan specifies semi-annual sampling of all surface impoundments that will remain in place for closure and post-closure storm water control. The water quality parameters to be analyzed and the reporting frequency are also provided in the plan.

5.1.4. Contingency and Emergency Response Plans

To fulfill of the requirements of Conditions 70 and 73 of DP-1341, Tyrone is required to "*…submit to NMED for approval a contingency plan to address the reasonably foreseeable failure of any component of the closure plan…*", and "*…submit to NMED for approval an Emergency Response Plan that identifies operational parameters and provides contingencies for operational failures associated with water management at the Open Pits, the Leach Ore Stockpiles and Waste Rock Piles, process water, collection impoundments, sumps or any other type of impoundment that contains water that may be harmful or toxic."* The original Contingency Plan and Emergency Response Plan was submitted in December 2003 (PDTI, 2003l) and subsequently revised in April 2004 (PDTI, 2004b). The contingency plan presents details for addressing potential failures of individual components of the Tyrone Mine closure plan, including an increase in the extent or magnitude of ground water and/or surface water contamination, potential failures associated with interceptor systems and impoundments, and potential failures of various components of closed lands. The emergency response plan outlines operational parameters and contingencies to address operation failures at Tyrone associated with pumping water from the open pits, sumps, and other impoundments that may contain affected water.

5.1.5. Conditional Studies Schedule

To fulfill the requirements of Condition 74 of DP-1341, PDTI submitted a Work Plan and Conditional Study Schedule. The original schedule was submitted in May 2003 (PDTI, 2003a) and subsequently revised in October 2003 (PDTI, 2003i). The schedules provide proposed submittal dates for the work plans associated with the conditional studies as well as the estimated completion dates for the conditional studies. The Work Plan and Conditional Study Schedule were approved by the NMED on February 20, 2004 (NMED, 2004b).

5.1.6. Comprehensive Cover Performance Evaluation

To fulfill of the requirements of Condition 75 of DP-1341, Section 9.L.1(a) of the MMD Permit, and Paragraphs 29, 31, and 32 of the DP-27 Settlement Agreement, Tyrone is required to "*…perform a comprehensive cover performance evaluation. The purpose of the comprehensive cover performance evaluation is to evaluate the type and thickness of the proposed cover materials and to further characterize the physical and hydraulic properties of the proposed cover materials for the Leach Ore*

Stockpiles and Waste Rock Piles." The MMD Permit and DP-27 Settlement Agreement specify the comprehensive cover performance evaluation (CCPE) for the Mangas Valley tailing impoundments as well as the leach ore and waste stockpiles. The CCPE Work Plan was submitted in December 2003 (PDTI, 2003k) detailing the proposed scope of work and schedule for the CCPE for the stockpiles and tailing impoundments at the Tyrone Mine.

The Comprehensive Cover Performance Evaluation – Stockpiles and Tailing Impoundments Report was submitted in January 2005 (Golder, 2005a). The primary emphasis of the report was to validate the input parameters that had been used in the water-balance models for the Tyrone Mine. Thus, information was collected on the physical and hydraulic characteristics of the cover materials (Gila Conglomerate and associated soils, and leached cap materials), and leaf area indices and root distributions of the native plants within the reference areas at Tyrone. Long-term average drainage below the proposed covers at Tyrone was evaluated using the using the UNSAT-H soil water and heat flux model (Fayer, 2000). Three cover depths were evaluated using UNSAT-H for the waste rock piles and leach ore stockpiles (60, 90, and 120 cm) and four cover depths (45, 60, 90, and 120 cm) were evaluated for the tailing impoundments to compare long-term drainage through the covers. These simulations also incorporated revisions to the input parameters based on the additional data obtained as part of the CCPE. The UNSAT-H simulation results indicated that the average annual drainage for the 100-year simulation period was less than 1 percent of mean annual precipitation (MAP) for all cover scenarios. This suggests that a 60 cm cover composed of similarly textured Gila Conglomerate could meet the goal of limiting average drainage to less than 1% of the MAP.

5.1.7 Cover, Erosion, and Revegetation Test Plot Study

To fulfill of the requirements of Condition 76 of DP-1341, Section 9.L.1(a,b,d) of the MMD Permit, and Paragraphs 29 and 30 of the DP-27 Settlement Agreement, Tyrone is required to *"...perform a cover, erosion and revegetation test plot study for the Leach Ore Stockpiles and Waste Rock Piles. The purpose of the study is to evaluate, at a minimum: net infiltration through the store and release cover with differing cover thicknesses; feasibility of construction and construction techniques required during cover placement; erosion rates; vegetation success; and the potential upward migration of acidic solutions from the Waste Rock Piles and Leach Ore Stockpiles"*. The MMD Permit and DP-27 Settlement Agreement specify the test plot study for the Mangas Valley tailing impoundments as well as the leach ore and waste stockpiles. In December of 2003, PDTI submitted two work plans for Cover, Erosion, and Revegetation Test Plot (CERTP) Studies for the Tyrone Mine. One was for the stockpiles (Tetra Tech, 2003a) and the other one was for the tailing impoundments (Tetra Tech, 2003b). In September 2006, PDTI submitted the

As-Built-Cover, Erosion, and Revegetation Test Plot Study for the Tailing Test Plots and the Stockpiles (Golder, 2006b and 2006g). These reports detail the as-built designs of the test plots at the No. 1 stockpile and No. 3 and 3X tailing impoundments, the associated materials testing of the waste and cover materials, instrumentation calibration results, and schedules for future work on the test plots. These as-builts were conditionally approved by the NMED and MMD (NMED and MMD 2006a).

The first Annual Reports for the stockpiles and tailing impoundment test plots were submitted in January 2007 (Golder, 2007a and 2007b). The annual reports present the status of the test plots, as well as responses to MMD and NMED comments regarding the As-Built-Cover, Erosion, and Revegetation Test Plot Study – Tailing Test Plots (Golder, 2006g). Because data acquisition is on-going, no substantive results were available. However, the report included, in addition to the status of the test plots, outstanding issues and a schedule for completion of additional work, as well as recommendations for improving the test plot program.

5.1.8 Tailing Cover Effectiveness Study

To fulfill of the requirements of Condition 77 of DP-1341, Tyrone is required to *"…submit to NMED for approval a work plan including an implementation schedule for determining the effectiveness of the cover system for the Tailing Impoundments following cover placement"*. The work plan, at a minimum, shall address revegetation success, erosion, potential upward migration of contaminants into the cover and infiltration." The requirements of this condition are being fulfilled under deliverables submitted for Condition 75.

5.1.9 Supplemental Stability Study

To fulfill the requirements of Condition 78 of DP-1341 and Section 9.L.2 of the MMD Permit, additional studies were performed to supplement previous analyses of the stability of the stockpiles at Tyrone. In accordance with Condition 78, Tyrone is required to *"…evaluate the long-term physical stability of Waste Rock Piles and Leach Ore Stockpiles after closure. The study shall include an evaluation of the recently reported data for materials interior to the stockpiles and whether additional data collection is warranted to evaluate long-term stability."* A slope stability work plan was submitted in December 2003 (Golder, 2003), detailing the proposed scope of work and schedule for the study. Individual slope stability analysis reports were submitted for the No. 1 stockpile in February 2006 (Golder, 2006b), the Nos. 1C and 7A stockpiles in May 2006 (Golder, 2006d), the Nos. 1A and 1B stockpiles in July 2006 (Golder 2006e), the

Nos. 2A/2B and 3A stockpiles in April 2007 (Golder, 2007c), and for the No. 4C and interior stockpiles in May 2007 (Golder, 2007d and Golder, 2007e).

The results of the analyses indicate that the past performance of the Tyrone stockpiles has been good and there have been no major slope movements. The stockpile foundation conditions were assessed from consideration of the mapped geology, previous geotechnical investigations, available drill-hole data, and through a program of surface mapping conducted during the stability studies. The stability analyses indicated that the stockpiles will be stable in their post-reclamation configurations. The factors of safety for stockpiles in a regraded configuration are high and these would not be expected to experience instability in the long term. Evaluations of the potential impacts of long-term weathering indicate that a very significant change in the physical character of the stockpile material would be required to reduce the shear strength to the degree that would be required to lead to potential slope instability. Reasonable predictions of strength reductions due to long term weathering do not indicate that the regraded stockpiles would become unstable.

5.1.10 Revised Borrow Source Material Investigation

To fulfill of the requirements of Condition 79 of DP-1341, Tyrone is required to *"…revise the borrow source materials investigation for the Leach Ore Stockpiles and the Waste Rock Piles. The investigation shall, at a minimum, identify all borrow source locations and the collection of an adequate number of samples to establish the relevant physical and chemical characteristics of the borrow material proposed to be used for cover."* Section 9.L.5 of the MMD Permit also details the requirements for the borrow materials investigation for the stockpiles and open pits. The Supplemental Borrow Materials Investigation Work Plan was submitted in March 2004 (Tetra Tech, 2004b) detailing the proposed scope of work and schedule for the investigation.

In October 2005, PDTI submitted the Preliminary Report for the Supplemental Borrow Source Materials Investigation for the Leach Ore and Waste Rock Stockpiles (Golder, 2005e). The borrow areas identified in this study represent potential borrow areas that could be used as cover sources. Two of the borrow areas are located on relatively undisturbed lands and Tyrone may select alternative sources once they are more definitively identified. For instance, substantial volumes of residual Gila Conglomerate underlie the 5A (former 1D) and Savanna stockpiles. These materials could become available if mining progresses into the east side of the Main Pit, or if Tyrone elects to excavate borrow materials in this area. Thus, the use of the pit wall Gila Conglomerate or additional materials from the 5A Stockpile may eliminate the need to excavate borrow outside the current disturbance area of the mine. In January 2006, PDTI submitted an addendum to the preliminary investigation (Golder, 2006a), which augmented the October 2005 report. Supplemental drilling on the 5A stockpile indicated that materials with mixed character (Gila Conglomerate, leached cap, and sulfides) may occur within the stockpile. The far southern end of the stockpile appears to be relatively free of mixed materials and suggests that additional volume could be recovered in this area. The addendum noted that because of the uncertainty of the exact distribution and character of the materials in the lower lifts of the 5A stockpile, Tyrone does not intend to modify the October 2005 estimates of the volume of cover materials at this time.

The results of the Supplemental Borrow Materials Investigation and Addendum to the investigation indicate that the cover requirement for the Mine/Stockpile Unit at Tyrone is approximately 15.5 million yd^3 based on the current permit requirements. More than 20.3 million yd^3 of Gila Conglomerate and leached cap cover materials have been conservatively identified at Tyrone. Additional materials may be available from alternative leached cap sources and from the deposits of residual Gila Conglomerate. Thus, the total volume of materials designated for the Mine/Stockpile Unit is more than that needed to cover these facilities. The surplus of cover material will ultimately allow for flexibility in siting borrow areas at Tyrone to account for operational considerations.

5.1.11 Supplemental Materials Characterization Study

To fulfill the requirements of Condition 80 of DP-1341 and Section 9.L.6 of the MMD Permit, additional studies were performed to supplement previous materials characterization studies at Tyrone. In accordance with Condition 80 and Section 9.L.6, Tyrone is required to *"…perform a supplemental materials characterization study of the Leach Ore Stockpiles and Waste Rock Piles located at the Tyrone Mine Facility. The evaluation shall include, but not be limited to, the collection of an adequate number of samples to establish the geotechnical and geochemical characteristics of each individual Leach Ore Stockpile or Waste Rock Pile as necessary to refine closure designs."* The Supplemental Materials Characterization Study Work Plan was submitted in October 2003 (Greystone, 2003) detailing the proposed scope of work and schedule for the investigation.

In October 2004, PDTI submitted the Supplemental Materials Characterization Study of the Leach Ore Stockpiles and Waste Rock Stockpiles - Interim Report (Greystone, 2004b). This interim report presents information collected during the Phase I investigations and proposed future characterization efforts to be presented in a future report. In December 2005, EnviroGroup prepared the Supplemental Materials Characterization of the Leached Ore Stockpiles and Waste Rock Stockpiles Final Report for DP-1341(EnviroGroup, 2005b). The results of the Supplemental Materials Characterization (SMC) Study indicated that the material properties of Tyrone stockpile materials of various ages are highly variable and that the variability of stockpile material properties is similar to that of the fresh mine materials at Tyrone. The sulfate content in the stockpile materials is significantly higher than that of fresh mine materials owing to the effects of pyrite oxidation. Sulfate is stored in the stockpiles in the form of jarosite and other sulfate minerals which occur in significantly greater abundances in the stockpile materials as compared to fresh mine materials. The leach ore stockpiles appear to be more reactive and release higher concentrations of constituents than waste rock stockpiles.

The SMC Study also indicated that the stockpile materials at Tyrone are geochemically stable with respect to silicate matrix mineral reaction with water, air and acidity. The levels of acidity produced in the stockpiles are relatively low and most paste pH results were 4 and above. These conditions do not result in pervasive weathering and leaching of the primary rock forming minerals at Tyrone. The materials have been subject to hypogene and supergene alteration as part of the ore forming processes that have occurred over the course of millions of years and significant alteration from their present state in the stockpiles will take very long periods of time. Stockpile temperature and pore gas composition monitoring was also conducted for approximately one year at the Tyrone Mine as part of the SMC. Borehole temperatures were elevated in sulfide rich zones due to the heat of reaction generated by sulfide oxidation, and oxygen concentrations measured within the stockpiles were generally sufficient to support pyrite oxidation. Pyrite oxidation appears to be occurring at a rate such that pyrite is partially depleted in the stockpiles as they age.

5.1.12 Revised Seepage Investigation Study

In fulfillment of Condition 81 of DP-1341, Tyrone conducted a revised seepage investigation of the leach ore and waste rock stockpiles. Condition 81 requires that Tyrone *"submit a revised seepage investigation report for the Leach Ore Stockpiles and Waste Rock Piles under closure conditions. The purpose of this investigation is to predict, at a minimum, the quantity and quality of seepage from individual Leach Ore Stockpiles and Waste Rock Piles and potential associated impacts to ground water and surface water following Cessation of Operation."* The Revised Seepage Investigation Study Work Plan was submitted in April 2004 (Greystone, 2004a) detailing the proposed scope of work and schedule for the investigation.

In 2005, EnviroGroup prepared the Revised Seepage Investigation of Leach Ore Stockpiles and Waste Rock Stockpiles Interim Report (EnviroGroup, 2005a). The report presented some of the preliminary data gathering results to be discussed in detail in the final report. It included a description of seepage flow monitoring that was being conducted to support the seepage flow modeling investigations, available seepage quality monitoring data, and calibration of the geochemical model.

In October 2006, DBS&A prepared the Final Revised Seepage Investigation Report (DBS&A, 2006a). Stockpile runoff and seepage monitoring results from the study show that these waters are characterized by low pH and high sulfate concentrations. The range in seepage pH was from less than 2 to greater than 7 and the range in seepage sulfate concentrations was from less than 10 to more than 42,000 mg/L. The concentrations of aluminum, copper, iron, manganese, and zinc could also be high in surface water and seepage samples. It should be noted that some of the seepage that was being monitored was natural seepage that emanates where the ground water table intersects the surface; not all of the seeps represented water that had for the most part passed through stockpiles. The mass loading modeling results indicated that sulfate and other constituent mass loading may be approximately an order of magnitude higher for the existing uncovered stockpiles than for the scenario where stockpiles are regraded and covered as currently required in DP-1341. The reduction in mass loading that may be achieved upon closure in this manner was attributed to a reduction in infiltration that was achieved with the cover. However, the difference between the uncovered and covered scenarios may not be significant, because the uncertainty in modeling complex systems such as these is greater than this order of magnitude result. In other words, the two closure scenarios performed similarly within the uncertainty of their ability to model these systems, although the results do indicate some benefit to constructing a cover system that reduces infiltration.

5.1.13 Supplemental Existing Ground Water Study

To fulfill of the requirements of Condition 82 of DP-1341, Tyrone is required to *"…perform a study to supplement existing ground water studies and evaluate the hydrologic conditions beneath the Tyrone Mine Facility. The study shall be designed to determine whether the proposed closure alternatives will achieve the requirements of the WQA and the WQCC regulations."* The Supplemental Ground Water and Hydrologic Conditions Study Work Plan was submitted in November 2003 (DBS&A, 2003b) detailing the proposed scope of work and schedule for the investigation. The results of the Supplemental Ground Water Study are presented in two reports, a status report submitted in October 2005 (DBS&A, 2005b), and a final report submitted in August 2007 (DBS&A, 2007). As part of the study, a total of 29 monitor wells and 2 soil borings were installed at the Tyrone Mine between April and July 2006. Water quality samples were collected from all newly installed monitor wells and aquifer tests were conducted in 9 of the newly installed wells to determine the hydraulic properties at various locations throughout the mine. The primary hydrogeologic units at the Tyrone Mine include the igneous rocks (primarily granite and quartz monzonite), Gila Conglomerate, and alluvium. The geometric mean of the hydraulic conductivity values determined from the new aquifer tests were similar to those determined during previous studies (DBS&A, 1997c). The geometric mean of the hydraulic conductivity values determined for igneous rocks and Gila Conglomerate were 1.3 feet/day (ft/d) and 7.1 ft/d (excluding one anomalously high value), respectively. It was noted that the bulk permeability of the igneous rock body is expected to be lower (in some cases substantially so) than that determined from aquifer testing given that the hydraulic conductivity determined from the wells is representative of fractures or fracture zones intercepted by a given well. No tests were conducted in the alluvial wells.

Analyses and interpretation of the newly collected hydrogeologic, water level, and water quality data relative to ground water occurrence, potential ground water flow paths, and identification of potential contaminant sources was conducted for the Mangas Valley area, No. 3 Stockpile area, northwestern Mine/Stockpile Unit, Deadman Canyon, and East Side and Gettysburg Pit area. A discussion of these results is presented in Section 3.2 of this CCP.

5.1.14 Supplemental Pit Lake Formation Model Study

To fulfill of the requirements of Condition 83 of DP-1341, Tyrone is required to *"…perform a study to supplement the existing Pit Lake Formation Model submitted January 22, 1999. The study shall address the comment letter from NMED regarding the Tyrone Mine Pit Lake Formation Study and Pit Lake Water Quality Modeling dated January 30, 2001"*. The Work Plan for Additional Ground Water Modeling Analysis to Supplement the Existing Tyrone Mine Pit Lake Formation Model was submitted in July 2005 (DBS&A, 2005b). The work plan details the proposed technical approach for the supplemental Pit Lake Formation model as well as a schedule for completion of the project. The final report for this study is anticipated to be submitted to the NMED on or before November 9, 2007.

5.1.15 Supplemental Tailing Spill Reclamation Evaluation

To fulfill the requirements of Condition 84 of DP-1341, an assessment of the No. 3 Tailing Pond reclaim area was performed to supplement previous investigations in the area. In accordance with Condition 84, Tyrone is required to *"submit to NMED for approval an evaluation of the reclamation activities conducted after the October 14, 1980 Tailings Spill at the No.3 Tailings Impoundment. The study shall be submitted as an update to the Assessment of No.3 Tailing Pond Reclaim Area submitted on June 28, 2001. The evaluation shall be designed to determine whether the reclamation previously performed achieves the requirements of the WQA and the WQCC regulations."* The Supplemental Assessment of the No. 3

Tailing Pond Reclaim Area Work Plan was submitted in February 2004 (Tetra Tech, 2004a) detailing the proposed scope of work and schedule for the investigation.

The Update to the 2001 Assessment of the No. 3 Tailing Pond Reclaim Area was submitted in April 2005 (Golder, 2005c). The assessment included an analysis of the vegetation performance of the repositories, a water quality assessment, and an analysis of the upward migration of acidity in the repository cover soils. The results of the vegetation performance indicated that there is no apparent relationship between vegetation cover and cover thickness for the repositories. In contrast, vegetation performance was found to be strongly related to the texture of the surface soil layer. Vegetation cover tended to be higher where coarse- and moderately coarse-textured soils occurred at the surface. Vegetation canopy cover on the repositories ranged from 15 to 30 percent, which is adequate to control erosion. Mean maximum leaf area index (LAI) measured on the repositories was 0.29, which provided adequate transpiration demand based on unsaturated flow water balance modeling. Localized erosion was noted on some repositories, where run-on from adjacent lands was uncontrolled.

The results of the assessment of the upward migration of acidity indicated that evidence for time-transgressive upward redistribution of constituents of sufficient magnitude to disrupt biological processes was not demonstrated and the changes in the chemistry of the cover soil were restricted to a relatively thin zone at the interface between the cover and underlying waste material. The mechanisms leading to acidification of the basal contact zone is difficult to determine with certainty, but probably include physical mixing of tailing during construction and/or a component of upward migration. Regardless of the mechanism, the degree and magnitude of change in chemistry in the cover soils were considered practically insignificant with respect plant growth and cover function.

Ground water quality data from monitor wells located within the Mangas Valley did not show any indications of impacts from the October 1980 tailing spill and associated reclaimed areas. The water quality data also indicated that individual constituent concentrations are relatively consistent in each of the wells. Time-series plots of pH, sulfate, and TDS concentrations in water samples collected from the wells over a 6 year period did not show any trends that may be indicative of impacts from the reclaim areas, and the concentrations of the individual constituents have remained relatively constant through time. Additionally, average pre-spill (i.e., before October 1980) concentrations of individual constituents calculated for Wells 13, 14, 15, and G indicated that the concentrations of individual constituents observed recently in these wells were consistent with those observed prior to the tailing spill, indicating that the October 1980 spill had no observable impact on ground water quality in the area. Analytical results from surface water samples collected downgradient of two of the tailing repositories did not show any indications of impacts from surface drainage off the areas.

5.1.16 Tailing Wind and Water Deposition Investigation

In fulfillment of Condition 85 of DP-1341, Tyrone is required to "*…perform a study to investigate the extent of deposition of tailings transported by wind or water off the Tailing Impoundments. The investigation shall address potential impacts to surface water, ground water and abatement and closure of areas containing the tailings.*" In April 2004, PDTI submitted the Final Investigation of Tailing Transport and Deposition Impacts Work Plan (Golder, 2004a) and in March 2006, the Tailing Transport and Disposition Impacts Investigation Report was completed (Golder, 2006c).

The investigation included an assessment of the extent and magnitude of wind and water deposited tailings from the Mangas Valley tailing impoundments. Tailing mapping conducted as part of the investigation revealed that wind blown and water transported tailing redistribution was limited in extent and restricted primarily to the perimeter of the tailing impoundments. The wind blown tailing, including water deposited materials, occupy about 150 acres around the perimeter of the tailing impoundments, which cumulatively cover more than 2,300 acres. These deposits are relatively thin and in many cases occur upstream of the sediment containment/catchment systems. The relatively thin accumulations of tailing were not expected to impact ground water given the depth of ground water in this area (40 to > 80 feet) and the attenuation capacity of the soils. It was recommended that Tyrone mitigate areas with the more extensive deposits of tailing as part of ongoing tailing reclamation activities. Removal of the tailing was recommended with minimal soil disturbance. The tailing deposition areas are being remediated in conjunction with the closure of the tailing impoundments.

5.1.17 Preliminary Sludge Handling Plan and Cost Estimate

To fulfill the requirements of Condition 86 of DP-1341 and Section 9.L.4 of the MMD Permit, a preliminary sludge handling plan and cost estimate was developed. In accordance with Condition 86, Tyrone is required to "*…develop a preliminary sludge handling plan and cost estimate. At a minimum, the plan shall address the locations and design of sludge management areas, volumes and tonnages of sludge, an operational plan, compliance with applicable waste management regulations (including chemical characterization of the sludge), and long-term sludge stabilization.*" In February 2004, PDTI submitted the Preliminary Sludge Handling Study Work Plan and Cost Estimate (Van Ripper Consulting, 2004a) which was followed in October by the Preliminary Sludge Handling Plan and Cost estimate (Van Riper et al., 2004b).

The focus of this plan was to quantify the amount of sludge that will be generated by the proposed Tyrone Water Treatment Plant, evaluate the quality of the sludge from a chemical and physical standpoint, and identify the most environmentally protective site for long-term sludge disposal. The plan includes a detailed review of site waters that would be collected and treated in the Tyrone Water Treatment System and a preliminary operational plan for the sludge management program when implemented following closure. The treatment system included an Evaporative Treatment System (ETS) and a nanofiltration/High-density Sludge (HDS) Plant. The amount of sludge generated by year was projected and the physical characteristics of the sludge were considered essentially the same as gypsum produced from the neutralization of sulfuric acid. Analogous data from a plant that produces the same type of sludge were used to project physical properties of the sludge, which differ only slightly from those presented to the State Agencies in the past.

In addition, a detailed screening analysis was conducted to identify potential sites for disposal of the sludge. The screening procedure focused on identifying the most environmentally acceptable sites, followed by a comparison of the capital and operating costs for the preferred sites. Two sites were identified as environmentally sound alternatives, the first being on a bench in the Main Pit and the second being on the 8C Stockpile in the Main Pit. Specific design of the sludge management facilities were presented, with associated capital and operating costs. Capital and operating costs were estimated for both of the identified preferred alternatives. In 2004 dollars, capital costs ranged from $1.651MM for the 8C stockpile site, to $2.149MM for the Main Pit bench. Operating costs ranged from $83,700 to $97,500 per year.

5.1.18 Surface Impoundment Study

In fulfillment of Condition 87, Tyrone is required to *"…submit to NMED for approval, a work plan and implementation schedule for a Surface Impoundment study. The study shall be designed to determine which of the existing Surface Impoundments will be needed during closure and post-closure for storm water retention or seepage interception and an implementation schedule for completion of reclamation."* In November 2006, PDTI submitted the Tyrone Mine Surface Impoundment Study Work Plan (DBS&A, 2006b). The work plan details the proposed scope of work, surface impoundment closure methodologies and design criteria, and an implementation and reporting schedule. A comprehensive list of the surface impoundments at the Tyrone Mine was also provided in the work plan. Three methods of closure were identified based on the type and location of the surface impoundments, including impoundments located within a facility footprint, impoundments located outside a facility footprint that are not a potential source of ground water contamination, and impoundments located outside a facility footprint that are a potential source of ground water contamination. The work plan recommended that closure plans be submitted in conjunction with the closure plans for the major facilities they are associated with during detailed closure design.

5.1.19 Process Solution Elimination Study

In fulfillment of Condition 88, Tyrone is required to "*…perform a process solution elimination study. The purpose of the study is to evaluate alternatives and identify environmentally sound and cost effective methods to treat or eliminate the process solutions following Cessation of Operation or closure at the Tyrone Mines Facility. Based upon the study results, Tyrone shall submit to NMED for approval a method for process water elimination.*" In July 2003, PDTI submitted a Process Solution Elimination Study Work Plan and Implementation Schedule (PDTI, 2003c), which was revised in October (PDTI, 2003g). In June 2004, PDTI submitted the Original Process Solution Elimination Study (M3, 2004c), which was further revised in March 2006 (M3, 2006a).

The process solution elimination study evaluated alternatives to identify environmentally sound and cost-effective methods to treat or eliminate the process solutions following the cessation of mining operations or closure of Tyrone. In the event of "Cessation of Operations" at Tyrone, process solutions, such as PLS, raffinate, and make-up water, and fluids in pipelines and impoundments will be drained, collected, and treated as the means to eliminate process solutions. The study evaluated two options for process solution elimination: a recirculation option and an existing evaporative system option. A total of 1.8 billion gallons of process water (1.1 billion gallons of leach solution in the process recirculation system and 0.7 billion gallons in the pits and ponds) would need to be eliminated. Alternative 1 is an evaporative system that would utilize forced evaporation to maximize the evaporation rate of water distributed at a maximum rate of 30,000 gallons per minute to the top surface of the 2A Leach Stockpile. With this alternative, evaporation would be accomplished though a spray system (forced evaporation) and evaporation from the surface of process reservoirs. Alternative 2 differed from Alternative 1 in that no forced evaporation would be implemented. Water would be pumped to the 2A Leach Stockpile where it would be distributed through a network of drip irrigation pipelines. Evaporation would occur from the wetted surface of the stockpile and from the process water reservoirs. Although both options rely on surface and spray evaporation as the mean to eliminate process water, the spray evaporative system was recommended as the preferred alternative because it would require the use of a smaller stockpile surface, has higher evaporation loss rates, and has an overall lower total cost.

5.1.20 Tyrone Mine Closure Feasibility Study

In fulfillment of Condition 89, Tyrone is required to "*…perform a feasibility study for closure of the Tyrone Mine Facility. The evaluation shall include a range of options for each alternative: for example, partial to full regrading of the Waste Rock Piles and Leach Ore Stockpiles. At a minimum, alternatives to be evaluated shall include: a) a no action scenario; b) relocation, regrading, cover placement, and revegetation; c) storm water collection; d) leachate collection; e) contaminated ground water collection and remediation; f) reclamation of the Open Pits, including complete and partial backfill and reclaiming the area backfilled within the pits; g) water treatment; and h) appropriate combinations of the foregoing.*" In July 2003, PDTI submitted the original Feasibility Study (FS) Work Plan and Implementation Schedule (PDTI, 2003d) which was further revised in February 2004 (DBS&A, 2004). Conditional Approval of the FS work plan by both NMED and MMD was received in August 2004 (NMED and MMD, 2004). Since this approval, quarterly reports have been routinely submitted as per the permit requirements. Revised soil water balance simulations were recently completed using the UNSAT-H model based on comments received by the NMED on various input parameters used in previous model runs. The results of these revised soil water balance estimates were presented in a technical memorandum to the NMED in May 2007 (Golder, 2007f).

The Tyrone Mine FS will be submitted following NMED review and comment on the May 2007 technical memorandum. The closure/closeout alternatives that are being addressed in the Tyrone Mine FS were delineated in consultation with staff from NMED and the MMD, and in consideration of the reclamation plan included herein. The alternatives range from a "minimal action" scenario to varying degrees of waste material relocation, regrading, cover placement and vegetation. All of the alternatives, including the minimal action scenario, are assumed to include the collection and treatment of storm water, leachate and contaminated ground water. A total of nine closure alternatives are being evaluated in the FS, including:

1. Minimal Action – Assumes no relocation, regrading or covering of the stockpiles. Impacted storm water, leachate and contaminated ground water are assumed to be collected and treated. Water entering the open pits is removed and treated to maintain the OPCZ.

2. DP-1341 Option – All stockpiles outslopes, with the exception of those inside the pit waiver area, are regraded to a 3:1 (horizontal:vertical) interbench slope except in areas with physical

constraints such as major drainages and Highway 90 that are regraded to a 2.5:1 angle. The San Salvador Hill and South Rim Pits are backfilled with waste rock to a point that allows for positive drainage of surface water to the perimeter of the mine following cover placement. The stockpile tops, regraded stockpile outslopes, and backfilled pits are covered with 90 cm (36 in) of cover material and revegetated. Impacted storm water, leachate and contaminated ground water are collected and treated.

3. DP-1341 Option with Thicker Cover – Identical to Alternative 2 except the stockpile cover thickness is increased to 120 cm (48 in).

4. DP-1341 Option with Thinner Cover – Identical to Alternative 2 except the stockpile cover thickness is reduced to 60 cm (24 in).

5. DP-1341 Cover Option with Partial Pit Backfill – Identical to Alternative 2 with partial backfilling of the Copper Mountain Pit (to above the water table) and complete backfilling of the smaller pits (San Salvador, Savanna, South Rim and Valencia pits).

6. DP-1341 Cover Option with Complete Backfill – All open pits are completely backfilled with stockpile material. Remaining stockpile outslopes are regraded to a 3:1 interbench slope. All stockpile and backfilled pit surfaces are covered with 90 cm of cover material and revegetated. Impacted storm water, leachate and contaminated ground water are assumed to be collected and treated.

7. Tyrone Proposed Plan - All stockpile outslopes, with the exception of those inside the surface water catchment zone (SWCZ), are regraded to 2.5:1 (horizontal:vertical) interbench slope. The stockpile tops within the SWCZ are not regraded or covered. The stockpile tops and regraded outslopes outside the SWCZ are covered with 60 cm (24 in) of cover material and revegetated. Impacted storm water, leachate and contaminated ground water are collected and treated.

8. Tyrone Proposed Plan with Thicker Cover – Identical to Alternative 7 except the stockpile cover thickness is increased to 90 cm (36 in).

9. DP-1341 Option with Thinner Cover and Steeper Outslopes – Identical to Alternative 2 except the cover thickness is reduced to 60 cm (24 in) and the outslopes are regraded to a 2.5:1 interbench slope.

The closure alternatives are being evaluated using a dynamic system model (DSM) that considers the combined environmental, operational, and economic effects of each alternative. Post-closure water quantity and water quality projections were completed for the proposed reclamation plan described herein (Alternative 7) to provide a basis for the water treatment capital and operation and maintenance (O&M) cost estimates associated with this CCP. Details on the DSM analysis and results are provided in Appendix D along with the water treatment capital and O&M cost estimate.

5.1.21 Industrial PMLU Building Inspection Certification

In fulfillment of Section 9.I.1 of the MMD Permit, Tyrone is required to *"…provide to MMD a building inspection certification signed by a professional engineer, that the buildings are in good condition, meet all applicable codes, are structurally sound, meet all zoning requirements, meet all local ordinances, and all utilities are operable."*, and *"…submit a general erosion control plan to be implemented at closeout for the area covered by the Industrial PMLU."* The original Industrial PMLU Inspection Report was submitted in January 2004 (M3, 2004a), and a second inspection report that included two facilities that were not included in the original inspection (Jerome Building and Diesel Tank Farm) was submitted in March 2004 (M3, 2004b). The results of these inspections indicated that the buildings and structures proposed for Industrial PMLU in the 2001 CCP were all in good condition. The inspection reports included the field inspection forms, photographic documentation of the facilities, and updated building and structure maps. An Industrial PMLU Erosion Control Plan was submitted in October 2004 (PDTI, 2004h) that described the erosion control measures to be implemented for the Industrial PMLU areas. The plan also provided erosion estimates of the Industrial PMLU areas.

5.1.22 Affected Areas Study

In fulfillment of Section 9.L.3 of the MMD Permit, Tyrone is required to *"…conduct a study to identify areas affected by mining."* The Affected Areas Study Work Plan was submitted in April 2005 (DBS&A, 2005a). The work plan describes the known and potential affected areas at the Tyrone Mine, as well as the conditional studies that will provide additional information on the nature and extent of the affected areas. The proposed investigation involves the evaluation of potential effects to land surface attributable to mining operations outside the MMD permit boundary that have not previously been evaluated in detail. The affected areas study will be completed within 240 days of MMD approval of work plan.

5.1.23 Wildlife Monitoring Plan

In fulfillment of Section 9.N.3 of the MMD Permit, Tyrone is required to *"…submit for MMD approval, a wildlife monitoring workplan, identifying sampling methodologies and a map with sampling locations by December 2005."* The Wildlife Monitoring Plan for Post Closure – Tyrone Mine was submitted in December 2005 (Golder, 2005f). The plan presents a description of the proposed mine reclamation plan as it applies to wildlife and wildlife habitat, an overview of the existing wildlife species and wildlife habitat near the Tyrone Mine, and the proposed methods for deer pellet group counts and bird diversity surveys. A map of the proposed wildlife monitoring units was also provided in the plan.

5.1.24 Elimination of Discharges to Tailing Impoundments Study

In fulfillment of Paragraph 18 of the DP-27 Settlement Agreement, Tyrone is required to *"…submit to the Department for approval one or more work plans to evaluate alternatives to eliminate the following discharges to the tailing impoundments: (1) mine dewatering water; (2) interceptor system water from the No. 1X Tailing Impoundment; (3) seepage collected from the Little Rock Mine; (4) sanitary effluent; and (5) municipal sewage sludge."*Additionally, Paragraph 19 requires that Tyrone *"…submit to the Department for approval an evaluation report for the elimination of each of the discharges listed in Paragraph 18 above"*. The original Discharge Elimination Work Plan, which covered all five of the discharges at Tyrone was submitted in January 2004 (PDTI, 2004a). Based on this plan and according to subsequent conversations with NMED, PDTI submitted five separate plans, one for each of the discharges. The results of these plans/analyses are presented in the following reports: *Analysis for Discharge Elimination of Municipal Sewage Sludge, Tailing Dam 3* (PDTI, 2004i); *Analysis for Discharge Elimination of Sanitary Effluent to Tailing Dam 2* (PDTI, 2004j); *Analysis for Discharge Elimination of Seepage Collected from the Little Rock Mine* (PDTI, 2005d); *Analysis for Discharge Elimination of Effluent Collected from the 1X Tailing Dam Interceptor Well System* (PDTI, 2005e); and *Analysis for Discharge Elimination of Mine Dewatering Water and Main Pit Interceptor Well Water* (PDTI, 2005f).

5.2 Description of Ongoing and Completed Reclamation Projects

As previously noted, a substantial amount of reclamation work has been conducted at the Tyrone Mine since the submittal of the 2001 CCP and subsequent issuance of DP-1341 and MMD Permit Revision 01-1 to Permit No. GR010RE. Reclamation activities have primarily been focused on the tailing impoundments in the Mangas Valley Tailing Unit, but a substantial amount of reclamation work has also occurred in the Mine/Stockpile and East Mine Units. The following sections describe the ongoing and completed reclamation activities that have occurred since the issuance of DP-1341 and MMD Permit Revision 01-1 to Permit No. GR010RE.

5.2.1 Reclamation Activities Within the Mangas Valley Tailing Unit

3X Tailing Impoundment

A Basic Engineering Report (BER) for the 3X tailing impoundment was submitted to NMED and MMD in June 2004 (M3, 2004d) prior to the initiation of reclamation activities at the site. Reclamation activities commenced at the 3X tailing impoundment during the first quarter of 2005 and included: outslope and top surface grading, construction of storm water diversions, top surface drainages, outslope drainage conveyances, and placement of suitable cover sub-base on both top and outslope surfaces. Rip-rap placement began on the top and outslope drainage conveyances. Starting in the fourth quarter of 2006, corrective actions were implemented on the primary storm water conveyance channel on the top surface of the 3X tailing impoundment. Reclamation of the 3X tailing impoundment was completed in the first quarter of 2007 and work on the Construction Quality Assurance Report (CQAR) is under way.

No. 3 Tailing Impoundment

A site-wide BER for the Nos. 3, 2, lA, 1 and 1X tailings impoundments was submitted in May 2005 (PDTI, 2005b/M3, 2005a), and regrading activities began on the No. 3 tailing impoundment shortly thereafter. During the second quarter of 2005, pumps and discharge lines were installed to dewater potential storm water collected on the No. 3 tailing impoundment surface to discharge to the 1X tailing impoundment for reclamation storm water management. In December 2005, PDTI submitted Amendments to the BER for the Top Surface Overland Flow Requirements for the Tyrone Mine's Tailing Impoundments 3, 2, lA, 1, and 1X (PDTI, 2005e). Cover placement, seeding and mulching activities began during the first quarter of 2006 and cover placement was completed during the fourth quarter of 2006. Reclamation of the No. 3 tailing impoundment was completed during the second quarter of 2007 and work on the CQAR is under way.

No. 2 Tailing Impoundment

During the second quarter of 2005, pumps and discharge lines were installed to dewater potential storm water collected on the No. 2 tailing impoundment surface and discharge to the 1X tailing impoundment for reclamation storm water management. Reclamation activities commenced at the No. 2 tailing impoundment during the second quarter of 2006 and included rough grading of the outslopes and the top surfaces. Grading of the tailing outslope and top surface were completed during the third and fourth quarters of 2006, respectively. During the first quarter 2007, all regrading activities were completed; placement of the top surface sub-base material was completed; seeding and mulching activities were initiated; and placement of the top 6 inches of cover material was initiated. As of September 2007, all cover has been placed on the top surface and outslopes, and the top surface and side slope channels have been completed. Construction of the two down drains on the impoundment has been initiated. Reclamation of the No. 2 tailing impoundment is projected to be completed by January 2008.

1 Series Tailing Impoundments

During the third quarter of 2005, detailed designs were completed for storm water management plans at the Nos. 1 and lA tailing impoundments, including a plan for moving surface water collected on the 1X tailing impoundment into the SX/EW plant makeup or raffinate system and during the next quarter, all outstanding plans to evaluate alternatives for elimination of discharges to the 1X tailing impoundment were submitted. Reclamation activities began in May 2006 with the construction of access roads and storm water controls on the tailing impoundments. In the fourth quarter of 2006, regrading of the No. 1A tailing impoundment outslope was initiated, and the construction access road was completed. During the first quarter of 2007, regrading activities along the crest perimeters of the Nos. 1 and 1X tailing impoundments and regrading of the 1A rock dam were completed. Also, placement of a limited thickness of Gila conglomerate was completed along the northwest side of the 1X tailing impoundment. In July 2007, the Final Construction Design Quality Assurance Plan (CDQAP) was submitted for Agency approval. As of September 2007, the 1A tailing impoundment top surface cover placement was approximately 95% complete, and the outslope subgrade cover placement was 100% complete; the No. 1 tailing impoundment top surface subgrade cover placement was 66% complete; and the 1X tailing impoundment top surface subgrade cover placement was 80% complete. Reclamation of the No. 1 and 1A tailing impoundments are projected to be completed by April 2008, and the 1X tailing impoundment is projected to be completed by December 2008.

Tailing Launder

Demolition and removal/burial of the tailing launder, which was constructed along the western flank of the Little Burro Mountains and extended approximately 5.3 miles from the thickening cells below the concentrator to the NE corner of the 3X tailing impoundment, was initiated in the fourth quarter of 2004. Demolition of the launder line south of the No. 2 tailing impoundment was conducted during the first quarter of 2005 and demolition and burial of the launder line and associated structures north of the Red Rock Diversion crossing was conducted during the 3X tailing impoundment reclamation activities in late 2004 and early 2005. The 30-inch Ameron pipeline was left in place in both the slot cut and cut/fill sections of the corridor. In the embankment sections, the Ameron pipe was completely removed and buried. The general approach to decommission the launder line was to demolish all concrete materials along the entire corridor and remove buried pipe and concrete materials from the embankment areas. The pipe and launder debris were then buried in repositories or trenches in the slot cut or combined cut/fill sections of the corridor and covered with minimum of 3 feet of Gila conglomerate.

Tailing Repositories

Reclamation activities associated with the tailing repositories began in the first quarter of 2004 with the reshaping of the Wind Canyon Mangas Valley tailing repository. Topographic surveys and soil boring investigations were conducted on all repositories during the second quarter of 2004. Additionally, during this quarter, reshaping and cover placement was completed on the Wind Canyon Mangas Valley, Laney Canyon, MV1, and Red Rock repositories. During the third quarter of 2004, the Wind Canyon, Mangas East, Laney Canyon, Red Rock, MS-10, and Main Deposit North repositories were revegetated, cover placement on the Main Deposit South repository was completed, and rip-rap began to be placed on sections of the repositories for erosion control. The repositories are all fenced at this time, and all repositories have been reclaimed with the exception of two repositories located on United States Forest Service lands. Reclamation of these two repositories are projected to be completed by April 2008.

5.2.2 Reclamation Activities Within the Mine/Stockpile Unit

Mill/Concentrator Reclamation Activities

The original Tyrone Mill Demolition Plan was submitted to the NMED and MMD in June 2004 (PDTI, 2004d), and demolition activities at the site began in August 2004. The BER for reclamation of the site was submitted to the NMED and MMD in January 2005 (Golder, 2005b). Grading and cover placement activities began during the second quarter of 2006 and were completed during the fourth quarter of 2006. Construction of the drainage channels were initiated upon completion of grading and cover placement at the site. Seeding and mulching of the site was completed during the first quarter of 2007. Reclamation of the Mill/Concentrator area was completed during the first quarter along with cover thickness quality control (QC) testing performed by the NMED. The as-built design set and CQAR are currently being developed and will submitted to the NMED and MMD upon completion.

1C Waste Stockpile

Removal of 1C stockpile material from Oak Grove Wash was initiated in March 2004. A Water Management Plan, Engineering Designs and a Contingency Plan for the Oak Grove Wash Restoration project were submitted in August 2004 (PDTI, 2004e). The original CDQAP for the Oak Grove Stockpiles (1C, 7A and 7A Far West stockpiles) was submitted in July 2006 (PDTI, 2006a), and on December 14, 2006, PDTI received from NMED and MMD conditional approval of the CDQAP (NMED and MMD, 2006b). Removal of the 1C stockpile material from Oak Grove Wash was completed during the first quarter of 2005. Construction of seepage collection and cutoff trenches within three ancestral drainages located along the toe of the 1C stockpile began in the second quarter of 2005, and they were operational by the end of the fourth quarter. During that same quarter, regrading and shaping of the ridge and valley outslope design was initiated. Regrading activities were completed during the first quarter of 2007 and placement of Copper Mountain Leach Cap cover material on the outslope began. During the second quarter of 2006 Gila Conglomerate from the 5A stockpile started to be loaded to the top of 1C stockpile for future placement on the stockpile outslope. Hauling and loading of Gila Conglomerate material from the 5A Stockpile was completed during the fourth quarter 2006. The placement of additional cover material on the outslope was completed in July 2007, and placement of rip-rap within the valley outslopes is scheduled to begin shortly. Reclamation of the former footprint of the stockpile, including reconstruction of the Oak Grove Wash, is scheduled to begin in October 2007. The former footprint of the 1C stockpile and the majority of the 1C stockpile outslope (all but a small section located adjacent to the 1A stockpile) are projected to be fully reclaimed by April 2008.

7A Waste Stockpile

Reclamation activities at the 7A stockpiles began in the fourth quarter of 2005 with the construction of storm water best management practices (BMPs) along the toe of the stockpiles (surface dikes). Additionally during the fourth quarter of 2005, the 3H:1V and 2.5H:1V test plots on the 7A stockpile were completed, with the exception of the vadose zone monitoring instrumentation installations. Regrading of the 7A Far West stockpile began during the first quarter of 2006 and outslope grading was completed during the second quarter. Also during the second quarter of 2006, a series of six seepage collection systems were installed along the toe of the 7A stockpiles and are currently fully operational. Placement of cover material (Gila Conglomerate from the 5A stockpile) also began on the outslope of the 7A Far West stockpile during the second quarter of 2006. Placement of cover material on the outslope of the 7A Far West stockpile was completed during the third quarter of 2006 and cover thickness verification was performed by NMED. Loading and hauling of cover material (Gila Conglomerate from the 5A stockpile) to the crest of the 7A West/East Wing segment was conducted during the fourth quarter of 2006 to provide an additional one-foot of cover on the stockpile. During the first quarter 2007, loading and hauling of Gila Conglomerate was nearly complete on the No. 7A West/East Wing segment. The outslopes of the 7A stockpiles are projected to be fully reclaimed by April 2008, and the remaining top surfaces are projected to be reclaimed later in 2008.

1A/1B Leach Stockpiles

Under the current reclamation plan for the 1A and 1B leach stockpiles, waste rock and leach ore material from the outslope of the 1A stockpile will be mined out as part of the stockpile pull-back. Leach ore material is being placed on top of the 1B stockpile and waste material from the outslope will be placed along the entire toe of the 1B stockpile. The outslope of the 1B stockpile will then be regraded to a 3H:1V slope, and the entire existing PLS collection system will be covered with waste rock. As such, the existing 1B PLS collection system was modified to ensure that the system continues to operate effectively following placement of the waste rock in the area. Mining of the 1A stockpile outslope began in the first quarter of 2006, and was temporarily halted at the beginning of the fourth quarter of 2006 with the shovel moving back into production in the West Main Pit. All existing piezometers, monitor wells, and extraction wells located within the regrade footprint of the 1B Stockpile were plugged and abandoned between August and September 2006 in accordance with NMED Monitor Well Completion and Abandonment guidelines. Construction of the modified PLS collection system began in September 2006 and was completed in February 2007. The 1B stockpile PLS Collection System Relocation As-Built design set was completed in May 2007 and submitted to the NMED in July 2007 (PDTI, 2007b).

3A Leach Stockpile

The current reclamation plan for the 3A leach stockpile calls for pull-back of the eastern outslope and placement of the mined-out material along the northern/northwestern toe of the stockpile. Plans are under review to evaluate the option of steepening the reclaimed interbench slopes to 2.5H:1V (max). Several of the existing collection systems and a significant number of monitor wells located near the existing toe of the stockpile will be covered under the plan to regrade to 2.5H:1V (max.) interbench slopes. As such, new collection systems (seepage, PLS, and regional and perched ground water collection systems) will need to be installed outside the projected regrade stockpile toe limit. In June 2006, preliminary design drawings for the monitoring well replacement/installation and PLS/seepage collection systems were provided to the NMED and MMD. The 3A stockpile well program activities were conducted between November 2006 and May 2007. These activities were performed in accordance with the 3A stockpile well program work plan (DBS&A and Golder, 2006) and a March 2007 letter from PDTI to the NMED addressing NMED work plan comments (PDTI, 2007a). Well abandonment and installation activities were initiated during the first quarter of 2007. A total of 49 wells have been plugged and abandoned, including 23 perched zone and 26 regional ground water monitor wells. A total of 57 new wells were installed. The wells consist of 25 5-inch-diameter extraction wells and 34 4-inch-diameter monitor wells. The wells were placed immediately north of the projected reclaimed stockpile footprint. The new seepage collection system installations and remaining well abandonment and installation activities will be conducted in the future.

5.2.3 Reclamation Activities Within the East Mine Unit

Burro Mountain Tailing Impoundment

Design work for closure/closeout activities began during the second quarter of 2004; and regrading, cover placement, and fencing of the Burro Mountain tailing impoundment was initiated in the third quarter. Regrading, cover placement, and fencing were completed during the fourth quarter of 2005. Reclamation of the Burro Mountain tailing impoundment was completed in February 2005. The CQAR for the Burro Mountain tailing impoundment was submitted in September 2005 (M3, 2005b).

No. 1 Stockpile

Under the current reclamation plan, the outslope of the No. 1 stockpile will be regraded to overall slopes of between 3H:1V and 3.5H:1V and the top surface will be constructed to a final grade of between 0.5 to 5% to provide positive drainage. Regrading of the stockpile outslope will result in covering of the existing seepage collection systems and wells, and placement of waste material within one new drainage located to the east of the stockpile. As such, new collection systems were installed and wells located within the projected footprint were abandoned. The reclamation plan also includes designs for closure of the existing No. 1 PLS Pond and the C Sump Pond located southeast of the No. 1 stockpile, removal of approximately 11,650 feet of existing non-functional pipelines adjacent to the stockpile, and relocation of approximately 4,760 feet of existing functional pipelines outside the projected toe of the regraded stockpile. The CDQA plan for the No. 1 Stockpile was submitted in April 2006 (M3, 2006b).

Reclamation activities at the No. 1 stockpile began in May 2006 with the abandonment of nine wells, initiation of pipeline removal, C Sump Pond closure, and seepage collection system installation activities. The existing seepage collection systems and monitor wells located within the projected regrade footprint of the stockpile were plugged and abandoned in May 2005 in accordance with NMED Monitor Well Completion and Abandonment guidelines. Removal of the existing non-functional pipelines in the No. 1

stockpile area was completed in June 2006, and relocation of the existing functional pipelines was completed in July 2006. The C Sump Pond closure and seepage collection system installations were completed during the fourth quarter of 2006. Rough grading on the top surface was initiated in the second quarter of 2006 and regrading activities on the stockpile outslope were initiated in July 2007. Regrading activities on both the top surface and outslope are currently ongoing, and full reclamation of the No. 1 stockpile is projected to be completed by April 2008. Five additional monitor wells will be installed down gradient of the newly installed seepage collection systems by July 2008 in accordance with operational DP-896.

6.0 RECLAMATION DESIGN CRITERIA AND POST-CLOSURE MONITORING

This section presents the reclamation design criteria and post-closure monitoring plans for closure/closeout of the Tyrone Mine facilities. The reclamation practices proposed herein are intended to limit future environmental impacts and, to the extent practicable, provide protection of air and water resources consistent with state and federal laws. Reclamation design criteria and post-closure monitoring plans were developed in consideration of the site-specific conditions that exist at Tyrone including soil, ecological, operational, and economic constraints.

Open pit mining and recovery of metals is projected to continue at Tyrone for many years, therefore, the size and topography of the mining area will change. Leaching and SX/EW recovery of metals is projected to continue beyond open pit mining. Therefore, the conceptual reclamation design approach for closure/closeout has been prepared to consider changing site conditions to the degree practical. Final designs, technical specifications, and construction quality assurance plans for each facility will be prepared when mining and SX/EW recovery of metals cease or as part of accelerated reclamation activities. The basic conceptual design criteria should be applicable to any time period even though quantities and unit costs may change with time. Final designs, technical specifications and construction quality assurance plans for each facility will continue to be prepared until mining and recovery of metals cease.

Descriptions of the facilities covered by the reclamation designs and their design criteria are included in Section 6.1. The performance objectives and reclamation designs for closure/closeout of the facilities are included in Section 6.2. The water treatment methodology is outlined in Section 6.3, and Section 6.4 contains post-closure monitoring and contingency plans. The existing and planned closure/closeout activities for Tyrone are presented in association with each of the three main mine facility areas in Section 7.0.

6.1 Facility Characteristics and Classification

To standardize the development of the financial assurance cost estimate associated with this CCP, facilities with common characteristics and mine function have been grouped together in this section. The reclamation plans and facilities are also grouped by the three main mine facility areas in Section 7.0. Thus, the tailing impoundments, stockpiles, open pits, surface impoundments, disturbed areas, and water treatment are identified as the primary reclamation facility groups. Sections 6.1.1 through 6.1.7 provide general descriptions of these facility groups.

The characteristics of individual tailing impoundments, stockpiles, open pits, surface impoundments, and other disturbed areas at Tyrone are summarized on facility characteristics forms (Appendix B). The general areas of disturbance and associated major facilities to be reclaimed at Tyrone are summarized in the following sections.

6.1.1 Tailing Impoundments

As previously described in Section 5.2, the majority of the tailing impoundments and tailing repositories at the Tyrone Mine have been, or will be, fully reclaimed prior to the renewal of DP-1341 (April 2008) and Permit Revision 01-1 to Permit No. GR010RE (April 2009). As such, this CCP applies only to those facilities that will not be fully reclaimed by April 2008. The only facilities that are projected to be under active reclamation in April 2008 are the 1X tailing impoundment and the surface water catchments/impoundments located around this impoundment. The 1X tailing impoundment and surface water catchments/impoundments located around the facility are presented on Plate 2.

6.1.2 Stockpiles

A total of approximately 2,070 acres of stockpile surfaces are targeted for reclamation under this plan. This area includes all top surfaces and outslopes of leach and waste stockpiles that are located outside the SWCZ. The SWCZ is defined as approximately 490 acres of stockpiles and disturbed areas adjacent to the open pits where surface water cannot feasibly flow out to the perimeter of the Mine/Stockpile Unit due to existing topographic constraints (Plate 3). Under the proposed plan, the stockpiles and associated disturbed areas located within the SWCZ will not be reclaimed. Impacted surface water runoff from the stockpiles located within the SWCZ will be collected in the pit sumps and PLS collection sumps located within the SWCZ and conveyed to the proposed water treatment plant. Impacted stockpile seepage will be collected from the existing seepage collections, pit sumps, and PLS collection systems and conveyed to the proposed water treatment plant. The leach stockpiles located inside the SWCZ include: the 6B (former East Main); and interior slopes of the 1B, 2A, 2B, 2C, 4A, 4B, and 7B stockpiles. he waste rock stockpiles located inside the SWCZ include the 8C, and the interior slopes of the 3B and 5A (overburden) stockpiles. The leach stockpiles located outside the SWCZ include: the No. 1, 1A, 3A, 4C, 6C, and Copper Mountain stockpiles; and all but the interior slopes of the 1B, 2A, 2B, 2C, 4A, 4B, and 7B stockpiles. The waste rock stockpiles located outside the SWCZ include the 1C, 2B, 7A, 7C, and proposed 9A stockpiles; and all but the interior slopes of the 3B and 5A (overburden) stockpiles. The No. 1 leach stockpile and 1C and 7A waste rock stockpiles are currently under various stages of reclamation. The No. 1 leach stockpile is currently being regraded and channels are being constructed. The majority of the 1C stockpile outslope has been graded and covered. The facility still requires: grading of a small area of outslope adjacent to the 1A stockpile; construction of surface water conveyance structures, cover placement on the top surface, former footprint area, and minor outslope area; and seeding over the entire stockpile area. The 7A stockpile outslopes have been graded and covered, but the top surfaces still need to be covered, surface water conveyance structures need to be constructed, and the entire stockpile needs to be seeded. The No. 1 leach stockpile is projected to be fully reclaimed by April 2008. Additionally, the outslope of the 7A stockpile, the majority of the 1C stockpile outslope (all but a small section located adjacent to the 1A stockpile), and the former footprint area of the 1C stockpile, are projected to be fully reclaimed by April 2008. The status of on-going and completed stockpile reclamation projects is presented in Section 5.2.

6.1.3 Open Pits

The Open Pits at the Tyrone Mine Facility encompass approximately 1,250 acres. The open pit areas include the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna and San Salvador Hill pits. Previously mined and now partially or completely backfilled pits include the San Salvador Hill, Virginia Racket, West Racket, East Main, Gettysburg Entry, BA-O, and Upper Main. Of the existing open pits at the mine, the Main, West Main, Valencia, Savanna, and Gettysburg Pits are contiguous. The West Main and Valencia pits are part of the Main open pit. These pits, which as of the EOY 2007 covered an area of about 1,250 acres, have been granted a conditional waiver (see Plate 3) from the requirement of achieving a self sustaining ecosystem, and will not be reclaimed during mine closure. The Copper Mountain Pit, covering approximately 155 acres, has also been granted a conditional waiver from the requirement of achieving a self sustaining ecosystem, and will not be reclaimed during mine closure. Additionally, as part of this CCP, Tyrone has identified additional open pit areas within the interior portion of the Mine/Stockpile Unit for which a waiver from achieving a PMLU or SSE will be requested (Plate 3). These additional areas include: 1) approximately 105 acres associated with additional mining around the Main and Copper Mountain Pits; 2) approximately 121 acres of pit wall area (comprised primarily of stockpile material at the hard rock/stockpile interface) that was inadvertently omitted from the previous waiver; and 3) approximately 62 acres of future expansion of the eastern portion of the Main Pit associated with mining the residual Gila Conglomerate borrow source for cover. The water that accumulates in the waiver pits will be managed through combined processes of evaporation and pumping. The pits form a hydrologic sink capturing ground water flowing from all directions. Surface water conveyances from the stockpiles located within the SWCZ will be directed to the individual pit sumps and/or PLS sump collections for incorporation into the mine process water circuit while the mine is still operational, and to the water treatment system circuit during closure and post-closure.

The two remaining pits (i.e., non-waiver pits), the South Rim Pit and the San Salvador Hill Pit (see Plate 3) cover areas of approximately 60 and 50 acres, respectively. These pits will be partially backfilled with waste rock and regraded during reclamation, such that drainage is directed toward the Oak Grove Drainage and any ponding that may occur is minimized.

6.1.4 Surface Impoundments, Tanks, and Catchments

The most current survey of the surface impoundments, tanks, and storm water catchments at the Tyrone Mine was compiled as part of the Final Surface Impoundment Study Work Plan (DBS&A, 2006b). This list has been updated as part of this CCP to include more recent information on the status of the surface impoundments, tanks, and storm water catchments associated with the ongoing reclamation efforts at the mine. Table 2-1 in this plan presents an updated summary of the surface impoundment list in the 2006 study and shows the surface impoundments grouped by the operational DP areas. According to this summary, 146 surface impoundments, tanks, and catchments have been identified at Tyrone. Of these, 67 have been closed as part of the ongoing reclamation activities at the mine.

6.1.5 Disturbed Areas

A miscellaneous group of disturbed areas such as haul and operational roads, existing borrow areas, facilities such as the SX/EW, Acid Unloading, Lube Shop, equipment storage areas, and pipeline and utility corridors are present at the Tyrone Mine. Performance objectives for disturbed areas include creation of a self sustaining ecosystem and erosion control for all areas located outside the SWCZ. Reclamation of the disturbed areas located outside the SWCZ will be accomplished by removing or burying utility and structure foundations, pipelines, power lines, and buildings and providing erosion and drainage control and revegetation. Compacted soils in areas such as haul roads will be loosened by ripping on an as needed basis. Where possible, the ripping and grading of compacted areas will be accomplished during near-closure operational phases. Disturbed sites located outside the SWCZ will be ripped to a depth of 24 inches and revegetated. Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

Temporary erosion and drainage control practices will include rough grading and installation of water bars, minor diversions, sediment containment structures, mulching, straw bales, and silt fences. The need for these practices will be evaluated on a site-specific basis at closure.

6.1.6 Facility Demolition

Those facilities not designated for industrial PMLU will be demolished, removed, and/or buried or otherwise closed in accordance with an approved plan. A total of approximately 62 buildings/tanks/structures containing approximately 7,687,500 cubic feet will be demolished and removed under this plan. The list of facilities that are scheduled to be removed is provided in Table 6-1. Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 24 inches minimum.

6.1.7 Industrial Facilities

The majority of the infrastructure (shops, buildings, roads and utilities) associated with the Industrial PMLU areas will be adapted for non-mining industrial applications. NMED requires abatement of contaminated soils that are potential source areas for ground water and surface water contamination in accordance with NMAC Sections 20.6.2.1203, 20.6.2.3109.E.1, and 20.6.2.4103 in and around all facilities and structures approved by MMD to be left for an Industrial PMLU or structures necessary for post-closure treatment and disposal of ground water and/or surface water. Tyrone will maintain erosion controls, structures, equipment, and utilities within the Industrial PMLU areas until they are occupied by tenants. Tyrone proposes to cover the disturbed areas located within the Industrial PMLU areas with 24-inches of cover material and revegetate the areas in accordance with Appendix C of the MMD Permit.

6.2 Performance Objectives/Reclamation Design

Performance objectives and design criteria were developed with the intent of meeting rules and requirements associated with the WQA, WQCC Regulations and NMMA. This section presents the reclamation design criteria in accordance with these objectives. The closure or reclamation designs are depicted in the drawing set provided in Appendix A. The designs were developed to provide enough information to calculate the financial assurance cost estimate. The following sections present the performance objectives and reclamation design criteria for the major facilities at the mine. A summary of the key design criteria for the facilities is presented in Table 6-2.

6.2.1 Tailing Impoundments

The performance objectives for the top surface and exterior outslopes of the 1X tailing impoundment include establishment of a self sustaining ecosystem, control of fugitive dust, control of runoff and erosion, prevention of overtopping, and the reduction of infiltration of meteoric water. The major performance objectives associated with the 1X tailing impoundment toe and hill-slope perimeters include maintenance of regional ground water quality and prevention of undercutting erosion from channel flow, subsurface inflow, and run-on. The following subsections describe the conceptual-level design criteria for the reclamation of the 1X tailing impoundment.

Structural Stability of Tailing Impoundments

The gross stability of the Mangas Valley Tailing Unit tailing impoundments with respect to mass failure has been determined to be adequate, whereby factors of safety are greater than 1.1 (URS, 2006a, 2006b, and 2006c). The regrading and cover placement will result in an overall improvement of the physical stability of the 1X tailing impoundment due to flatter slopes, draindown, and reduced infiltration. Ultimately, the New Mexico Office of the State Engineer (OSE) is required to review the reclamation plans to determine that the designs will not negatively affect the safety of the impoundments in the post-closure period.

Tailing Impoundment Erosion and Drainage Control

The final grade of the top surface will range from 0.5 to 5 percent and will be graded to rock-protected aprons at the entrance to storm water conveyance structures. Channels and hydraulic structures will be designed to convey storm water from the top surface, while grading and perimeter berms will protect the outslopes from water erosion. Where necessary, energy dissipation structures will be provided for channel outlets where erosive velocities are expected.

The 1X tailing impoundment inter-bench outslopes will be graded to 3H:1V or flatter. Storm water will be controlled on the outslopes using conventional terrace channels integrated to downdrains. Run-off drainage and erosion control for the 1X tailing impoundment will be achieved by storm water conveyance channels, stable out-slopes, and revegetation.

Run-on control is is addressed in the closure plan designs primarily through the construction of diversions. Specific run-on control plans are discussed in Section 7. Temporary erosion control measures will be provided during the construction and early vegetation establishment periods, as necessary. These measures may include mulch, straw bales, silt fences, and minor corrective regrading.

Tailing Impoundment Cover and Revegetation

The tailings are highly susceptible to wind and water erosion and a soil cover is necessary to prevent dispersion of these materials in the environment. Finish grading of the tailing subgrade will be performed as needed based on pre-construction surveys. Earth moving equipment such as bulldozers and motor graders will be used to smooth the surfaces and facilitate access for supplemental cover placement and mulching/seeding. The cover on the 1X tailing impoundment will be a minimum of 24-inches thick and will be constructed of Gila Conglomerate and native soils obtained from two borrow areas located immediately south and west of the impoundment. Sufficient quantities of borrow materials for soil cover and topdressing exist in these two areas.

Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The revegetation requirements including the planned seed mix for the tailing impoundment are summarized in Section 4.0. The seed will be applied using appropriate methods, such as drill or broadcast seeding, depending on the final cover and site characteristics. The mulch will be specified as weed free and will contain a minimum of viable seeds associated with the mulch source (barley or wheat are proposed). Long-stem mulch will be given preference over shorter materials. Straw or native grass mulch will be applied at a rate of approximately 2 tons per acre and stabilized by crimping.

Tailing Impoundment Ground Water and Surface Water Containment

With the ongoing reclamation of the 1X tailing impoundment, there are no impacted surface water or tailing decant water associated with the facility. Water quality data from Mangas Valley show very limited impacts in the area and the impacts that are observed may be the result of past or current tailing-impacted storm water seepage, or may be naturally occurring due to the proximity of these wells to the Mangas Fault and uplifted igneous rocks east of the fault. Additional evaluation of the water quality impacts in the area will be conducted as part of the background geochemistry evaluation proposed as part of the Tyrone Stage 1 Abatement Plan. Water quality will continue to be monitored to differentiate impacted from non-impacted water.

6.2.2 Stockpiles

The performance objectives for closure/closeout of the stockpile facilities include establishment of a self-sustaining ecosystem (except in areas within the SWCZ that cannot feasibly be drained to the outside of the mining area); reduction of infiltration; containment of seeps and sediment; and control of run-on, runoff, and releases to perched and regional ground water. Lists of the major reference documents used in the development of conceptual-level designs for the reclamation of stockpiles can be found in Section 5.1 and in Appendix E.

A summary of the key design criteria for the stockpile facilities is presented in Table 6-2. It should be noted that the conceptual designs and associated earthwork cost estimate presented in this CCP for the stockpiles are based on an overall outslope gradient of 3H:1V, 15-foot wide terrace benches, and 175-foot inter-bench slope lengths to allow for flexibility in the final design of the terrace benches and associated surface water conveyance channels. With these designs, the inter-bench slope is 2.75H:1V. Tyrone is not proposing this interbench slope, it is only a by-product of this conceptual design effort. It is anticipated that the final reclamation designs will be developed based on 2.5H:1V inter-bench slopes with uninterrupted slope lengths of no greater than 175 feet consistent with the design criteria referenced in Table 6-2. Precise designs for each reclamation unit will be prepared and submitted to the agencies at final design and may alter the 3H:1V overall slope in this conceptual design.

Structural Stability

The existing stockpile outslopes at Tyrone are composed of clast-dominated run-of-mine rock in various stages of weathering, placed through end-dumping at angle of repose with occasional benches resulting in overall slopes that are flatter than angle of repose. The gross stability of the stockpiles has been determined to be adequate and is expected to remain stable under post-closure conditions (Golder 2006b, 2006d, 2006e, 2007c, 2007d, and 2007e).

Stockpile Erosion and Drainage Control

For the stockpile top surfaces located outside the SWCZ, the surfaces will be graded to direct non-affected water to designated discharge areas. The stockpile top surfaces will be graded to slopes of between 0.5 and 5 percent. The slopes will be graded to rock-protected aprons at the entrance to storm water conveyance structures. Rock-lined channels, perimeter berms, and hydraulic structures will be designed to control erosion on the top surfaces and outslopes and safely convey storm water for release. The existing berms on the stockpile top perimeters will be improved, where necessary, and maintained to prevent the concentration of flow onto the outslopes.

For the stockpile outslopes located outside the SWCZ, inter-bench outslopes will be graded to 2.5H:1V or flatter with uninterrupted slope lengths of no greater than 175 feet. Storm water will be controlled on the outslopes using conventional terrace channels integrated to downdrains for facilities that are not currently being reclaimed. For the No. 1, 1C, and 7A Far West stockpiles, the outslopes are constructed with the ridge-valley design and no benches are present. Run-off drainage and erosion control for the stockpiles will be achieved by storm water conveyance channels, stable out-slopes, and revegetation. For the stockpile outslopes and top surfaces located inside the SWCZ, outslopes will remain at angle-of-repose and the top surfaces will remain at their current grade. Storm water within the SWCZ will be controlled using constructed downdrains and/or existing surface conveyance channels that will direct storm water to existing surface impoundments or mine pit sumps.

Energy dissipation structures will be constructed at channel outlets to reduce erosive velocities where necessary. Where possible, channels will be constructed to incorporate existing topography, grade controls, and exposed inert bedrock thus, promoting long-term integrity of the structures. The final design will be adjusted for local conditions.

Run-on is not expected to be a post-closure concern for most of the stockpiles since, with the exception of in-pit stockpiles, they are constructed above the surrounding terrain. The need for run-on protection of these stockpiles will be fully evaluated in the final design process.

Temporary erosion control measures will be provided during the construction and early vegetation establishment periods for the stockpiles located outside the SWCZ. These measures include, but are not limited to, berms, mulch, straw bales, silt fences, and minor corrective regrading. All construction will be in compliance with state regulations for temporary storm water control.

Stockpile Cover and Revegetation

Finish grading of the stockpile subgrade will be performed based on pre-construction surveys. Earth moving equipment such as bulldozers and motor graders will be used to smooth the surfaces and facilitate access for supplemental cover placement and mulching/seeding. Stockpile covers will be placed according to the following criteria:

Inside Surface Water Containment Zone	
Top Surface Cover Thickness	No cover
Outslope Cover Thickness	No cover
Top Surface Grade	Existing
Slope (overall)	Existing (approx. angle of repose)
Outside Surface Water Containment Zone	
Top Surface Cover Thickness	24 inches
Outslope Cover Thickness	24 inches
Top Surface Grade	0.5 to 5%
Slope (Inter-Bench Slope)	2.5H:1V max.

The results of the Supplemental Borrow Materials Investigation and Addendum to the investigation indicate that the cover requirement for the Mine/Stockpile Unit at Tyrone is approximately 15.5 million yd^3 based on the current permit requirements. More than 20.3 million yd^3 of Gila Conglomerate and leached cap cover materials have been conservatively identified at Tyrone. Under this CCP, the borrow sources for stockpile cover are assumed to be Gila Conglomerate from the 5A overburden stockpile and residual Gila Conglomerate in the Lube Shop area.

Once vegetation is established, the Gila Conglomerate cover will reduce the amount of water entering the underlying wastes. The suitability of the Gila Conglomerate as cover material to reduce water entry into the stockpiles and support a self-sustaining ecosystem is being studied to fulfill the requirements of Conditions 75 and 76 of DP-1341.

Ongoing regrading and ripping during mining operations will result in top surfaces with minor irregularities. Thus, only finish grading to achieve 0.5 to 5 percent slopes is planned on the top surfaces located outside the SWCZ to facilitate cover placement and/or storm water run-off controls. Substantial grading is planned for the stockpile outslopes located outside the SWCZ. Terraced benches will be constructed to control erosion from run-off. With the exception of the No. 1, 1C, and 7A Far West stockpiles (ridge-valley designs currently being reclaimed), these benches will be constructed on inter-bench outslope angles of 2.5H:1V at slope lengths no greater than about 175 feet.

Revegetation of the stockpile top surfaces and outslopes located outside the SWCZ will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The planned seed mix is discussed in Section 4.0. The seed will be applied using an appropriate method (such as drill or broadcast) depending on the cover and site characteristics. This CCP assumes drill and broadcast seeding into a roughened bed and will be covered by mechanical methods. Straw or native grass mulch will be applied at a rate of approximately 2 tons per acre and stabilized by crimping. The mulch will be specified as weed-free and contain a minimum of viable seeds associated with the mulch source (barley or wheat). Long-stem mulch will be used when possible.

Stockpile Surface Water, Ground Water, and Sediment Containment

The existing and planned surface impoundments, berms, sumps, collector pipes, seepage and PLS collection systems, and ground water pump-back systems will be integrated into a new overall system to control releases to surface water, perched water, and ground water. Impacted waters will be directed to the proposed water treatment plant described in Section 6.3.

6.2.3 Open Pits

Tyrone received a conditional waiver from the requirements of achieving a self-sustaining ecosystem pursuant to Section F of the MMD Permit (MMD, 2004) (Figure 4-1). Based on this waiver, the pits at Tyrone are divided into two categories: exempt and non-exempt pits. The exempt pits at Tyrone are the Main, East Main, Valencia, Savanna, Gettysburg, and Copper Mountain Pits. Additionally, as part of this CCP, Tyrone has identified additional open pit areas within the interior portion of the Mine/Stockpile Unit that will be requested for a waiver from achieving a PMLU or SSE (Plate 3). These additional areas include: 1) approximately 105 acres associated with additional mining around the Main and Copper Mountain Pits; 2) approximately 121 acres of pit wall area (comprised primarily of stockpile material at the pit/stockpile interface) that was inadvertently omitted from the previous waiver; and 3) approximately 62 acres of future expansion of the eastern portion of the Main Pit associated with mining the residual Gila Conglomerate borrow source for cover. The non-exempt pits are the San Salvador and South Rim Pits. Tyrone has developed this closure plan proposal with the assumption that agency personnel will support efforts by Tyrone to partially backfill the two non-exempt pits during operations. If these efforts are not possible during operations, Tyrone may request waivers for these pits again.

The performance objectives for the exempt pits and additional proposed waiver area are to control run-on and public access, maintain operational access, seepage and ground water control. A safety berm will be constructed of local rock and soils around the circumference of the exempt pits and additional proposed waiver area to control site access. Site access will also be controlled by new 6-foot high fences installed around the perimeter of the pits. Signs will be posted on the fencing at 500·foot intervals and at all access points, warning of potential hazards present. The performance objectives for the exempt pit floor areas are to provide a hydraulic sink for capture and removal of impacted water Pit walls are sufficiently stable that a specific conceptual design is not needed. Any materials eroded from these slopes will be contained within the pit. Impacted water will be captured in pit floor sumps then pumped to the proposed water treatment facility.

The performance objectives for closure/closeout of the non-exempt open pit facilities include establishment of a self-sustaining ecosystem; reduction of infiltration; containment of seeps and sediment; and control of run-on, runoff, and releases to perched and regional ground water. The South Rim and San Salvador Hill pits will be partially backfilled with waste rock in a manner that ensures positive drainage from the areas to be covered and revegetated and to eliminate, to the extent practicable, ponding on final cover surfaces. Tyrone's position is that it is not economically feasible to backfill open pits unless it can be accomplished as part of mine operations. The San Salvador Hill pit has been partially backfilled as part of mining operations, but requires additional backfill to accomplish the reclamation configuration presented herein. The South Rim pit has not had historic backfilling. These are the smallest pits at Tyrone, but the volume to backfill them is still considerable.

Top surfaces will be graded to a slope of between 0.5% and 5.0% to direct non-affected water to designated discharge areas. For the remaining pit walls, inter-bench slopes will be graded to 2.5H:1V or flatter with uninterrupted slope lengths of no greater than 175 feet. The slopes will be graded to rock-protected aprons at the entrance to storm water conveyance structures. Rock-lined channels, perimeter berms, and hydraulic structures will be designed to control erosion on the top surfaces and pit slopes and safely convey storm water for release. The existing berms on the stockpile top perimeters will be improved, where necessary, and maintained to prevent the concentration of flow onto the pit slopes.

Energy dissipation structures will be constructed at channel outlets to reduce erosive velocities where necessary. Where possible, channels will be constructed to incorporate existing topography, grade controls, and exposed inert bedrock thus, promoting long-term integrity of the structures. The final design will be adjusted for local conditions. Temporary erosion control measures will be provided during the construction and early vegetation establishment periods. These measures include, but are not limited to, berms, mulch, straw bales, silt fences, and minor corrective regrading. All construction will be in compliance with state regulations for temporary storm water control.

Revegetation of the top surfaces and regraded pit slopes of the non-exempt pits will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The planned seed mix is discussed in Section 4.0. The seed will be applied using an appropriate method (such as drill or broadcast) depending on the cover and site characteristics. This CCP assumes drill and broadcast seeding into a roughened bed and will be covered by mechanical methods. Straw or native grass mulch will be applied at a rate of approximately 2 tons per acre and stabilized by crimping. The mulch will be specified as weed-free and contain a minimum of viable seeds associated with the mulch source (barley or wheat). Long-stem mulch will be used when possible.

6.2.4 Surface Impoundments

The performance objectives for surface impoundments facilities are to retain or convey process waters, seepage collection waters, extracted ground water and pit water, and surface water. For the purposes of this plan, surface impoundments include: storage tanks for process waters, seepage collection waters, and extracted ground water/pit water; storm water catchments; and lined and unlined surface impoundments. The surface impoundment facilities are planned to be the last features to be closed following the establishment of vegetation and site stabilization on the other facilities. Impoundments that serve PMLU functions or are associated with the stockpile toe perimeter and ground water control systems are planned to be permanent parts of the reclamation system and will be maintained throughout the post-closure period. The disposition of specific facilities with respect to closure/closeout is discussed in Section 7.0.

The impoundments to be closed will be characterized sequentially, by facility and will include the definition of the drainage of the surface impoundment, characterization and abatement of sediments that could potentially impact ground water quality, and characterization of ground water to determine if abatement is necessary. Closure and reclamation of surface impoundments not designated for PMLU may involve removal of contaminated material if present and/or grading to achieve drainage, followed by capping with 24 inches of suitable cover material and revegetation. Cover will be applied only where contamination is present. Synthetic liners (if present) will either be removed and disposed of, or ripped, and completely covered with 24-inches of suitable material. Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

6.2.5 Disturbed Areas

Performance objectives for disturbed areas located outside the SWCZ include creation of a self-sustaining ecosystem and erosion control. Reclamation of the disturbed areas outside the SWCZ will be accomplished by removing or burying utility and structure foundations, power lines, and buildings and providing erosion and drainage control and revegetation. Pipeline corridors located outside the regrade footprint of stockpiles and tailing impoundments will be inspected and characterized for evidence of past spills that could potentially cause exceedances of water quality standards of Section 20.6.1 NMAC and Section 20.6.2.3103 NMAC. If they do not constitute a source of contamination (defined as exceedances of standards), they can be left in place and buried, after they have been rinsed if they contain contaminated materials. If soils have been impacted, the material will be removed. Where pipelines are removed, the pipeline corridor will be revegetated in accordance with Appendix C of the MMD Permit.

Where pipelines are buried, they will be revegetated in accordance with Appendix C of the MMD Permit. Tyrone intends to request that MMD modify the permit language so that the agency can exercise it's discretion to meet the environmental objectives, but not require cover, for example, where it is not warranted if there is not contamination present.

All haul roads and access roads will be reclaimed if not located within the SWCZ or regrade footprint of stockpiles and tailing impoundments, or are needed for post-closure access. If the roads are located on non-acid generating material, compacted road material will be loosened by ripping to a depth of 24 inches and revegetated. For haul roads located on acid-generating material, the roads will be ripped, covered with 24 inches of the cover material and revegetated. All culverts will be removed unless they serve a post-closure purpose. Where possible, the ripping and grading of compacted areas will be accomplished during near-closure operational phases.

The necessity for removing utility structures will be determined on a site-specific basis. Buildings will be demolished or converted to an alternative industrial use. or footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations located outside the SWCZ that are not included in the Industrial PMLU are located on non-acid generating materials, they will be abandoned in place and covered with 24 inches of topdressing. For footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations located outside the SWCZ that are not included in the Industrial PMLU are located on impacted soils that could potentially cause exceedances of water quality standards of Sections 20.6.1 NMAC and Section 20.6.2.3103 NMAC, the soils will be abated, and the structures abandoned in place. The structures and impacted soils will be covered with 24 inches of Gila Conglomerate (or other suitable cover material). The other disturbed sites located outside the SWCZ will be ripped and revegetated.

The temporary erosion and drainage control practices will include rough grading and installation of water bars, minor diversions, sediment containment structures, mulching, straw bales, and silt fences. The need for these practices will be evaluated on a site-specific basis at closure. The seed mix to be used is presented in Section 4.0. Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

6.2.6 Borrow Areas

Tyrone's experience with cover excavation and placement on the tailing impoundments revealed that flexibility in materials handling is critical to achieving quality control objectives and efficient management of cover soil resources. The exact location and configuration of the borrow areas will ultimately be determined during the final design and construction phases of the reclamation.

The results of the Supplemental Borrow Materials Investigation and Addendum to the investigation indicate that the cover requirement for the Mine/Stockpile Unit at Tyrone is approximately 15.5 million yd^3 based on the current permit requirements. More than 20.3 million yd^3 of Gila Conglomerate and leached cap cover materials have been conservatively identified at Tyrone. Additional materials may be available from alternative leached cap sources and from the deposits of residual Gila Conglomerate on the east side of Main Pit. Thus, the total volume of materials designated for the Mine/Stockpile Unit is more than that needed to cover these facilities. The surplus of cover material will ultimately allow for flexibility in siting borrow areas at Tyrone to account for operational considerations. Gila Conglomerate within the 5A overburden stockpile and residual Gila Conglomerate on the east side of the Main Pit are considered the two primary sources of cover material for this CCP.

The top surface and outslopes of the 5A stockpile, which will be only partially consumed, will be reclaimed using methods similar to those described for the other stockpiles located outside the SWCZ (Section 6.2.2). The remaining borrow pits, with the exception of the east side of the Main Pit which is part of the open pit waiver area, will have low-angle sideslopes as a result of the specified excavation plan.. Borrow pit sideslopes and bottoms will be ripped where required and revegetated with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. .

6.3 Water Management and Treatment

There are four sources of water that are likely to be sent to the proposed Water Treatment System: 1) residual PLS from the leach operations, 2) meteoric water that infiltrates through and is collected as seepage from the base of stockpiles, 3) impacted storm water runoff, and 4) impacted ground water. Surface water (runoff and seepage flows) and ground water will be managed and or treated throughout site reclamation activities and for a duration of 100 years following cessation of mining operations. The following methods are proposed for management and treatment of impacted surface water and ground water.

6.3.1 Performance Objectives

The primary performance objectives for water management and treatment are to meet the applicable NMWQCC criteria for the anticipated beneficial use or discharge. To meet the performance objectives the following strategy will be utilized:

- Minimization of impacted surface runoff requiring treatment. Diversion of non-impacted meteoric water and storm water surface runoff away from potentially impacted sources will allow for discharge to an approved surface discharge area in accordance with state regulations. Non-impacted water sources will not require treatment prior to discharge;

- Storage of stockpile seep water in tanks or impoundments will allow for sampling and analysis prior to final disposition. Water that is shown to be in compliance with NMED DP requirements will be discharged. Impacted water will be conveyed to the proposed water treatment plant;

- Impacted ground water from extraction systems will be sent to the proposed water treatment plant.; and

- Pit water will be pumped to the proposed water treatment plant.

This strategy will maximize the quantity of non-impacted water and minimize the quantity of impacted water that must be treated prior to release. Treatment of these waters is discussed in the following paragraphs.

6.3.2 Closure/Closeout Plan Objectives

To meet the performance objectives, elements have been designed to segregate affected and non-affected waters as close to the source as possible. Non-impacted waters are to be released at approved points of discharge, and impacted waters are treated to meet NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subpart III, Section 3103, Standards for Groundwater of 10,000 mg/L TDS concentrations or less), prior to beneficial use. The basis of the design of water management and treatment operations considers the following:

- Quantity and quality of water to be managed through segregation from impact areas allowing for direct discharge;

- Quantity and quality of water to be treated (design basis influent);

- Water quality requirements for managed waters (direct discharge) and treated waters (treatment plant effluent);

- Water treatment unit process configuration

- Treatment facility performance

- Treatment facility location(s), and

- Sludge management.

6.3.3 Management and Treatment Processes

The four sources of water requiring management and or treatment through the 100-year period following cessation of mining operations will be handled as follows:

- Residual process solution will be eliminated through the use of an Evaporative Treatment System (ETS) during the first 5 years following closure of the leach circuit. Residual process solutions will be fully treated within five years after cessation of mining operations and the ETS will be shut down.

- Stockpile seepage will be treated through the time period from year 5 to year 100 for removal of metals, sulfate and TDS. Treatment will involve a combination of membrane filtration and a lime-high density sludge (HDS) process. The lime HDS process will produce a treated effluent that will be compliant with discharge or beneficial use requirements and a sludge waste stream.

- Storm water runoff will be managed through surface reclamation to preclude potential for contact with stockpiles and tailing piles. All stockpile top surfaces and outslopes located outside the SWCZ will be coved with 24 inches of suitable borrow material, and the tailing areas will be covered with 24 inches of suitable borrow material. Storm water runoff that is impacted by stockpiles or tailing piles will be collected and treated at the proposed treatment facility, similar to the seepage flows discussed above.

- Impacted ground water and pit water will be pumped to the proposed treatment facility, for treatment and discharge as described above for seepage and runoff.

The ETS and proposed water treatment facility are described in more detail in the following sections.

Evaporative Treatment System

Integral with the water treatment system is development and operation of the ETS. The ETS will collect and evaporate residual process solutions on the top surface of the 2A leach stockpile. Collected process solution will be distributed through a network of drip irrigation pipelines over the stockpile. The flow rate will be controlled such that evaporation will occur at the wetted surface of the stockpile and from the process water reservoirs/impoundments Process solution elimination through operation of the ETS is expected in the first 5 years. The ETS is designed to handle approximately 1.8 billion gallons of residual process leach solution (PLS) that is assumed to be present at the end of mining operations plus:

- Leached stockpile seepage;
- Ground water inflows into the pit sumps;
- Ground water inflows from remediation wells; and
- Impacted runoff from uncovered stockpiles and pit walls.

The proposed ETS is fully described in the Condition 88 Revised Process Solution Elimination Study report (M3, 2006a).

Water Treatment Facility

The design basis for the proposed water treatment facility was derived from implementation of a conceptual mathematical dynamic system model (DSM) using the GoldSim simulation software platform and the proposed reclamation plan presented in this updated CCP. The DSM is a dynamic, probabilistic simulation model that projects the behavior of the mine system and the influence various closure activities have on its performance. DSM results that are used as “inputs” for water treatment design include the predicted flow rates and sulfate concentrations of waters collected for treatment.

As mentioned before, the DSM segregates runoff into impacted (contaminated) and non-impacted (clean) flows.Runoff from covered and relegated stockpile surfaces is assumed to be non-impacted and eventually discharged to the environment (i.e., not sent to the water treatment system) Water quality has a defining role in which water treatment technology can effectively meet established limits. Water quality is also key to operating costs of all technologies, with high concentration waters being more expensive to treat By separating the transient, process-related waters from the longer-term, better quality waters, specific technologies can be applied to each of the waters. Therefore, one of the objectives of the water treatment system for the Tyrone Mine is to separate the process-related impacts, which are transient and represent poorer quality water, from the longer-term, steady-state background conditions, and to treat them separately.

The projected rate and quality of the influent to the water treatment plant over a 100-year simulation period was based on the CCP design drawings and associated areas presented in Appendix A that were subsequently used as input into the DSM.

Based on these estimates, the proposed water treatment facility will involve membrane filtration and lime precipitation high density sludge (lime/HDS) processes as follows:

- A membrane system for treatment of the majority of collected water at low to moderate sulfate levels.
- A lime precipitation high density sludge (lime/HDS) process for treatment of high sulfate seeps and reject from the membrane system.
- Discharge of a combined permeate from the membrane system and lime treated water from the lime/HDS system to provide a final discharge stream with sulfate values less than 600 mg/l.

Sludge Management

Condition 86 of DP-1341 required Tyrone to develop a detailed Sludge Management Plan. The Preliminary Sludge Handling Plan and Cost Estimate was submitted in satisfaction of this condition (Van Riper Consulting, 2004b). The focus of this effort was to quantify the amount of sludge that would be generated by the Tyrone water treatment plant, evaluate the quality of the sludge from a chemical and physical standpoint, and identify the most environmentally protective site for long-term sludge disposal. It also presented a preliminary operational plan for the sludge management program when implemented following closure.

In addition to generating predicted flows and water quality characterization of the proposed treatment facility influent, the DSM contains two coupled subsystems that were used to estimate the mass and volume of sludge produced during a 100-year closure period:

- A water balance–mass balance model that tracks the volume and quality of water and process solutions that will be treated, and
- A water treatment model that projects the mass and volume of sludge produced based on the influent water quality and treatment method.

DSM results were used in development of the sludge management plan.

Capital costs included two components: a storage and load-out bunker adjacent to the water treatment facility and the disposal cell. The disposal cell included construction of stormwater diversion channels and final closure. The sludge facility costs developed in the Preliminary Sludge Handling Plan and Cost Estimate were used as the basis for this CCP with scaling to account for the sludge volumes projected based on updated flow and sulfate concentrations developed from the DSM. The projected 100-year sludge volumes have increased approximately 60% based on the updated flow and water quality projections obtained from the DSM.

A detailed screening analysis was also conducted in the Preliminary Sludge Handling Plan and Cost Estimate to identify potential sites for disposal of the sludge. Based on the results of this analysis, the 8C stockpile was the sludge disposal site selected and has also been selected as the preferred site for this CCP.

6.4 Closure & Post- Closure Monitoring, Reporting, and Contingency Plans

All the closure and post-closure ground water, surface water, seep, spring, interceptor system, tailing draindown, and piezometer monitoring data will be reported quarterly under the applicable Tyrone Operational DPs and in accordance with Condition 58 of the Supplemental Discharge Permit DP-1341 (NMED, 2003a). Additionally, as specified under Condition 59, Tyrone will submit to NMED quarterly reports on or before January 15, April 15, July 15, and October 15 of each year. Tyrone will also prepare two potentiometric maps annually that include data from all monitoring wells, extraction wells, piezometers, seeps, and springs.

Tyrone will also submit annual reports to MMD beginning in Year Two of the test plot study in accordance with Condition L.1.d of the MMD Permit (MMD, 2004). The MMD guidelines require monitoring of revegetation during the bonding period to evaluate revegetation success, and NMWQCC 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. The following sections summarize the general approach that will used to meet these requirements.

6.4.1 Erosion and Drainage Control Structures

The reclaimed lands, including those in the Industrial PMLU areas will be visually inspected for signs of excessive erosion, and significant erosion features will be mitigated to prevent future degradation of the site in accordance with Condition 62. Based on the monitoring of revegetation and erosion required in

Conditions 53 and 54, Tyrone will provide recommendations for maintenance work in quarterly monitoring reports, including a schedule for completion of the work.

As specified in Condition 63, Tyrone will routinely inspect and maintain all drainage channels, diversion structures, storm water and retention impoundments, and auxiliary erosion control features in accordance with professionally recognized standards such as Natural Resources Conservation Service and NMOSE. Post construction/reclamation inspection schedules will be developed to include provisions for periodic (annual or semi annual) and extreme event monitoring as appropriate for individual facilities. Tyrone will report evidence of excessive erosion and/or structural failures to the appropriate agencies (MMD, NMED, or NMOSE) in a timely manner. A written report detailing the nature and extent of the problem and a corrective action plan will be developed within 30 days after the problem is identified.

6.4.2 Ground Water and Surface Water Control Facilities

In accord with Condition 61 of DP-1341 (NMED, 2003a), Tyrone will perform quarterly inspections and annual evaluations of all ground water abatement systems, including the seepage interceptor systems, and perform maintenance as necessary to ensure that all water contaminants are managed in a manner that is protective of ground water quality.. Monitoring of site water quality will be accomplished through sampling and analysis of potentially impacted water at site locations. Ground water quality will be monitored throughout the post-closure period. The intent of the ground water monitoring is to evaluate the effectiveness of the ground water containment systems and demonstrate compliance with applicable regulations and standards. The monitoring schedule, analytical requirements, location, and construction specifications for the monitoring wells will be determined in consultation with NMED. The analytical results will be reported to the NMED on a semi annual basis.

A Contingency Plan and Emergency Response Plan was submitted in April 2004 (PDTI, 2004b) that presents details for addressing potential failures of individual components of the Tyrone Mine closure plan, including an increase in the extent or magnitude of ground water and/or surface water contamination, potential failures associated with interceptor systems and impoundments, and potential failures of various components of closed lands. The emergency response plan outlines operational parameters and contingencies to address operation failures at Tyrone associated with pumping water from the open pits, sumps, and other impoundments that may contain affected water. Accordingly, Tyrone will verify potential exceedances, report exceedances to NMED within 24 hours of confirmation, prepare a corrective action plan for mitigation within 15 days, and implement the mitigative measures within a reasonable period of time. The corrective action plan will be developed and implemented in collaboration with NMED.

Surface water quality will be monitored to determine the effectiveness of the reclamation. Surface water sampling will be conducted in accordance with the Closure and Post Closure Surface Water Sampling Plan (PDTI, 2003f). The plan identifies 10 drainages to be sampled quarterly in accordance with the protocols established for the SWPPP for the Tyrone Mine. hese include Wind Canyon, three locations in Mangas Wash, Red Rock Canyon, Whitewater/Deadman Canyon, Brick Kiln Gulch, two locations in Oak Grove Creek, and Deadman Canyon. Additionally, the surface water sampling plan specifies semi-annual sampling of all surface impoundments that will remain in place for closure and post-closure storm water control. The water samples will be analyzed to determine total suspended sediment and dissolved constituents required to demonstrate compliance with applicable standards. The results of the surface water quality monitoring will be reported to the NMED Surface Water Quality Bureau (SWQB). A corrective action plan will be developed and submitted to the NMED SWQB and MMD if data indicate degradation of water quality has occurred.

Samples will be collected quarterly in all monitoring wells currently required to be monitored in the Operational DPs, and in all new monitoring wells installed after closure. Tyrone reserves the right to modify the sampling frequency based on water quality trends observed during the closure period. Sample collection will be done in-house or under contract by an independent environmental engineering firm. Collected samples will be shipped to an independent analytical laboratory for analysis. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

The water treatment plant will be on a continuous schedule of sampling and recording for operational control. Automatic samplers will be employed to collect composite samples of influent and effluent streams. Each month, one composite sample of water treatment plant influent and one composite sample of water treatment plant effluent will be shipped to an independent analytical laboratory for analysis of COCs. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

6.4.3 Revegetation Success Monitoring

The reclaimed areas will be monitored periodically after the final grading and the initial establishment of vegetation on the reclaimed lands. Tyrone will conduct vegetation monitoring of both volunteer revegetation and re-seeded areas during the third year after seeding. Tyrone will inter-seed or reseed those areas that have volunteer vegetation as well as other areas, if necessary. Monitoring will be performed at the sixth year after planting and for 2 consecutive years prior to bond release Revegetation monitoring will include canopy cover, plant diversity, and woody stem density as specified in Section N.2 of the Revision 01-1 to Permit GR010RE (MMD, 2004).

6.4.4 Wildlife Monitoring

Pursuant to Section N.3 of the MMD Permit, Golder submitted a wildlife monitoring plan for post closure in December 2005 (Golder, 2005f). This plan was conditionally approved by the MMD and New Mexico Department of Game and Fish February 15, 2006. The monitoring plan provides a description of the proposed reclamation plan as it applies to wildlife and wildlife habitat, an overview of the existing species and wildlife habitat within the vicinity of the Tyrone Mine, and the proposed methods for deer pellet group counts and bird diversity surveys.

Results will be evaluated to determine wildlife use trends during re-establishment of a self-sustaining ecosystem. The results of the surveys will not be a condition of, or given consideration with regard to financial assurance bond release.

7.0 SUMMARY OF CLOSURE/CLOSEOUT PLAN ACTIVITIES

This section summarizes the existing and planned closure/closeout activities for Tyrone associated with each of the three main mine facility areas.

7.1 Mangas Valley Tailing Unit

The facilities located within the Mangas Valley Tailing Unit are regulated under the DP-27 Settlement Agreement and Stipulated Final Order (NMED, 2003b), DP-1341 (NMED, 2003a), and Revision 01-1 to MMD Permit GR010RE (MMD, 2004). As previously noted, a substantial amount of reclamation work has been completed in the area, and ongoing reclamation work will result in the majority of the facilities in the Mangas Valley Tailing Unit being fully reclaimed prior to the renewal of DP-1341 in April 2008. As such, the following CCP applies only to those facilities that will not be fully reclaimed by April 2008. The primary facilities that will remain to be closed in April 2008 are the 1X tailing impoundment and the surface water catchments/impoundments surrounding the 1 Series tailing impoundments.

The general setting of the Mangas Valley Tailing Unit is shown on Plate 2. The following sections describe specific components on the 1X tailing impoundment and the surface water catchments/impoundments located around the 1 Series tailing impoundments that will remain to be closed after April 2008.

7.1.1 1X Tailing Impoundment

Based on the current reclamation progress on the 1Series tailing impoundments, it is projected that rough grading and terrace bench construction on the 1X impoundment will be completed by April 2008. The components that will be required to be completed after April 2008 include:

- Covering of top surfaces and outslopes of the 1X tailing impoundment with 24 inches of suitable cover material;
- Construction of hydraulic structures on the 1X tailing impoundment where needed to direct run-off from the covered top surfaces;
- Construction of spillways and down chutes on the 1X tailing impoundment as necessary to direct excess water off of the tailing impoundment surfaces; and
- Seeding of covered and disturbed areas at the 1X tailing impoundment to reestablish vegetation.

The 1X regional ground water interceptor system will continue to be operated during closure. The current configuration of the 1X tailing impoundment, grading and drainage plan, and cut/fill isopach map for the tailing impoundment are presented in Appendix A. The reclaimed area of the 1X tailing impoundment and associated disturbed areas are summarized on the facility characteristic forms included in Appendix B.

7.1.2 Surface Impoundments Adjacent to the 1X Tailing Impoundment

Table 2-1 in this plan presents an updated summary of the surface impoundment list and shows the surface impoundments grouped by the operational DP areas. According to this summary, there are 22 surface impoundments have been identified around the 1Seriest tailing impoundments. The planned closure activities for the surface impoundments are described below.

Planned Closure/Closeout Activities

The closure/closeout activities planned for these surface impoundments consist of:

- Pumping of remaining water in the impoundments to an approved discharge point or allowed to evaporate;
- Removal of contaminated material (if present) and grading to achieve positive drainage;
- Covering of impoundments with 24-inches of suitable cover material; and
- Seeding of covered and disturbed areas to reestablish vegetation.

The reclaimed areas of the surface impoundments at the mine are summarized on the facility characteristic forms included in Appendix B.

7.2 Mine/Stockpile Unit

The primary facilities to be closed and/or maintained in the Mine/Stockpile Unit include: 1) the 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B (former East Main), 6C (former Gettysburg In Pit), 7B (former Gettysburg Out Pit), and Copper Mountain leach stockpiles; 2) the 1C, 2B Waste, 3B, 5A (overburden) 7A, 7C, 8C, proposed 9A, and portions of the Savanna and Upper Main waste rock stockpiles; 3) the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna, and San Salvador Hill pits; 4) the SX/EW Plant and associated facilities; 5) the main mine facilities; 6) the lubrication shop area which includes the fuel dock, explosives storage building and prill (ammonium nitrate) tanks; 5) various lined and unlined surface impoundments; 6) various seepage and PLS collection/interceptor systems; 7) various tanks; 8) regional and perched ground water extraction systems, and; 9) booster pump stations.

A substantial amount of reclamation work is currently being conducted in the area As such, the following CCP applies only to those facility components that will not be fully reclaimed by April 2008. The former footprint of the 1C stockpile and the majority of the 1C stockpile outslope (all but a small section located adjacent to the 1A stockpile) are projected to be fully reclaimed by April 2008. Additionally, the outslope of the 7A stockpile is projected to be fully reclaimed and placement of waste material from the 2A leach stockpile as a buttress on the west side of the No.2B waste stockpile will be completed by April 2008. Five additional monitor wells will be installed down gradient of the newly installed seepage collection systems by July 2008 in accordance with operational DP-896.

The general setting of the Mine/Stockpile Unit is shown on Plate 3 and the reclamation areas are presented on the facility characteristic forms in Appendix B. The following sections describe the specific facilities that will still have components to be closed in April 2008 and the components that will be retained for further use during the closure/post-closure period.

7.2.1 Stockpiles Located Outside the SWCZ

Stockpile Facilities to Be Closed

Stockpile facilities located outside the SWCZ to be closed are shown on Plate 3 and include:

- 1A, 3A, 4C, 6C and Copper Mountain leach stockpiles;
- 2B, 7C, and proposed 9A waste rock stockpiles;
- Remaining portions of the 1C and 7A stockpiles that will not be reclaimed by April 2008;
- All but the interior slopes of the 1B, 2A, 2B, 2C, 4A, 4B, and 7B leach stockpiles;
- All but the interior slopes of the 3B waste rock and 5A waste rock/overburden stockpiles.

Existing Components That Will Be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the stockpiles located outside the SWCZ that will be used for post-closure purposes include:

- Construction and maintenance of stockpile top surface perimeter berms;
- Construction and maintenance of berms at the toes of the stockpiles;
- Installation, operation, and maintenance of seven seepage collection systems (seep collection systems 2, 3, 4, 5E, 8, 9, and DC2-1) and associated pipelines in the Deadman Canyon area;
- Installation, operation, and maintenance of six seepage collection systems (7R1A, 7R1B, 7R2A, 7R2B, 7R3A, and 7R4A) and associated pipelines along the 7A waste rock stockpile;
- Installation, operation, and maintenance of three seepage collection/cutoff systems (collections 1, 2, 3), four shallow toe seepage collection systems, and associated pumps and pipelines located along the toe of the 1C waste rock stockpile;
- Installation, operation, and maintenance of three seepage collection/cutoff systems (1AGFT-1, 1AGFT-2, and OGTU-1) and associated pumps and pipelines located around the 1A leach stockpile;
- Installation, operation, and maintenance of two seepage collection/cutoff systems (1BU-1 and 1BU-2) and associated pumps and pipelines located down gradient of the 1B leach stockpile;
- Installation, operation, and maintenance of perched seepage zone collection well systems and associated pumps and pipelines located in Oak Grove Wash;
- Installation, operation, and maintenance of 9 seepage collection/cutoff systems (canyon 4, canyon 5, canyon 6, canyon 7, upper canyon 8, lower canyon 8, upper canyon 10, lower canyon 10, canyon 11) and associated pumps and pipelines located down gradient of the 3A leach stockpile;
- Installation, operation, and maintenance of existing perched seepage and regional aquifer collection systems and associated pumps and pipelines located down gradient of the 3A stockpile;
- Installation, operation, and maintenance of PLS collection systems and associated pumps and pipelines associated with the leach stockpiles;
- Installation of storm water controls in the Copper Mountain stockpile area;
- Placement of waste material from the 2A leach stockpile as a buttress on the west side of the No.2B waste stockpile;

- Grading and cover placement completed on the outslopes of the 7A stockpiles;
- Installation and operation of new regional aquifer collection system located outside the projected footprint of the 3A stockpile; and
- Abandonment of non-essential wells located within the regrade footprint of the 3A stockpile; and
- Installation of replacement monitor wells located outside the projected footprint of the 3A stockpile.

Planned Closure/Closeout Activities

The design criteria for the stockpiles located outside the SWCZ are summarized in Table 6-2 and the planned approaches for closure of these facilities are described below. Reclamation design drawings for the facilities are presented in Appendix A. The planned approaches for closure of the stockpiles located outside the SWCZ include:

- Flushing of pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner;
- Grading of the stockpile top surfaces to a final grade of between 0.5 and 5% to direct storm water to slope drainage channels;
- Grading of the stockpile outslopes down to interbench slopes of 2.5H:1V;
- Construction of 15 foot wide terrace benches on the outslopes at slope lengths of approximately 175 feet (not applicable for 7A Far West stockpile, which is constructed with ridge-valley design);
- Covering of the top surfaces and outslopes of the stockpiles with 24 inches of Gila;
- Construction of surface water conveyance channels on the top surfaces (where required) and terrace benches or valleys (for ridge-valley designs) to direct surface water off the covered stockpile surfaces;
- Construction of spillways and down chutes to divert excess water off the covered top surfaces;
- Grading of the disturbed areas associated with the stockpiles to provide positive drainage;

- Seeding of covered and disturbed areas to reestablish vegetation;
- Plugging and abandonment of any unneeded monitor wells;
- Replacement of monitor wells that are abandoned that are required to be monitored as part of operation DPs;
- Breaching of existing seepage collection systems that will be covered by stockpile regrading;
- Installation of new seepage collection/cutoff systems to replaced breached systems;
- Providing additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility; channels to have energy dissipaters as required; and
- Providing facilities to discharge non-impacted stockpile runoff.

7.2.2 Stockpiles Located Inside the SWCZ

Stockpile Facilities to Be Closed

Stockpile facilities located inside the SWCZ to be closed are shown on Plate 3 and include:

- 6B leach and 8C waste rock stockpiles;
- Interior slopes of the 1B, 2A, 2B, 2C, 4A, 4B, and 7B leach stockpiles;
- Interior slopes of the 3B waste rock and 5A waste rock/overburden stockpiles.

Existing Components That Will be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the stockpiles located inside the SWCZ that will be used for post-closure purposes include:

- Construction and maintenance of stockpile top surface perimeter berms;
- Construction and maintenance of berms at the toes of the stockpiles;
- Installation, operation, and maintenance of PLS collection systems and associated pumps and pipelines associated with the leach stockpiles; and

- Installation of storm water controls in the area.

Planned Closure/Closeout Activities

The design criteria for the stockpiles located inside the SWCZ are summarized in Table 6-2 and the planned approaches for closure of these facilities are described below. The planned approaches for closure of the stockpiles located inside the SWCZ include:

- Flushing of pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner;
- Stockpile top surfaces to remain at their current grades;
- Stockpile outslopes to remain at angle of repose;
- Plugging and abandonment of any unneeded monitor wells; and
- Providing additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility; channels to have energy dissipaters as required.

7.2.3 Open Pits (Non Waiver Areas)

As previously noted, the Main, West Main, Valencia, Savanna, Gettysburg Pits, and Copper Mountain pits have been granted a conditional waiver from the requirement of achieving a SSE, and will not be reclaimed during mine closure (Plate 3). Additionally, as part of this CCP, Tyrone has identified additional open pit areas within the interior portion of the Mine/Stockpile Unit that will be requested for a waiver from achieving a PMLU or SSE (Plate 3). These additional areas include: 1) approximately 105 acres associated with additional mining around the Main and Copper Mountain Pits; 2) approximately 121 acres of pit wall area (comprised primarily of stockpile material at the hardrock/stockpile interface) that was inadvertently omitted from the previous waiver; and 3) approximately 62 acres of future expansion of the eastern portion of the Main Pit associated with mining the residual Gila Conglomerate borrow source for cover. The two remaining open pits, the South Rim and San Salvador Hill pits will be partially backfilled and regraded as part of this CCP, such that drainage is directed toward the Oak Grove Drainage and any ponding that may occur is minimized. Current plans call for the San Salvador Hill Pit to be backfilled with material from the north end of the Copper Mountain Pit as part of near term, ongoing mining activities. The south Rim Pit, may in the future, also be used for placement of newly mined waste rock.

Tyrone emphasizes that this plan is put forth in good faith to attempt to achieve agency goals that these pit areas not be granted a waiver as originally requested by Tyrone. However, the partial backfilling of these two pits can only be practically achieved if the agencies cooperate with Tyrone by allowing the backfilling to occur as part of mining Even though the pits are relatively small, the amount of material required to backfill them is substantial and costly. If the opportunity to complete the desired amount of backfilling is not achieved or is not allowed as part of the active mining operation, then Tyrone may again request that these pits be granted a waiver.

The South Rim and San Salvador Hill pits are shown on Plate 3, and their reclamation areas are presented on the facility characteristic forms in Appendix B. The existing closure components and the planned closure activities for the non-waiver pits are described below.

Existing Components That Will be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the non-waiver pits that will be used for post-closure purposes include:

- Construction and maintenance of pit perimeter berms; and
- Partial backfilling of the San Salvador Hill Pit with waste rock.

Planned Closure/Closeout Activities

The design criteria for the non-waiver pits are summarized in Table 6-2 and the planned approaches for closure of these facilities are described below. Reclamation design drawings for the facilities are presented in Appendix A. The planned approaches for closure of the non-waiver pits include:

- Flushing of pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner;
- Backfilling of pits with available waste rock to a point that will allow for surface water flows to be directed to the Oak Grove Wash drainage;
- Grading of the backfill over the pit walls to maximum inter-bench slopes of 2.5H:1V;

- Construction of 15 foot wide terrace benches on the pit slopes at slope lengths of 175 feet;
- Grading of the top surfaces of the backfill material to a final grade of between 0.5 and 5% to direct storm water to drainage channels;
- Covering of the top surfaces of the backfill and pit slopes with 24 inches of Gila Conglomerate (or other suitable material);
- Construction of surface water conveyance channels on the top surfaces of the covered backfill and terrace benches (where required) to direct surface water off the covered surfaces;
- Construction of spillways and down chutes to divert excess water off the covered top surfaces and into natural drainages;
- Seeding of covered and disturbed areas to reestablish vegetation; and
- Providing facilities to discharge non-impacted runoff into natural drainages.

7.2.4 Open Pits (Waiver Areas)

The Main, West Main, Valencia, Savanna, Gettysburg Pits, and Copper Mountain pits have been granted a conditional waiver from the requirement of achieving a self-sustaining ecosystem, and will not be reclaimed during mine closure. Additionally as described above, Tyrone has identified additional open pit areas within the interior portion of the Mine/Stockpile Unit that will be requested for a waiver from achieving a PMLU or SSE. These areas are also proposed for reclamation in this CCP. These pits and additional areas are shown on Plate 3. The existing closure components and the planned closure activities for the non-waiver pits and additional proposed waiver areas are described below.

Existing Components That Will Be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the waiver pits and additional proposed waiver areas that will be used for post-closure purposes include:

- Construction and maintenance of pit perimeter berms;
- Operation and maintenance of Main Pit dewatering system (five main pit production wells and associated electrical distribution and piping systems);

- Operation and maintenance of Gettysburg Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of Savanna Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of Copper Mountain Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of HDPE-lined East Main Booster Pond; and
- Operation and maintenance of HDPE-lined North Racket Sump located on the east side of the Copper Mountain Pit.

The existing pit dewatering systems (sumps, pumps, electrical distribution and pipeline systems) will continue to be operated and maintained to eliminate all surface water, to the maximum extent practicable, and capture and transfer impacted water to the site-wide water treatment facility.

Planned Closure/Closeout Activities

The design criteria for the waiver pits are summarized in Table 6-2 and the planned approaches for closure of these facilities are described below. The planned approaches for closure of the waiver pits include:

- Construction of a 10-foot wide berm five feet high around the perimeter of the pits to control access; and
- Construction of a 6-feet high continuous chain-link security fence around the pit crest perimeter to control access.

7.2.5 Surface Impoundments and Tanks

Table 2-1 in this plan presents an updated summary of the surface impoundment list and shows the surface impoundments grouped by the operational DP areas. According to this summary, 146 surface impoundments, tanks, and catchments have been identified at Tyrone. Of these, 67 have been closed as part of the ongoing reclamation activities at the mine. For the purposes of this plan, surface impoundments include: open-top storage tanks for process waters, seepage collection waters, and extracted ground water/pit water; storm water catchments; and lined and unlined surface impoundments. The surface impoundment facilities and tanks are planned to be the last features to be closed following the establishment of vegetation and site stabilization on the other facilities. Impoundments that serve PMLU functions or are associated with the stockpile toe perimeter and ground water control systems are planned to be permanent parts of the reclamation system and will be maintained throughout the post-closure period. A summary of the surface impoundments and tanks to be utilized throughout the post-closure period are presented in Table 7-1. All remaining surface impoundments and tanks listed in Table 2-1 that are not included in Table 7-1 will be closed. The existing closure components and the planned closure activities for the surface impoundments and tanks are described below.

Existing Components That Will be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the surface impoundments and tanks that will be used for post-closure purposes include:

- Operation, and maintenance of the HDPE-lined No. 2 PLS Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the HDPE-lined No. 3 PLS Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 6-million-gallon HDPE-lined 1A PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 1A stainless steel PLS tank and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 1A Storm water Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 4-million-gallon HDPE-lined 1B PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 1B stainless steel PLS tank and associated pumps, electrical distribution and pipeline systems; and

- Operation and maintenance of the HDPE-lined Oak Grove Pond and associated pumps, electrical distribution and pipeline systems.

These surface impoundments and associated tanks will be an integral part of the post-closure sediment, seepage, and surface water management system at the mine. The few auxiliary structures not needed to operate these systems (unused power lines and pipelines) will be removed and salvaged or buried upon closure.

Planned Closure/Closeout Activities

All other surface impoundments and tanks that will not be used for post-closure purposes will be closed. The closure/closeout activities planned for these surface impoundments consist of:

- Flushing of pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner;

- Salvaging tanks and salvaging or burying pipelines with 24 inches of suitable cover material;

- Pumping of remaining water in the impoundments and tanks to an approved discharge point or allowed to evaporate;

- Removal of contaminated material (if present, unless agencies approve leaving impacted material in place under specific circumstances) and/or grading to achieve positive drainage;

- Covering of impoundments with 24-inches of suitable cover material where impacted materials remain or unsuitable growth media exists after grading; and

- Seeding of covered and disturbed areas to reestablish vegetation.

7.2.6 Buildings and Structures

Those facilities not designated for industrial PMLU will be demolished, removed, and/or buried. A total of approximately 62 buildings/tanks/structures covering approximately 7,687,500 cubic feet will be demolished and removed under this plan. The list of facilities that are scheduled to be removed is provided in Table 6-1. The existing closure components and the planned closure activities for the buildings and structures are described below.

Existing Components That Will Be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the mine buildings and structures that are not part of the Industrial PMLU that will be used for post-closure purposes include diversion of storm water runoff from paved areas and along access roads at the Mine Maintenance Facilities area, SX/EW plant, lubrication shop area, and Mill and Concentrator area through ditches and culverts to existing sediment/storm water control ponds

Planned Closure/Closeout Activities

All buildings and structures that will not be used for post-closure purposes will be closed. The closure/closeout activities planned for these buildings and structures consist of:

- Salvaging and demolition of the buildings, tanks and structures listed in Table 6-1;
- Removal of all debris and visually affected soil at or near the surface in unpaved areas, disposal of debris or affected soil in an approved manner, and covering with 24 inches of suitable cover material;
- Collection of confirmation samples from areas where soils were removed, as necessary;
- Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 24 inches minimum;
- Flushing of pipelines (if they contained contaminated materials) that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner;
- Salvaging or burying all non-functional pipelines;
- Maintaining and improving existing culverts and surface water conveyance structures (if required);
- Placement of 24 inches of suitable cover material over disturbed areas (unless suitable cover material already exists in the case of a buried pipe approved to remain in place); and
- Seeding of covered and disturbed areas to reestablish vegetation.

7.3 East Mine Unit

The facilities located within the East Mine Unit are regulated under operation DP-896.The primary facilities to be closed and/or maintained in the East Mine Unit include the B Sump (former No. 1 PLS Pond), and the acid-unloading facility at the former precipitation plant. A substantial amount of reclamation work is currently being conducted in the area. As such, the following CCP applies only to those facility components that will not be fully reclaimed by April 2008. The No. 1 leach stockpile is currently being regraded and is projected to be fully reclaimed by April 2008. The B-Sump (former No. 1 PLS Pond is also being reclaimed as part of the No. 1 stockpile reclamation project and is projected to be fully reclaimed by April 2008. Additionally, the Burro Mountain Tailing Impoundment and the C-Sump Pond have been fully reclaimed. Consequently, the acid-unloading and former precipitation plant area are the only facilities in the East Mine Unit that will require closure after April 2008.

The general setting of the East Mine Unit is shown on Plate 3. The following section describes planned closure activities for the acid-unloading and former precipitation plant area, and the components within the East Mine Unit that will be retained for further use during the closure/post-closure period.

Existing Components That Will Be Used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the East Mine Unit that will be used for post-closure purposes include:

- Construction and maintenance of berms at the toe of the No. 1 stockpile;
- Installation, operation, and maintenance of seepage collection/cutoff systems around the southern perimeter of the No. 1 stockpile;
- Removal of the existing non-functional pipelines in the No. 1 stockpile area;
- Closure of the B and C Sump Ponds;
- Installation of an above-ground storage tank, booster pumps/station, and HDPE-lined overflow pond to handle all seepage waters and convey them to the No. 1B PLS tank;
- Abandonment of existing monitor wells and extraction wells located within the regrade footprint of the No. 1 stockpile; and

- Diversion of storm water runoff from parking areas and along access roads through ditches and culverts to existing sediment/storm water control structures in the acid-unloading facility area.

Planned Closure/Closeout Activities

The planned approaches for closure of the acid-unloading and former precipitation plant area will support industrial development in the post-mining era. All buildings and structures that will not be used for post-closure purposes will be closed. The closure/closeout activities planned for this area consists of:

- Flushing of the acid or process water pipelines and tanks and former precipitation plant cells with water to remove residual solutions and dispose of them in an approved manner:

- Salvaging and demolition of the buildings, tanks and structures listed in Table 6-1;

- Removal of all debris and visually affected soil at or near the surface in unpaved areas, disposal of debris or affected soil in an approved manner, and covering with 24 inches of suitable cover material;

- Collection of confirmation samples from areas where soils were removed, as necessary;

- Salvaging or burying of all non-functional pipelines;

- Filling and grading the former precipitation plant area to promote positive drainage;

- Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 24 inches minimum;

- Maintaining and improving existing culverts and surface water conveyance structures (if required);

- Placement of 24 inches of suitable cover material over the pipeline corridor (if suitable fill is not already in place in the case of buried pipelines approved to remain in place); and

- Seeding covered and disturbed areas to reestablish vegetation.

7.4 Borrow Areas

Gila Conglomerate within the 5A stockpile and residual Gila Conglomerate on the east side of the Main Pit are considered the two primary sources of cover material for this CCP. Additional borrow areas are located along the northern perimeter of the No. 1 stockpile and areas located in the vicinity of the 1 Series tailing impoundments. These borrow pits, with the exception of the borrow areas associated with the construction of surface water diversions around the 1 Series tailing impoundments and the east side of the Main Pit, will have low-angle side slopes as a result of the specified excavation plans. The closure/closeout activities planned for these areas consist of:

- Grading of borrow areas to create positive drainage from them;
- Installation of storm water controls with slopes not steeper than 3H:1V;
- Ripping of the pit bottoms and slopes to depths of 24 inches;
- Seeding of covered and disturbed areas to reestablish vegetation; and
- If practical, incorporation of the borrow pits into the post-closure water management system.

8.0 CAPTIAL AND OPERATION AND MAINTENANCE COST ESTIMATES

This section provides a brief description of the capital cost estimate portion of the financial assurance. Cost estimates are budgetary and for the purpose of determining the value of the financial assurance performance bond.

8.1 Capital Cost Estimates

The cost estimate has been prepared in accordance with standard engineering practice and is supported with data from various references (Appendices C and D). The capital costs for closure are presented in detail in Appendices C and D and are summarized as follows:

Capital Cost Summary		
Item	**Amount**	**Total**
Earthwork		
Tailing Impoundments	$17,866,738	$24,941,967
Stockpiles	$97,306,879	$135,840,403
Non-Waiver Open Pits	$17,907,065	$24,998,262
Surface Impoundments	$484,923	$676,953
Other Disturbed Areas	$353,413	$493,364
Abandonment of Monitor Wells, and Exploration Holes and Seepage Collection Systems	$666,390	$930,280
Replacement of Monitoring Wells and Collection Systems	$633,856	$884,864
Building Demolition and Soil Removal	$1,994,868	$2,784,836
Earthwork Subtotal	**$137,214,132**	**$191,550,928**
Water Treatment		
Water Treatment Facility	-	$15,818,000
Evaporative Treatment System	-	$8,077,000
Water Collection and Conveyance	-	Existing
Sludge Disposal Facility	-	$1,588,000
Water Treatment Subtotal		**$25,483,000**
TOTAL CAPITAL COST		**$217,033,928**

8.2 Basis of Capital Cost Estimates

Capital cost estimate details for earthwork, including quantity takeoffs, calculations, and supporting documentation are provided in Appendix C. The capital costs associated with water management and treatment are provided in Appendix D.

8.3 Operation and Maintenance Cost Estimates

The O&M cost estimate details and supporting documentation are provided for earthwork in Appendix C and water treatment in Appendix D.

8.3.1 Earthwork

O&M costs are allocated over time periods of years 1 to 20, years 21 to 40, and years 41 to 100 as the requirements for O&M change as follows:.

- **Years 1 to 20**: erosion control will be will be required 30 days per year with monthly road maintenance.
- **Years 21 to 40**: erosion control work will be reduced to 24 days per year with bi-monthly road maintenance.
- **Years 41 to 100:** erosion control will be required 13 days per year with quarterly road maintenance.

Also included are erosion control and revegetation maintenance costs for all tailing impoundments:

- **Erosion Maintenance:** 75 days/year for years 1 and 2; 45 days/year for years 3, 4 and 5.
- **Revegetation Maintenance:** 5% failure every year for 12 yrs.

Appendix D provides the support for the operations and maintenance cost estimate. O&M costs (current year dollars) for closure are summarized as follows:

Earthwork O&M Cost Summary					
Period (years)	**Revegetation Maintenance**	**Wildlife Monitoring**	**Road Maintenance**	**Erosion Control**	**Total (Current Year $)**
General O&M					
1 to 20	-	$139,600	$4,432,031	$4,482,006	$9,053,637
21 to 40	-	$139,600	$2,216,016	$3,585,605	$5,941,221
41 to 100	-	$418,800	$3,324,024	$6,723,009	$10,465,833
Tailing Impoundments					
1 to 12	$1,890,412	NA	NA	$2,128,953	4,019,365
Total	**$1,890,412**	**$698,000**	**$9,972,071**	**$16,919,573**	**$29,480,056**

The Tyrone cost estimate was developed based on the format used previously at Cobre at the request of the MMD and NMED. The Cobre 2005 cost estimate update did not include the revegetation maintenance costs in the detailed cost estimate, but they were included in the financial assurance calculation. The Tyrone cost estimate follows the Cobre format, therefore revegetation maintenance costs calculated to be $2,366,369 for areas to be reclaimed and revegetated in the future are not included in the cost estimate, but are communicated here for completeness. These costs would be added later in the financial assurance calculation or can be added to this cost estimate in the future. Revegetation maintenance costs for tailings impoundments or portions of impoundments that are reclaimed, or are assumed to be reclaimed in accordance with the schedule shown in Table 9-1, are included in the cost estimate.

8.3.2 Water Treatment

Annual O&M costs are allocated over time periods of years 1 to 5, years 6 to 10, 11 to 15, 16 to 25, 26 to 32, 33 to 40, and 41 to 100 as the requirements for O&M change. Annual O&M estimated costs for out-year steps and sum total (100-year) O&M are as follows:

Estimate of Annual Operating Cost in Out-Year Steps						
Period (years)	Evaporative Treatment System	Nanofiltration/HDS Plant	HDS Plant	Water Collection/ Conveyance	Sludge Disposal	Total
1 to 5	11,809,000	-	-	2,985,000	-	14,794,000
6 to 10	- -	20,813,000	-	2,432,000	1,599,000	24,844,000
11 to 15	-	16,486,000	-	2,053,000	1,254,000	19,793,000
16 to 25	-	28,600,000	-	3,982,000	2,159,000	34,741,000
26 to 32	-	17,302,000	-	2,637,000	1,196,000	21,135,000
33 to 40	-	18,712,000	-	2,990,000	1,178,000	22,880,000
41 to 100	-	134,326,000	-	22,314,000	8,208,000	164,848,000
TOTAL	**11,809,000**	**236,239,000**	-	**39,393,000**	**15,594,000**	**303,035,000**

As shown, annual O&M costs for operation of the ETS are included for years 1 to 5 only. The ETS will be shut down when process solutions are eliminated, which is projected to occur at year 5. The O&M of the water treatment plant includes cost for labor, equipment replacement, utilities, chemical reagents, and testing. Further details on the water treatment system and the associated cost estimates are provided in Appendix D.

9.0 CLOSURE SCHEDULE

An update to the reclamation schedule is required pursuant to DP-1341 and the MMD Permit. Table 9-1 presents the anticipated schedule for implementation of closure activities based on best available information and forecasts based on the progress of ongoing reclamation efforts at the mine. The proposed schedule summarizes Tyrone's understanding of the existing near-term mine operation and reclamation commitments and longer-term projections. More specifically, the schedule is based on the following considerations

- Ongoing reclamation projects and previous schedule commitments;
- Practical phasing of the reclamation projects to account for water management, water treatment and the anticipated labor, equipment and other resources that would be necessary to complete these projects based on current conditions;
- Sequential closure of facilities in a phased cost efficient manner (i.e., closure of select leach and waste rock piles as mining operations cease followed by closure of the 2A leach stockpile upon completion of operation of the process solution elimination system); and
- Total annual acreages that would be reclaimed over this period.

The anticipated durations specified in Table 9-1 are based upon cessation of operation for the various facilities occurring at different times. If cessation of operation occurs for more than one facility at or near the same time, then reclamation of those facilities will occur within a time period that will be less than the sum of the total anticipated durations listed for those facilities. Ultimately, Tyrone reserves the right to modify the proposed reclamation schedule to respond to unforeseen changes in mine operations and ongoing mine reclamation efforts, and advancements in reclamation practices. The anticipated durations for reclamation presented in Table 9-1include earthwork and reseeding, but do not include vegetation success/O&M/monitoring.

For clarity, the financial assurance cost estimate and the proposed reclamation schedule are explicitly linked. Tyrone expects that the planned closure of the facilities represented by the proposed schedule will be conducted in a more cost efficient manner than that reflected in the financial assurance cost estimate, which is predicated on the unlikely condition of forfeiture. As indicated earlier, implementation of the mine-for-closure concepts are expected to result in more efficient reclamation than might be considered in a forfeiture scenario.

10.0 USE OF THIS REPORT

Golder has compiled this Closure/Closeout Plan (CCP) to present Tyrone Mine's 5-year update of the CCP to the New Mexico Environment Department (NMED) and the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department. In the compilation of this plan, Golder collaborated with MWH, who designed the closure/closeout configuration of the mine facilities and Telesto Solutions, Inc, who prepared the earthwork cost estimate. The Tyrone Mine CCP was updated to fulfill applicable requirements of the following two permits:

- **Supplemental Discharge Plan DP-1341, Phelps Dodge Tyrone, Inc., Tyrone Mine Facility,** (DP-1341), issued by the NMED on April 8, 2003 (NMED, 2003a); and
- **Revision 01-1 to Permit GR010RE, Tyrone Mine** (MMD Permit), issued by the MMD of the New Mexico Energy, Minerals and Natural Resources Department on April 12, 2004 (MMD, 2004).

Tyrone has completed numerous other studies required by DP 1341 and Mining Act Permit GR010RE and is in the process of completing a feasibility study. Information from these various studies has also been considered in preparing this CCP update.

Please contact the undersigned with any questions or comments on the information contained in this report.

Respectfully submitted,

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