Phelps Dodge Tyrone, Inc. P. O. Drawer 571, Tyrone, New Mexico 88065 • (505) 538-5331

February 10, 2004

Certified Mail #70993400000643556247
Return Receipt Requested

Ms. Mary Ann Menetrey
Program Manager
New Mexico Environment Department
Mining Environmental Compliance Section
P. O. Box 26110
Santa Fe, New Mexico 87502

Dear Ms. Menetrey:

Re: Phelps Dodge Tyrone, Inc. – DP-1341, Condition 89, Tyrone Mine Feasibility Study Work Plan, Response to NMED Comments

Attached please find the Phelps Dodge Tyrone, Inc. (Tyrone) revised work plan and implementation schedule as required in Condition 89 and by correspondence from the New Mexico Environment Department (NMED) dated October 24, 2003. Tyrone provided draft table revisions for discussion to NMED on January 22, 2004 in preparation for a meeting with NMED on January 26, 2004. At that meeting Tyrone provided draft revised language to address NMED's comments. Tyrone and NMED representatives discussed Tyrone's proposed changes to the Feasibility Study Work Plan. The representatives at the meeting also discussed issues specific to the Chino Feasibility Study Work Plan. Tyrone has incorporated the information requested in the NMED comments dated October 24, 2003 and from the discussions and comments received during the January 26, 2004 meeting. The following list summarizes Tyrone's understanding of the additional information required by NMED in these communications.

- Site maps Figures 1 and 2 identifying mine facility locations have been included.

- A bibliography of references is included as Section 6 of the Work Plan.

- The language of the last sentence of paragraph two of the introduction was clarified per NMED's request to reflect that the Feasibility Study will evaluate the relative performance of alternatives with respect to the WQA and WQCC Regulations.

- Table 1 summarizes closure plan alternatives. The specifics that NMED asked to be included in this table are: 1) 1D Stockpile added to appropriate alternatives; 2) Identify slope angles associated with stockpile regrading alternatives and evaluate NMED's preferred 3:1 alternative at a minimum; 3) Add four-foot cover alternative; and 4) Add specific backfill alternatives for open pits. NMED also requested that the options evaluated be integrated with Tyrone tailing water management options that are being evaluated as part of Paragraph 18 of the Discharge Permit 27 Settlement Agreement. Text has been added in this work plan to clarify that these tailing water management options will be integrated as appropriate into the feasibility study.

- Table 2 provides a matrix of preliminary water treatment alternatives.

- Table 3 names and summarizes the components in the Tyrone Mine System Model with specific references to the extent practicable. The mixing cell model component was also added to this table. NMED indicated at the meeting that it might have concerns with the methodology utilized in this model component. However, given that this is a work plan, the referenced mixing cell model should be considered preliminary and may be modified as a result of the supplemental studies and future technical interactions with NMED.

- Table 4 provides a list of preliminary parameters to include in sensitivity analyses. NMED requested that the sensitivity parameters include stockpile oxygen content, flow model results and precipitation. These items are now included in Table 4.

- Table 5 provides ongoing supplemental supporting studies and completion dates.

- Table 6 provides the potential inputs and anticipated integration of supplemental study results to the Tyrone System Model Components.

- Draft language for additional detail describing the generation of cost estimates for additional alternatives was provided to NMED at the January 26th meeting and agreed to as acceptable. It has been incorporated into this revised work plan in Section 3-Approach.

- The work plan schedule discussed on January 26th that updates NMED quarterly for the first year and annually through 2007 is discussed in Section 5 and included on Table 7.

- Examples of use of the GoldSim software (GoldSim Technology Group, 2003) for alternatives analysis and closure alternative analysis are cited in paragraph 4 of Section 4.1.

Please contact Mr. John Gearhart at (505) 537-4382, if you have questions or require additional information.

Very truly yours,

Ned Hall for J.A. Brunner

Joseph A. Brunner, Manager
Environment, Land & Water
New Mexico Operations

JAB:jg
Attachment
20040210-101

Feasibility Study Work Plan
Tyrone Mine Facility

Prepared for
Phelps Dodge Tyrone Inc.
Tyrone, NM

February 10, 2004

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1. Introduction

The New Mexico Environment Department (NMED) issued a Supplemental Discharge Permit for Closure, DP-1341 (Supplemental Discharge Permit) to Phelps Dodge Tyrone, Inc. (PDTI) on April 8, 2003. The Supplemental Discharge Permit contains the closure requirements for the Tyrone Mine Facility pursuant to the New Mexico Water Quality Act (WQA) and the New Mexico Water Quality Control Commission (WQCC) Regulations. The Supplemental Discharge Permit incorporates the Tyrone Closure/Closeout Plan (CCP) submitted to NMED in March 2001 and includes specific requirements for the closure activities associated with the Mangas Valley Tailings Area and Mining Area owned and operated by PDTI. The Supplemental Discharge Permit includes 117 Conditions that PDTI must comply with in order to comply with the WQA and WQCC Regulations.

Conditions 75 through 89 in the Supplemental Discharge Permit require PDTI to perform additional studies to assess the adequacy of the closure actions in the CCP. Conditions 75 through 88 are associated with scientific investigations to improve the understanding of the performance of specific closure activities. Condition 89 requires PDTI to perform a Feasibility Study to evaluate closure alternatives for each Tyrone Mine facility. The Feasibility Study will evaluate the relative performance of alternatives with respect to the WQA and WQCC Regulations. Other performance criteria are described in Section 2 below.

The Feasibility Study is closely tied to other studies and activities required under Conditions 75 through 88 in DP 1341. These studies are supplemental in nature meaning they are follow-up studies to the extensive body of work already completed to develop the CCP. The Feasibility Study will serve to tie together the technical information from the supporting studies. The Feasibility Study will compile, evaluate and compare technical and economic information to provide a comprehensive basis for recommending a closure alternative for each facility. Since the supporting studies will provide important new information for making closure alternative recommendations, it is critical that the Feasibility Study be initiated early in the process so that the studies can be integrated to meet the needs of the Feasibility Study. The early stages of the Feasibility Study will guide and help focus the supporting studies so that they provide the necessary information for a comprehensive analysis and the basis for making the ultimate decisions for closure.

Condition 89 requires PDTI to submit to NMED for approval, a work plan and implementation schedule for the Feasibility Study. The work plan and implementation schedule are provided in this document. PDTI's preliminary concept for integrating the Feasibility Study and other studies was submitted to NMED in a letter dated May 23, 2003. The Feasibility Study is expected to be a working process where adjustments can be made as phases are completed to incorporate new information and understandings and meet the objectives of the study. This document provides more detail on the initial phase of the study and allows the subsequent phases to be developed further as needed to meet the study objectives. The four major phases of the Feasibility Study are:

- System Model Development – develop a comprehensive representation of the physical system that provides an initial basis for evaluating closure alternative options based on what we know now.
- Sensitivity Analyses – use the system model to prioritize the information needed from the supporting studies.
- Information Integration – revise the system model based on the information from the supporting studies.
- Documentation and Recommendations – prepare a report describing the methodology for performing the Feasibility Study and the results and conclusions concerning the recommended closure alternatives.

2. Study Requirements

Condition 89 in the Supplemental Discharge Permit requires that the Feasibility Study be designed to evaluate closure alternatives for each facility to be closed. Condition 89 states:

> 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) stormwater collection; (d) leachate collection; (e) contaminated ground water collection and remediation; (f) reclamation of the Open Pits, including compete and partial backfill and reclaiming the area backfilled within the pits; (g) water treatment; and (h) appropriate combinations of the foregoing.

The basis for comparing the closure options are the WQA and WQCC Regulations and a variety of performance metrics associated with individual facility closure alternatives. Condition 89 states:

> The study shall be designed to determine whether the closure alternatives evaluated will ensure that the requirements of the WQA and the WQCC Regulations are met. At a minimum, alternatives shall be evaluated based on the following criteria: (a) percentage reduction in infiltration, concentration, volume, and mobility of water contaminant; (b) effectiveness in attaining ground water and surface water quality standards; (c) technical feasibility; (d) stability and durability; and (e) cost, including capital costs, operating costs, and other appropriate costs and the impact of additional costs on mine reserves and operating life. The costs evaluated shall be given the least weight of all the factors evaluated. The Feasibility Study shall include a cost estimate with supporting data for each alternative evaluated including implementation, long-term maintenance and long-term financial assurance requirements.

The Feasibility Study may incorporate additional requirements and criteria relating to compliance with the New Mexico Mining Act and other applicable regulations since the closure plan must ultimately address all applicable State and Federal Regulations.

The Supplemental Discharge Permit requires PDTI to perform additional studies to assess the adequacy of the closure actions in the CCP. Conditions 75 through 88 are associated with the scientific investigations to improve the understanding of the performance of specific closure activities. Many of these studies are supplemental to existing studies performed by PDTI and its consultants for the CCP. Condition 89 requires that the information from these investigations be incorporated in the Feasibility Study and that the study be completed and documented by April 8, 2007:

> This Feasibility Study shall incorporate data and other information derived from the other additional studies required in this Supplemental Discharge Permit. The study shall be completed within four years after the Effective Date of this Supplemental Discharge Permit.

At the completion of the Feasibility Study, PDTI is required to submit a Feasibility Study report that describes the options evaluated and recommends a closure alternative for each of the facilities within the Tyrone Mine.

3. Approach

As noted earlier, Condition 89 requires that the Feasibility Study evaluate closure alternatives for each facility to be closed. The Tyrone Mine includes numerous facilities including seven inactive tailing impoundments, eight open pits, nine leach ore stockpiles, seven waste rock piles, various surface impoundments for process solutions and storm water control and several building facilities for copper recovery, power generation, mine maintenance, etc. Figure 1 shows the location of the open pits and stockpiles. The

Figure 1 Location of Open Pits and Stockpiles at the Tyrone Mine

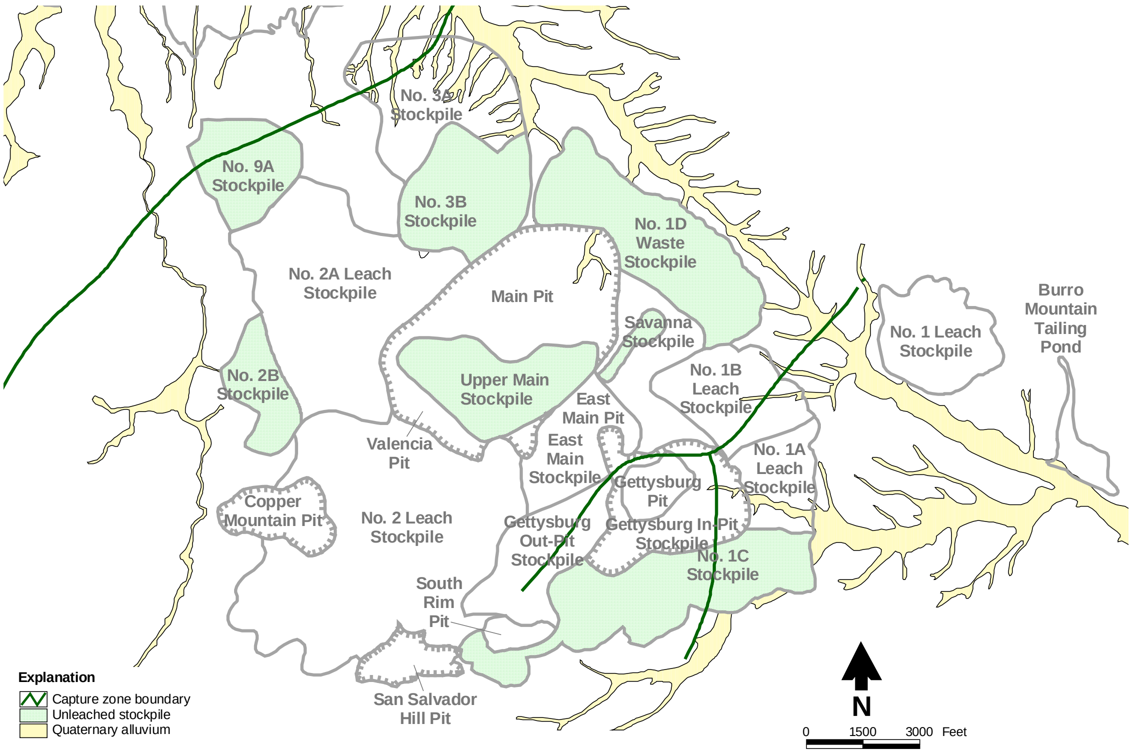
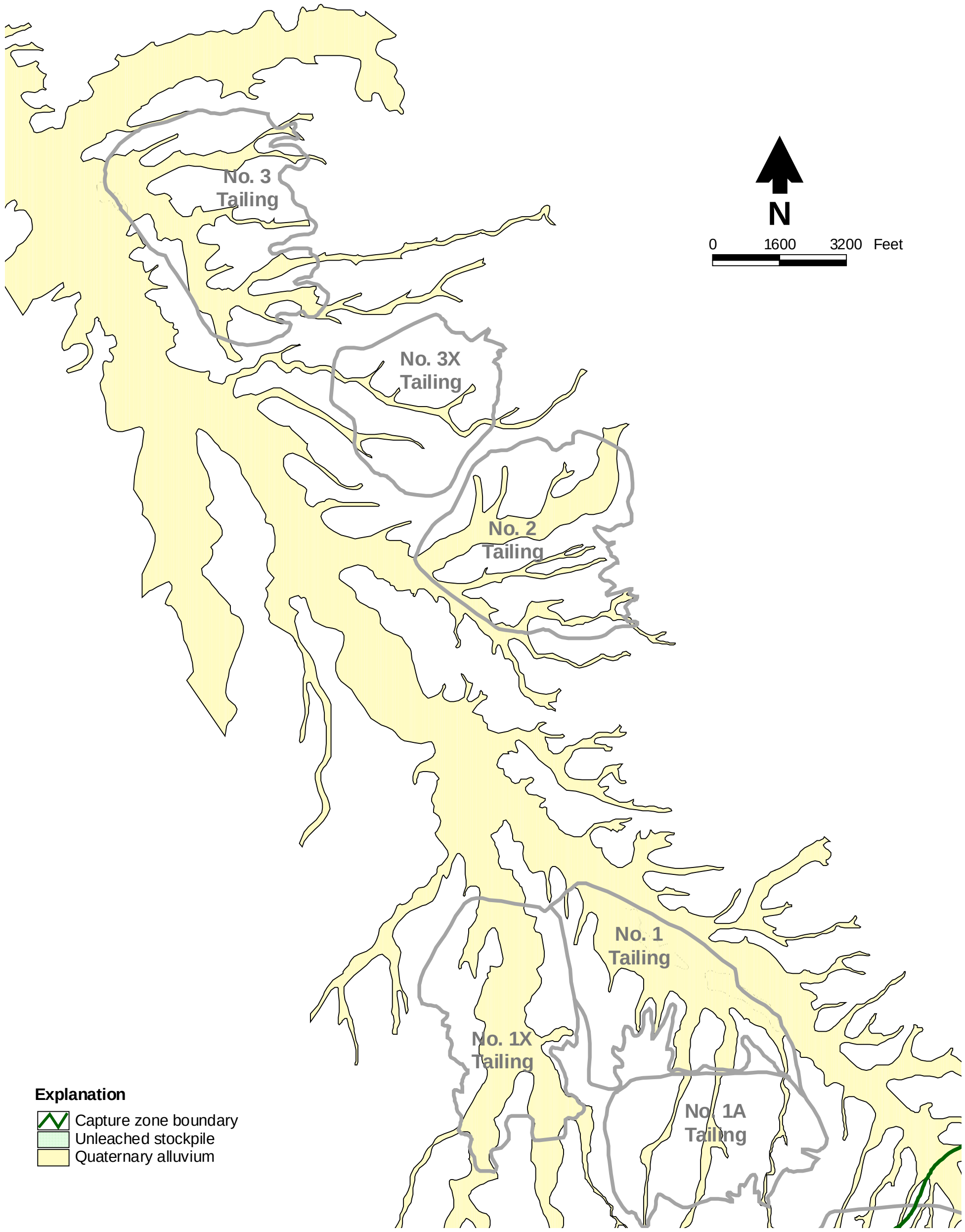
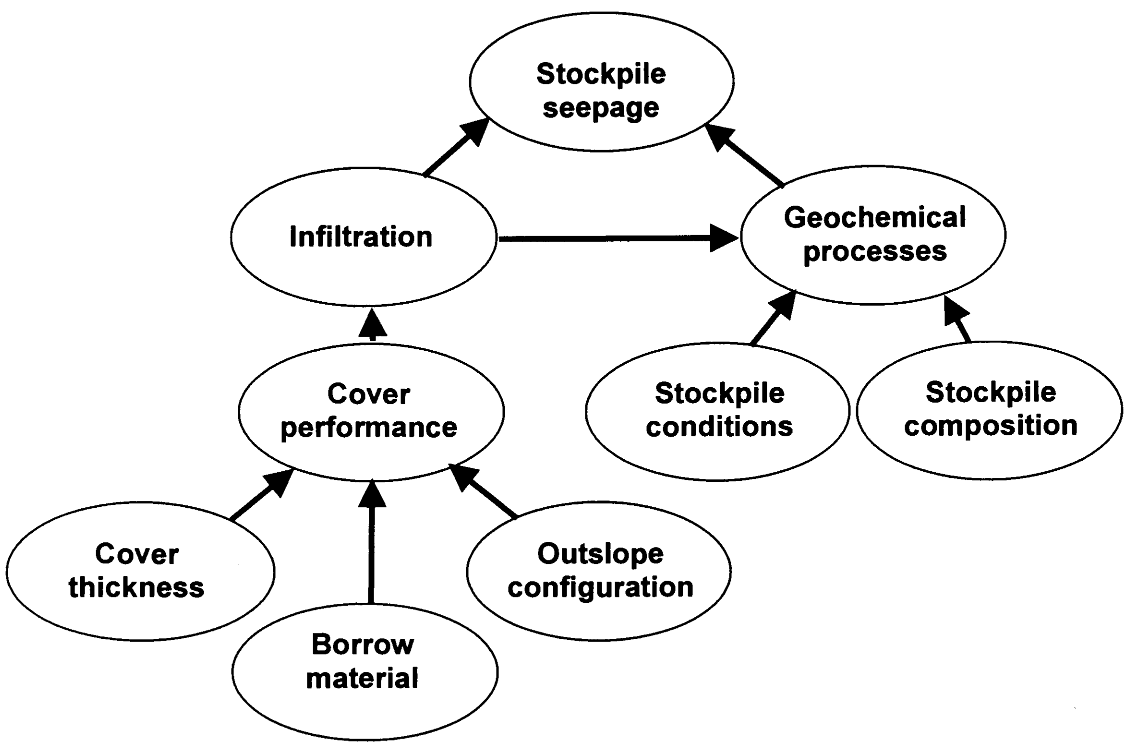


Figure 2 Location of Tailing Impoundments in Mangas Wash



inactive tailing impoundments are shown in Figure 2. The Supplemental Discharge Permit describes a range of closure alternatives for portions of the facilities, such as alternative cover configurations. The objective of the closure activities required under the Supplemental Discharge Permit is to establish conditions that comply with groundwater standards or that ensure abatement of groundwater contamination.

The ability of the closure alternatives to achieve the requirements of the WQA and the WQCC Regulations will depend on the performance of the Tyrone Mine system, not the performance of individual closure alternatives, e.g., stockpile covers. For example, the rate and quality of solution released from the base of a stockpile will depend on the geochemical characteristics and conditions in the stockpile which is influenced by the rate water percolates through the stockpile which is influenced by climate and the cover performance; cover performance will depend on the cover thickness, material properties, vegetation, etc. A simplified influence diagram of the interactions is shown in the figure below. The figure does not convey the fact that some of the processes and conditions are time-dependent, i.e., they change with time. Therefore, a holistic approach will be used in the Feasibility Study that considers the entire mine system and the interactions between the mine facilities and the closure alternatives and changes to the system as a function of time.



The basis for performing the Feasibility Study will be a system model that includes the processes in each of the mine facilities that could impact the groundwater systems and how these processes are influenced by the closure alternatives. A dynamic simulation program will be used to develop the system model to account for time-dependent processes and conditions. The simulation program will also allow for uncertainties in the system and system behavior to be explicitly represented in the model. The Monte Carlo method will be used to propagate uncertainties through the model simulations to understand the significance of uncertain parameters, conditions, processes, etc. These sensitivity analyses will help guide the studies required in Conditions 75 through 88 by identifying the key areas where additional information is needed to reduce the uncertainty in the performance of the overall system and confirm the underlying conceptual models for the system components. Therefore, the system model is iterative and will be periodically updated as new data and information become available from the ancillary studies.

The closure alternatives that will be considered in the feasibility study have not been finalized but are likely to consist primarily of different approaches for stabilizing mine facilities and managing surface and subsurface water sources to control water quality. The alternative evaluations will consider the long-term environmental, operational and economic performance implications of the alternatives. The closure alternatives that are likely to be considered in the feasibility include differences in:

- Thickness of the cover system on the tops of stockpiles
- Extent covers are applied to stockpile outslopes inside the pit capture zone
- The angle stockpile outslopes are regraded prior to cover construction
- Management and treatment of process water at the beginning of the closure period
- Treatment technologies for impacted surface water and groundwater
- Disposal of sludge from water treatment facilities

The above alternatives (and possibly others) will be combined into closure options that will be compared based on their projected environmental, operational and economic performance. Table 1 contains a preliminary list of closure options and associated facilities that will be evaluated. The options differ by the extent and angle the stockpile outslopes are regraded and covered, the cover thickness, and the extent the open pits are backfilled. The tailing cover options to be evaluated in the feasibility study include 2, 3 and 4-foot covers, otherwise configured as required in DP 1341. The tailing options may not be evaluated using the systems model approach, but water management options from tailing discharges that contemplate pumping to the mine area will be accounted for in the systems model for the mine area. Additional options may be evaluated based on the results of the preliminary set of options and as information from the supplemental studies become available.

The projected flows and quality of impacted surface and groundwater associated with these options will be integrated with alternative water treatment and sludge disposal options to develop comprehensive closure alternatives. A matrix of preliminary water treatment alternatives for impacted surface water and groundwater and the associated facilities is shown in Table 2.

The cost of the closure options will be developed by combining the expected capital and operating costs for the alternatives. The construction cost for the regrading and cover construction alternatives will be developed using the methodology used to prepare similar estimates for the CCP. The capital cost and operating cost for the water treatment alternatives will be based on the projected flow rates and quality of the impacted surface and ground waters. Similarly, the projected sludge production rate will be used to estimate the capacity, capital and operating cost of a sludge disposal facility.

The Feasibility Study will be performed in four phases. The system model will be developed in the first phase and provide the primary basis for evaluating closure alternative options based on the quantitative performance criteria. The initial version of the model will be based on existing information and studies.

The system model developed in the first phase will be used to perform sensitivity analyses in the second phase. The results of the sensitivity analyses will provide insights into the overall behavior of the mine following closure and the critical closure components and processes. This information will be used to prioritize the information needs from the supporting studies.

In the third phase, the component models (e.g., cover infiltration) will be revised based on new information and data from the supporting studies. Additional closure alternative options may also be added. Revisions will be an ongoing process over several years as the various supporting studies are completed. Additional sensitivity analyses will be performed to determine whether the relative importance of the processes and input parameters in the model has changed.

A report describing the methodology that was used to perform the Feasibility Study and the recommended closure alternatives for the Tyrone Mine will be prepared in the last phase. Descriptions of the various component models, including the supporting studies, data and verification will be provided periodically in quarterly and annual reports over the course of the study that are described in Section 5 below.

4 Work Plan

Condition 89 requires PDTI to submit to NMED for approval, a work plan and implementation schedule for the Feasibility Study. This section describes the proposed plan and schedule.

4.1 System Model Development

The models and analyses that were used to develop the technical basis for the CCP, as supplemented by the studies required under the Supplemental Discharge Permit, will provide the technical basis for developing the initial version of the system model. This work includes cover studies, seepage quality and groundwater models, water treatment technologies, cost estimates, etc.

The purpose of the system model is to integrate the various component models of the mine facilities and closure alternatives developed for the CCP. The integration process will include the development of simplified representations (e.g., analytical expressions, lookup tables) of the component models that capture the basic behavior of each of the major facilities over a range of conditions (i.e., closure alternatives). This model abstraction process allows the interrelationships between the component models and performance measures to be explicitly represented as a coupled system.

The current mine setting and other background information regarding closure/closeout of the Tyrone Mine is provided in the CCP (M3, 2001). Numerous technical studies were conducted to support the CCP. The studies that are most relevant to the development of conceptual models for developing a representation of the Tyrone Mine system are listed in Table 3.

The system model will be developed using the GoldSim Pro simulation program. The GoldSim program is a probabilistic, dynamic simulation program used to simulate complex systems. The software is used by industry and government on a wide range of projects including the U.S. Department of Energy's Yucca Mountain Project where GoldSim is being used in the license application phase to provide long-term performance projections for the proposed nuclear waste repository. The GoldSim software (GoldSim Technology Group, 2003) and the system model approach have been used to perform closure plan alternatives analysis mines in the US (Wickham et. al., 2004) and abroad (Davidge et. al., 2003, Golder Associates Inc., 2003). The approach has been used extensively in the reclamation of the Wismut GmbH uranium mines in eastern Germany, the largest mine reclamation project in Europe (Golder Associates Inc., 2000, Kossik et. al., 1996, Jakubick and Hagen, 2000).

Uncertainty in the inputs to the system model will be explicitly represented using appropriate probability distribution functions. Sources of uncertainty include a lack of information (e.g., sparse data) or natural variability within a facility (e.g., inside a stockpile). Conceptual model uncertainty will also be included.

4.2 Sensitivity Analyses

The system model will be used to perform sensitivity analyses to identify the parameters, assumptions, processes and closure components that have the greatest influence on system behavior. The results will provide insights into the relative importance of these issues and will provide focus and direction to the other studies in the Supplemental Discharge Permit. Table 4 contains a preliminary list of the major parameters that will be evaluated as part of the sensitivity analysis and the component model(s). Additional parameters may be added as the system model evolves over the course of the feasibility study and as the results of the supporting studies are integrated in the model.

4.3 Information Integration

The supporting studies that will be performed under Conditions 75 through 88 will provide supplemental information about the mine facility, closure alternatives and process important for assessing compliance. Revisions to the system model are likely and will occur over several years as the supporting studies are completed. A list of the supporting studies and the proposed completion dates are provided in Table 5.

The results from the supporting studies will be integrated with the system model. The results will be used to improve the parameter distributions and verify (or revise) conceptual models. A preliminary list of the inputs from the supporting studies that are likely to be integrated with the system model are shown in Table 6. Additional parameters may be added as the system model evolves over the course of the feasibility study and as the results of the supporting studies become available.

4.4 Feasibility Study Report

The performance projections for the closure alternatives will be combined with other criteria (e.g., technical feasibility, stability and durability) to arrive at a set of closure alternatives that meet the requirements of the WQA, WQCC Regulations and the Mining Act and are cost effective. Upon completion of the Feasibility Study, PDTI will submit a report detailing the work performed under this work plan. The report will describe the methodology, the technical basis for the study, the set of closure alternatives evaluated and their relative performance and cost. The report will identify the proposed closure alternative for each of the Tyrone facilities. Descriptions of component models, supporting studies, new data, verification studies, etc., will be provided periodically over the course of the study as the information becomes available.

5. Schedule

The work plan activities will be started within 30 days of receiving approval by NMED. The first phase of the study where the system model is developed is expected to be completed within 280 days after the start of the study. The second and third phases are iterative, i.e., multiple sensitivity analyses will be performed as new information from the supporting studies is made available and integrated with the system model. Therefore, the schedule for completing these phases must be consistent with the completion of the bulk of the supporting studies, that is, in late 2006. The report documenting the Feasibility Study will be completed by April 2007.

Quarterly updates will be provided to NMED during the first year of the study and then annually through 2007. The schedule for the updates is provided in Table 7.

PDTI is willing to meet with NMED periodically during the course of the Feasibility Study to discuss information provided in the updates. This may include the basis for system component models, integration of data from supplemental studies, new or revised alternative closure options and other questions that might arise.

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TABLES

TABLE 1

Description of Preliminary Set of Stockpile and Pit Closure Options to Evaluate

Option Description	Associated Facilities
1. Minimal action – Assumes no regrading of outslopes or cover emplacement on stockpile tops or outslopes. Impacted surface runoff and basal seepage is collected and treated.	PLS collection impoundments, seepage interception systems, stormwater retention ponds, open pits, pumping stations and conveyances as needed for stormwater and leachate collection and storage during closure. Impacted water assumed to be sent to water treatment system.
2. Option completely consistent with DP 1341. Regrade all stockpile outslopes to 3:1 (other than in-pit stockpiles and where there are physical constraints, e.g., highway) and cover (and revegetate) top and outslopes with 36" of material. Where physical constraints exist (major drainages and highways), stockpiles regraded to 2.5:1 with 36" of cover. No infilling of pits. Same water management/treatment as in Option 1.	Stockpiles 1, 1A (partial 2.5:1), 1B (partial 2.5:1), 1C (partial 2.5:1), 1D, 2, 2A, 2B, 3A (partial 2.5:1), 3B, 9A, East Main, Gettysburg Out-pit and Savanna. Stockpiles within the boundary of Main and Gettysburg Pit left at angle of repose with no cover. Main, Gettysburg and Copper Mountain pits dewatered to maintain minimal pit lake. Same water management and treatment facilities listed under Option 1.
3. Same as Option 2 except with a 48" cover.	48" cover on regraded stockpile facilities listed above.
4. Same as Option 2 except with a 24" cover.	24" cover on regraded stockpile facilities listed above.
5. Same as Option 2 except partially backfill Copper Mt. pit (to above water table elevation) and completely backfill the smaller pits.	Partial backfilling of Copper Mt pit and complete backfilling of the San Salvador, Savanna, South Rim and Valencia pits. Water collection and treatment in remaining pits (Main, Gettysburg).
6. Same as Option 2 except all pits are completely backfilled.	Same as Option 5 except Copper Mt., Main and Gettysburg pits are also completely backfilled.
7. Same as Option 2 except stockpile outslopes are regraded at 2.5:1.	Stockpiles listed under Option 2 as 3:1 slopes regraded to 2.5:1.
8. No regrading or covering of stockpile outslopes; stockpile tops are covered (and revegetated) with 24" material.	Tops of stockpiles 1, 1A, 1B, 1C, 1D, 2, 2A, 2B, 3A, 3B, East Main, Gettysburg Out-pit are covered. Same water management facilities listed under Option 1.
9. Tyrone proposed plan at October 2003 Appeal Hearing. Regrade (2.5:1) only the portions of stockpile outslopes outside the pit capture zone. Cover stockpile tops and regraded outslopes with 24" cover.	Stockpiles with some or all of the outslopes outside pit capture zone include 1, 1A (Partial 2:1), 1B (Partial 2:1), 1C (Partial 2:1), 3A (Partial 2:1). Stockpile 9A revegetated at 2:1 with no additional cover. Tops covered (24") for all other stockpiles except those within open pits and Savanna (same as 8). Same water management facilities listed under Option 1.

TABLE 2

Matrix of Preliminary Water Treatment Alternatives for Process Water, Impacted Surface Water and Groundwater

Alternative	Associated Facilities
Evaporative Treatment System	One or more of the stockpiles tops to construct and operate the spray evaporation system. Associated PLS, seepage interceptor systems, process water and stormwater management reservoirs (including Open Pits) to store process water for recycling to evaporative system. Remaining process water after cessation of evaporative system sent to water treatment facilities.
Nano-filtration	PLS collection impoundments, seepage interception systems, stormwater retention ponds, pumping stations and conveyances as needed for water management during closure. Existing or new reservoirs to provide holding capacity for influent to and effluent from treatment plant (e.g., reservoirs for leachate collection, process water and stormwater management, open pits). Permeate commingled with other water sources for on-site use or discharge. Concentrate sent to lime precipitation plant.
Chemical lime precipitation	PLS collection impoundments, seepage interception systems, stormwater retention ponds, pumping stations and conveyances as needed for water management during closure. Effluent (concentrate) from nano-filtration plant. Existing or new reservoirs to provide holding capacity for influent to and effluent from treatment plant. Sludge sent to disposal facility.

TABLE 3

Basis for Components in the Tyrone Mine System Model

Component model	Description	Reference(s)
Climate	Daily climate record from Ft. Bayard for years 1897 to 1998	Western Regional Climate Center
Stockpile (Leach Ore Stockpiles and Waste Rock Piles) and surface runoff	Soil Conservation Service (SCS) runoff curve number (CN) method. CN based on local stockpile and surface conditions.	USDA, 1986. Tetra Tech EM Inc., 2003(a). Golder, 2003(b). DBSA, 2001. Schroeder, S. A., 1994.
Stockpile runoff quality	Average water quality of runoff (and pit surfaces) is based on assumptions in the Tyrone Closure/Closeout Plan. Mass loading from runoff is assumed to be essentially constant on an annual basis, with concentrations increasing following dry periods, and decreasing during wet periods.	PDTI, 2002(a).
Cover infiltration	Based on UNSAT-H model using regional climate record (Ft. Bayard) and proposed cover material parameters.	Tetra Tech EM Inc., 2003(b). Golder, 2003(b).
Stockpile basal seepage rate	The steady-state basal seepage rate through the bottom a stockpile is approximated as the average infiltration rate over the 100-year climate period for the given cover condition. The initial rate transitions to the steady-state rate over several decades. The rate of transition is based on modeling conducted by DBSA.	DBSA, 2003(a). DBSA, 2003(b). Golder, 2003(b). PDTI, 2003(c). Tetra Tech EM Inc., 2003(b).
Stockpile seepage quality	For leach stockpiles, the initial seepage concentration is assumed to be equal to representative pregnant leach solution (PLS) chemistry from the Tyrone Mine. The seepage concentration is assumed to transition gradually from PLS to the values predicted by the Greystone/DBSA modeling. Transition times were estimated based on residence time calculations shown in Appendix C-2 of DBSA (1999).	DBSA, 1999(a) DBSA, 2001.
Stockpile basal flow partitioning	Some fraction of basal seepage from a stockpile is assumed to enter groundwater. The remainder is assumed to report as shallow seepage at the stockpile toe. This is an uncertain parameter that depends on the underlying rock type.	DBSA, 2003 (a) DBSA, 2003 (b) PDTI, 2003 (c)
Extent of the pit capture zone	Estimated from regional groundwater level measurements.	PDTI, 2002 (a)
Groundwater flow and quality	Estimated from MODFLOW modeling results, pit pumping data and regional groundwater monitoring data.	DBSA, 1997. DBSA, 1999(b) DBSA, 1999(c) PDTI, 2002(a), Table 5-10 PDTI, 2003(a). Table 5-11 PDTI, 2003(c)

TABLE 3

Basis for Components in the Tyrone Mine System Model (Continued)

Process solution elimination	The average annual spray evaporation rate is assumed to be 13% of the spray rate and is assumed to vary monthly based on the observed variability in pan evaporation data from the mine site and the surrounding area.	M3, 2001. PDTI, 2003(a). Hermsmeier, 1973 McLean et. al., 2000
Water treatment	Volume treated and influent quality will vary between closure options and are based upon the combined membrane and HDS process as proposed by Tyrone. The plant will be operated to accommodate impacted surface and ground waters. Operating cost estimates will be a function of the influent quality (e.g., TDS, sulfate concentrations), and volume treated.	Van Riper Consulting, 2002 NMED, 2003 (a), Pages 78-83. PDTI, 2003(a) PDTI, 2003(b).
Sludge generation	Preliminary estimates of quality and quantity of sludge will be based on bench-scale tests from lime precipitation treatment process. The lime process treats concentrated reject from the membrane plant and will be the only source of sludge in the water treatment process.	Van Riper Consulting, 2002.
Mixing Cell Model	Future water quality at selected locations around the Tyrone mine site are projected based on mass loading from stockpiles and tailing ponds. The relationships were developed through external geochemical modeling conducted by Greystone using the EQ3/EQ6 software.	Greystone, 2003. DBSA, 2003(c). PDTI, 2003(c)

TABLE 4

Preliminary List of Parameters to Include in Sensitivity Analyses

Parameter	Associated Component Model	Performance metric(s) or higher level parameter(s)
Cover thickness.	Cover infiltration.	Infiltration rate; mass loading in basal seepage; water treatment cost; constituent concentrations in groundwater; water treatment.
Transition time of basal seepage rate going from end of leaching to long-term steady state conditions.	Stockpile basal seepage rate.	Mass loading in basal seepage; water treatment cost; constituent concentrations in groundwater; water treatment.
SCS curve number for stockpile (top and outslopes).	Stockpile runoff.	Water treatment.
Runoff quality.	Stockpile runoff.	Water treatment.
Basal seepage quality.	Stockpile seepage quality.	Water treatment; groundwater quality.
Extent of pit capture zone.	Pit capture zone.	Water treatment; groundwater quality.
Spray evaporation rate.	Process solution elimination	Water treatment;
Water treatment process(es).	Water treatment; sludge generation.	Water treatment cost; sludge volume.
Extent of pit backfilling	Impacted groundwater and surface water runoff volumes.	Water treatment cost, sludge volume, groundwater quality.
Oxygen content in stockpile material.	Stockpile seepage quality	Water treatment; groundwater quality
Groundwater inflow rate into pits.	Impacted groundwater volumes.	Water treatment cost, sludge volume.
Climate conditions.	Precipitation, evaporation.	Runoff volume, process water elimination, water treatment cost.

TABLE 5

Supporting Studies and Completion Dates

Condition No.	Study Description	Proposed Completion Date
75	Comprehensive cover performance evaluation.	January 30, 2005
76	Cover erosion and revegetation test plot study for the Leach Ore Stockpiles and Waste Rock Stockpiles.	NA Portions of this work may be available
77	Cover system effectiveness study.	NA Portions of this work may be available
78	Supplemental stability study.	October 21, 2005
79	Revised borrow source material investigation.	November 15, 2004
80	Supplemental materials characterization study of the Leach Ore Stockpiles and Waste Rock Piles.	October 10, 2005
81	Revised seepage investigation report for the Leach Ore Stockpiles and Waste Rock Piles.	April 8, 2006
82	Supplement existing ground water studies and evaluate the hydrologic conditions beneath the Tyrone Mine Facility.	November 30, 2005
83	Supplement the existing Pit Lake Formation Model.	May 30, 2006
84	Supplemental evaluation of the reclamation activities conducted after the October 14, 1980 Tailings Spill at the No. 3 Tailing Impoundment.	March 30, 2005
85	Study to investigate the extent of deposition of tailings transported by wind or water off the Tailing Impoundments.	March 15, 2005
86	Preliminary sludge handling plan and cost estimate.	August 22, 2005
87	Surface Impoundment Study.	November 30, 2004
88	Process solution elimination study.	June 25, 2004

TABLE 6

Integration of Supplemental Study Results in Tyrone System Model Components

No.	Supplemental Study	Parameter(s)	Component Model(s)
75	Comprehensive cover performance evaluation.	Physical and hydrologic characteristics of the top dressing; leaf area indices; root distributions.	Cover infiltration, stockpile seepage quality; stockpile basal seepage rate.
76	Cover erosion and revegetation test plot study for the Leach Ore Stockpiles and Waste Rock Stockpiles.	Erosion rate; vegetative success; infiltration rate; cover constructability.	Cover infiltration; stockpile seepage quality; stockpile basal seepage rate.
77	Cover system effectiveness study.	Infiltration rate.	Cover infiltration, stockpile seepage quality; stockpile basal seepage rate.
78	Supplemental stability study.	Structural, chemical and physical state of the leach ore stockpiles and waste stockpiles; geological conditions of the foundation materials.	Stockpile basal seepage rate; stockpile seepage quality; stockpile basal flow partitioning.
79	Revised borrow source material investigation.	NA	NA
80	Supplemental materials characterization study of the Leach Ore Stockpiles and Waste Rock Piles.	Physical and chemical conditions, composition, structure, and leachate quality of the leach ore and waste rock stockpiles.	Cover infiltration; stockpile basal seepage rate; stockpile seepage quality.
81	Revised seepage investigation report for the Leach Ore Stockpiles and Waste Rock Piles.	Leachate quality of stockpiles; mass loading rate.	Stockpile basal seepage rate; stockpile seepage quality; stockpile basal flow partitioning.
82	Supplement existing ground water studies and evaluate the hydrologic conditions beneath the Tyrone Mine Facility.	Piezometric head with depth; horizontal and vertical flow gradients; hydraulic conductivity of geologic units; direction and rate of groundwater movement below stockpiles; water quality; area and volume of potentially affect groundwater.	Extent of pit capture zone; groundwater quality; fate and transport of constituents of concern; water treatment.
83	Supplement the existing Pit Lake Formation Model.	Head, flow rate and direction	Water treatment; groundwater flow.
84	Supplemental evaluation of the reclamation activities conducted after the October 14, 1980 Tailings Spill at the No. 3 Tailing Impoundment.	NA	NA
85	Study to investigate the extent of deposition of tailings transported by wind or water off the Tailing Impoundments.	NA	NA

TABLE 6

Integration of Supplemental Study Results in Tyrone System Model Components (Continued)

No.	Supplemental Study	Parameter(s)	Component Model(s)
86	Preliminary sludge handling plan and cost estimate.	Capital and operating costs.	Sludge management alternatives.
87	Surface Impoundment Study.	Impoundments (existing and new) that will be used for final reclamation; runoff and seepage estimates.	Stockpile and surface runoff; water treatment.
88	Process solution elimination study.	Evaporation rate, equipment capital and operating costs.	Spray evaporation.

Table 7

Tentative Feasibility Study updates to NMED

Report No.	Date[1]
Quarterly Report No. 1	June 30, 2004
Quarterly Report No. 2	September 30, 2004
Quarterly Report No. 3	December 30, 2004
Annual Report No. 1	March 30, 2005
Annual Report No. 2	March 30, 2006
Final Report	March 30, 2007

[1] Assumes NMED approval by March 1, 2004 and a start date of April 1, 2004.