REPORT

2013 TYRONE MINE CLOSURE/CLOSEOUT PLAN UPDATE – BASIS OF COST ESTIMATE FOR WATER MANAGEMENT AND TREATMENT

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181-06417.002.R.Rev1

April 28, 2020

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1.0 INTRODUCTION

This Freeport-McMoRan report for the Tyrone Mine (Tyrone) describes the cost basis for the updated closure mine water management and treatment system for the Tyrone Closure Closeout Plan (CCP). Tyrone operates an open-pit copper mine and solution extraction-electrowinning (SX/EW) plant located approximately 10 miles southwest of Silver City in Grant County, New Mexico (Figure 1). The associated water management system existing to support mine activities includes wells, tanks, pipelines, pumps, and process water ponds. The ancillary infrastructure includes roads/railway, fuel storage tanks, power lines, and stormwater controls. The updated closure water management and treatment system presented in this document utilizes some of the existing equipment and features and also includes new equipment and systems described in this document. The closure water management and treatment system presented herein was developed in accordance with Section 20.6.7.33.H NMAC and includes short-term and long-term evaporative treatment components, chemical precipitation with lime treatment and ancillary components, and membrane treatment components.

1.1 Sources of Water to be Treated and/or Managed

There are five sources of process water that are likely to be sent to the water management and treatment systems. Process waters are defined in the Copper Mine Rules (20.6.7 NMAC) as "*any water containing water contaminants in excess of the standards of 20.6.2.3103 NMAC that is generated, managed or used within a copper mine facility including raffinate; PLS; leachate collected from waste stockpiles, leach stockpiles, and reclaimed tailings impoundments; tailings decant water; pit dewatering water; intercepted ground water, laboratory or other waste discharges containing water contaminants; and domestic wastes mixed with process water*". As part of the development of the Tyrone water management and treatment program, process waters are separated into: (1) high TDS and sulfate (>10,000 milligrams per Liter [mg/L] TDS and >7,500 mg/L sulfate) waters; and (2) low TDS and sulfate (<10,000 mg/L TDS and <7,500 mg/L sulfate) waters. At the end of mining, there will be reclamation activities that will result in significant source control and this source control will reduce the quantity of poor quality water that will have to be treated over time. The five sources of process water streams to be sent to the proposed water management and treatment systems are assumed to be:

- Residual process solutions from the leach operation;
- Meteoric water that infiltrates through the acid-generating stockpiles to seepage collection;
- Storm water runoff that comes into contact with un-reclaimed stockpiles and storm water that falls within the Revised Open Pit Surface Drainage Area (Revised OPSDA);
- Dewatering water from the existing open pits; and
- Impacted groundwater captured in seepage collection and interceptor well systems.

These sources of process waters 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 described in the sections below are proposed for management and treatment of process waters.

1.2 Performance Objectives

The primary performance objective for water management and treatment is to collect process waters associated with mine operations and to treat these waters to meet the applicable New Mexico Water Quality Control Commission (NMWQCC) criteria for discharge. To meet the performance objectives the following strategies will be utilized:

- A short-term evaporative treatment system (ST-ETS) will be utilized to evaporate all process waters from Year 1 through Year 9 following closure.
- A long-term evaporative treatment system (LT-ETS) will be utilized to evaporate all process waters from Year 10 through Year 14, and high TDS and sulfate source waters beginning in Year 15 and continuing through Year 100 after closure. The LT-ETS will also be utilized to evaporate brine reject waters from the membrane system beginning in Year 15 and continuing through Year 100 after closure.
- A combined High-Density Sludge (HDS) and membrane system will be utilized beginning in Year 15 and continuing through Year 100 following closure to treat all low TDS and sulfate waters collected. The HDS and membrane system are collectively referred to as the Tyrone Treatment System (TTS).
- Minimization of impacted surface runoff requiring treatment. Storm water runoff will be managed through surface reclamation of areas located outside the Revised OPSDA and Revised Conditional Waiver Area associated with the end of year (EOY) 2014 Mine Plan Topography to preclude potential for contact with stockpiles. Impacted storm water runoff will be collected and treated for a period of 100 years following closure.
- Minimization of impacted pit water requiring treatment through the installation and operation of a pit inflow groundwater interceptor well system.
- Release non-impacted water (meteoric and storm water surface runoff), where possible, in accordance with state regulations and the Tyrone Mine Stormwater Handling Plan (Freeport-McMoRan Tyrone Inc., 2015). Manage potentially impacted sources in a manner to prevent their contact with non-impacted water where possible. Non-impacted water sources will not require treatment prior to discharge.
- Temporary storage of stockpile seep water and groundwater from seepage collection and interceptor systems in surface impoundments and tanks to allow for sampling and analysis prior to final disposition. Water that is shown to be in compliance with applicable NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subparts II and III), will be discharged in accordance with state regulations. Impacted water will be conveyed to the appropriate water management and treatment systems.

This strategy will maximize the quantity of non-impacted water and minimize the quantity of impacted water that must be treated prior to release. These sources will be managed and/or treated during reclamation activities and for a duration of 100 years following cessation of mining operations.

This report includes the following components:

- Characterization of the influent from flow and water quality predictions;
- Description of processes for water management and treatment;
- Capital and operating and maintenance (O&M) cost development assumptions and strategies for closure water management and treatment;
- Capital and O&M cost detail for the closure water management and treatment components; and
- Summary costs for the 100-year closure period.

2.0 BACKGROUND

This water management and treatment plan supports financial assurance cost estimates for closure/closeout based on the EOY 2014 mine plan (highest liability year). Use of the EOY 2014 mine plan is consistent with the snapshot in time philosophy that was adopted by Tyrone and the Agencies early in the closure planning process and represents the year with the greatest volume of regrading and cover placement required between 2012 and 2017. If mining activities were to cease between the years 2012 and 2017, the highest financial assurance requirements would be associated with the EOY 2014 conditions. Additionally, Tyrone recently evaluated the mine plans through year 2022. This analysis also showed that the EOY 2014 mine plan represents the year with the greatest volume of regrading and cover placement required between 2012 and 2022. Thus, the EOY 2014 plan is expected to represent the most onerous condition from a cost perspective.

The New Mexico Environment Department (NMED) requires a water management and treatment plan in the event of mine closure that includes water collection, handling, and treatment for 100 years. Impacted waters are to be treated to ensure compliance with applicable NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subparts II and III). The Tyrone water management and treatment plan in part is based on previous evaporative treatment studies (M3, 2004), water treatment studies (Van Riper Consulting [VRC], 2002 and 2008), and sludge handling plans (VRC, 2004), with updated projected water flows and water quality for the various sources of water to be treated. The components of the Tyrone water management and treatment plan include the following:

- Water conveyance systems that include pipelines and pumps required to move water to one of the water management and treatment facilities (ST-ETS, LT-ETS, TTS) and discharge treated water from the TTS;
- A ST-ETS for treatment of all process waters from Year 1 through Year 9 following closure;
- A LT-ETS for treatment of all process waters from Year 10 through Year 14, and all high TDS and sulfate waters beginning in Year 15 and continuing through Year 100 after closure. The LT-ETS will also be utilized to evaporate brine reject waters from the membrane system beginning in Year 15 and continuing through Year 100 after closure;
- Membrane and lime HDS treatment processes included in the planned TTS. The HDS system will be used to pretreat the low TDS and sulfate water streams. The membrane system will further treat the pre-treated HDS water. This strategy will be used for treatment of all low TDS and sulfate water streams from Year 15 through Year 100 during the closure period; and
- A Sludge Disposal Facility for sludge produced by the HDS system beginning in Year 15 and continuing through Year 100, and a Salt Disposal Facility for salt produced from the LT-ETS beginning in Year 10 and continuing through Year 100.

The proposed concept and other associated information for the evaporative treatment system (ETS) and TTS is presented in the following sections.

3.0 ETS SYSTEM

The following sections present information on previous evaporative treatment studies for Tyrone, and details of the current ETS plans for the mine associated with the Tyrone CCP.

3.1 Background

The NMED issued Supplemental Discharge Permit for Closure, DP-1341 to Tyrone on April 8, 2003 (NMED, 2003). Condition 88 of DP 1341 required that Tyrone perform a process solution elimination (PSE) study. The purpose of the PSE study was to evaluate alternatives and identify proven and cost-effective methods to treat and/or eliminate process solutions and impact water following cessation of operation or closure at the Tyrone Mine Facility.

In accordance with Condition 88, an initial ETS was conducted in 2004 (M3, 2004) that was based on post-mining water management and water treatment flow rates provided in the 2001 Tyrone Mine Closure/Closeout Plan (M3, 2001). The initial ETS was revised in 2006 based on comments received by the NMED on the initial PSE study (M3, 2006). This report provides an update to the 2006 ETS and is based on 2019 updated post-mining water management and water treatment flow rates and updated mine plans.

The 2006 ETS study proposed process solution elimination (evaporation) by natural (passive) and forced evaporation on previously disturbed stockpile areas. The inventoried process waters were comprised of pregnant leach solution (PLS), stockpile seepage, impacted runoff from stockpiles and impacted groundwater from inceptor wells and open pit sumps.

Two alternatives were previously examined to remove the water: Option 1 – recirculation, forced spray evaporation and drip irrigation system; and Option 2 - recirculation and drip irrigation system. The study assumed that processing of residual fluids for copper recovery ceases at the close of operations. In practice, leach stockpiles will continue to operate and generate copper production for many years after ore shipment to stockpiles ends. Over time, the copper production rate will decrease until leaching is no longer economic; therefore, this is a conservative water management and treatment plan only intended for closure/closeout planning.

The previous study projected both alternatives as capable of evaporating the inventoried process solutions within the prescribed 5-year time period for the 2001 Tyrone Mine Closure/Closeout Plan. Option 1 was the recommended alternative due to the smaller stockpile surface areas required, higher evaporative loss rates, and overall lower costs (M3, 2006).

3.2 Current ETS Plan

This report provides an update to the previous Condition 88 studies (M3, 2004 and 2006) and is based on the EOY 2014 mine plan and a 2019 estimate of the volume and sources of residual fluids that would be required to be handled upon cessation of mining operations. In addition, updated information on new spray evaporative technologies have been obtained, estimates of the volume of impacted water that will be required to be treated have been updated, and the impoundments and tanks available for use in the ETS have been updated as part of this CCP Update.

The updated ETS is based on recirculation of process water and residual process solutions with:

- Year 1 through Year 9: Use the existing drip irrigation systems at the mine and operation of new forced spray evaporation systems on top of the leach stockpiles (ST-ETS program);
- Year 10 through Year 14: Continued use of forced spray evaporation systems at newly constructed lined evaporation ponds for treatment of all process solutions (LT-ETS program); and

- Year 15 through Year 100: Continued use of forced spray evaporation systems at newly constructed lined evaporation ponds for treatment of all high TDS and high sulfate waters and brine reject waters from the TTS membrane system (LT-ETS program).

These high TDS and sulfate concentration waters and the brine reject water will be collected and treated over the 100-year closure period to provide life cycle operational cost benefits and reduce the quantity of residual solids generated by alternative treatment methods such as chemical precipitation.

3.3 System Design Basis

3.3.1 Climate

See Section 2.3.3 in the Tyrone Mine Closure/Closeout Plan Update for climate assumptions utilized in the water management and treatment plan.

3.3.2 Estimated Quantity of Residual Process Solutions to be Evaporated

The first step of the updated ETS analysis is to identify the volume of water requiring treatment or elimination. During the mining and copper leaching operations approximately 30,615 gallons per minute (gpm) of leach solution is circulated through the copper production system (Tyrone, 2019). Figure 2 outlines the projected configuration of the stockpiles at the EOY 2014 and the associated areas that will be utilized for the ST-ETS program between Years 1 through 9. Table 1 presents the estimated volumes of residual process solutions to be evaporated from the individual sources at the mine.

Estimates of the volume of residual process solutions to be evaporated are assumed to be accurate within plus or minus 25 percent. Actual inventory fluctuates with seasonal variations in precipitation and other climatic conditions such as temperature and humidity and with the production goals of the SX/EW plant. Table 1 identifies the total estimated quantity of residual process solutions to be evaporated at the beginning of the ST-ETS operation at approximately 1,862,873,600 gallons. Sections 3.3.2.1 through 3.3.2.3 provide a description of the methods used to estimate the volumes of residual process solutions to be evaporated.

3.3.2.1 Water in Open Pits

The estimated volume of water in open pits requiring elimination at the cessation of operations is based on measured open pit water stage readings and associated open pit storage information for the Main, Gettysburg, Copper Mountain, and San Salvador pits provided by the Tyrone Mine Engineering Group. The estimated residual pit volumes presented in Table 1 represents the average combined storage within these pits from January 2017 through December 2018.

3.3.2.2 Solutions in Reservoirs and Impoundments

The estimated volume of process solutions within the reservoirs and impoundments requiring elimination at the cessation of operations is calculated according to the following methodology:

- Volumes of process solutions within the surface impoundments and storage tanks at the start of evaporation program are assumed to be at 60 percent of their capacities;
- For HDPE-lined overflow ponds, it is assumed that process solutions will be added to the ponds (60 percent of their capacities) from the circuit at the start of the evaporation program to enhance surface evaporation of the fluids;

- The 4C and 6C collection ponds are actually collection points with drains at the base and do not store process solutions; and
- The overflow ponds will contain no process solutions at the inception of ST-ETS operation.

A summary of the surface impoundments, overflow ponds, and tanks included in the ST-ETS analysis are provided in Table 2 (Years 1 through 9) along with the estimated annual evaporation from each. A summary of the surface impoundments, overflow ponds, and tanks included in the LT-ETS analysis are provided in Table 3 (Years 10 through 14) and Table 4 (Years 15 through 100). The total volume of process solutions contained in the surface impoundments and tanks at the beginning of the ST-ETS is estimated to be approximately 17,612,200 gallons, and the estimated volume of process solutions added to, and maintained within, the surface impoundments and tanks is approximately 11,308,800 gallons.

3.3.2.3 Average Circulated Inventory

The initial Average Circulated Inventory (ACI) is calculated based on experience with leach operations at Tyrone. During mining and copper leaching operations, approximately 30,615 gpm of leach solution (raffinate) is circulated through the copper leach circuit and onto the leach stockpiles, referred to as the initial raffinate flow rate. The make-up water requirement during leaching operations typically averages eight percent of the initial raffinate flow rate. Therefore, after cessation of the mining operations, leaching operations are expected to be shut down and the process leach solution flow rate is estimated at 92 percent of the initial raffinate flow rate. Additionally, based on experience at Tyrone, the flow rate at a leach stockpile diminishes to approximately ten percent of the full flow rate in 45 days after leaching operations are halted. Based on these assumptions, the total estimated initial ACI is approximately 1,642,629,500 gallons (Table 1).

3.3.3 Estimated Process Water Flows to be Evaporated

Estimated flows for the individual sources contributing water to the ETS systems are provided in Attachment A. The estimates of the flow rates and sulfate concentrations for the individual seepage collection and interceptor well systems at the Tyrone Mine was based on existing flow and water quality data collected between January 2017 and the end of December 2018 for the individual systems that is recorded by Tyrone in accordance with applicable operational discharge plans (DPs). Sources of water in-flow to the system related to open pit dewatering were based on the Daniel B. Stephens & Associates, Inc. (DBS&A) Stage 2 Abatement Plan Proposal groundwater flow model (DBS&A, 2012) that was updated with the EOY 2014 base case mine plan configuration and associated regrade plan. DBS&A developed geochemical mixing models using PHREEQC Interactive (version 3.0) (Parkhurst and Appelo, 1999) to support the Tyrone CCP Update (DBS&A, 2019). The mixing models estimate future water quality at the Main, Gettysburg, Copper Mountain, and Savanna pits at 15, 50, and 100 years post-closure. Initial (year zero) water quality for each of the open pits was based on 2018 water quality data. A linear interpolation was subsequently performed by Golder to estimate the water quality of the open pits between the Year 0, 15, 50, and 100 mixing models estimates.

Surface water runoff flows and sulfate concentration estimates were 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 report. The DSM is a dynamic, probabilistic simulation model that projects the behavior of the mine system and the influence of various closure activities have on its performance. Runoff sources are segregated into impacted and non-impacted flows in the DSM. Runoff from reclaimed stockpile surfaces is non-impacted and can be discharged to the environment and is not conveyed to the ETS or water treatment system.

3.3.4 Water Quality

The water quality of the process waters is estimated to be the same as that which is currently collected from the individual sources listed in Sections 3.3.2 and 3.3.3.

3.3.5 Operational Periods

There are two ETS programs and associated operational periods. The ST-ETS analysis is based on an operational period of Years 1 through 9. During Years 1 through 9, the leach stockpiles will largely be un-reclaimed and the ST-ETS will include recirculation of all process solutions with drip irrigation systems, operational spigots, and forced spray evaporation systems on top of the leach stockpiles.

During Years 10 through 14, reclamation of all the leach stockpiles will have been initiated, which will preclude recirculation of the process solutions on top of the leach stockpiles. For this time period, the LT-ETS program will be initiated for treatment of all process solutions. The LT-ETS will include forced spray evaporation systems installed at two new HDPE-lined spray evaporation ponds constructed in the footprint of the Decant Ponds located east of the 2A Leach stockpile and near the SX/EW Plant (Figure 3). Beginning in Year 15, the LT-ETS will be used to treat all high TDS and sulfate waters and brine reject waters from the TTS membrane system and will operate for the remainder of the 100-year closure water management and treatment period. All the remaining low TDS and sulfate water sources will be treated through the TTS (membrane and lime/HDS treatment systems) for the remainder of the 100-year closure water management and treatment period. The ETS schedule for the 100-year closure treatment period is provided in Table 5.

3.4 Short-Term ETS Recirculation System

As part of the recirculation system at the Tyrone Mine, the existing mine process solution distribution system (drip system) will be utilized to recirculate all residual process solutions to the top surface areas of the leach stockpiles for a period of nine years (Figure 2). These waters will be collected and treated by evaporation by the ST-ETS system to allow time for construction of the TTS and to reduce the volume of process waters requiring treatment with the TTS during the initial years of closure.

Using the ST-ETS for residual process solutions allows for minimization of secondary waste (sludge) generation and associated optimization of operational costs. Evaporation during this nine-year period will mostly occur at the top surface of the leach stockpiles and to a lesser amount at the surface impoundments, overflow ponds, and tanks listed in Table 2. The residual process solutions will drain through the leach stockpiles and then will be recirculated through the existing mine process solution distribution system.

At the onset of the ST-ETS operation, residual process solutions will drain from the leach stockpiles into their respective surface impoundments or tanks. Initially the drain down water will be transferred to the SX/EW feed pond. Once the level in each of the surface impoundments, overflow ponds, and tanks have stabilized at sixty percent of their maximum capacities, the transfer is complete. This is the assumed fill level and operational level for these facilities for the entire 9 years of the ST-ETS operation.

Water from the SX/EW PLS Feed Pond will be transferred to the existing raffinate tanks. From the raffinate tanks, the water will be pumped to the leach stockpiles through the existing raffinate distribution system. Residual process solutions that are not evaporated during this process will drain through the stockpiles and be pumped through the existing distribution systems back to the existing PLS collection pond/tanks located adjacent to the leach stockpiles to complete the recirculation loop.

Initiation of leach stockpile reclamation will begin at the 6A Leach at the EOY 5, and reclamation of the remaining leach stockpiles will be initiated in the beginning of the second quarter of Year 10. Beginning in Year 9, two new HDPE-lined spray evaporation ponds will be constructed (one 7-acre pond in the footprint of the Decant Ponds located east of the 2A Leach stockpile, and one 3.2-acre pond constructed in the SX/EW Plant area). LT-ETS operations will then begin in Year 10 as detailed below in Section 3.6.

3.5 Short-Term ETS Forced Spray and Drip Irrigation System

The ST-ETS program will utilize the existing PLS drip systems and a new forced spray evaporation system to maximize the evaporation rate of the impacted water and residual process solutions distributed to the top surface areas of the leach stockpiles. Evaporation of the process waters during the first year of the ST-ETS program will occur through drip irrigation alone. During this first year, a mechanical forced spray system will be installed on top of the leach stockpiles and will be fully operational by the beginning of Year 2 of ST-ETS operation (Figure 2). Forced evaporation of these waters will be accomplished with mechanical spray systems designed to handle flows up to 123 gpm per unit. The forced spray evaporation and drip irrigation evaporation systems are expected to operate concurrently for Years 2 through 9; however, the time of operation may vary based on actual results.

Additional evaporation will naturally occur from the surfaces of the surface impoundments, overflow ponds, tanks, and pit lakes during this time (Figure 2). The stockpile areas that will be utilized for both drip irrigation (Year 1 through 9) and mechanical forced spray evaporation (Year 2 through 9) are shown on Figure 2. The surface impoundments, overflow ponds and tanks to be utilized in the ST-ETS program are included in Table 2.

The flow rate of the evaporation system will initially be the same as the flow rate during leaching operations and will be reduced each year thereafter as the water in storage is depleted. Table 5 provides a summary of the ETS schedule. Capital and operations and maintenance (O&M) cost estimates for the ST-ETS are provided in Attachment C and include spray evaporation units, piping, and pumps and their O&M. The basis for these estimates are provided in Attachment B.

3.6 Long-Term ETS Forced Spray System

The LT-ETS consists of forced evaporation and wetted surface evaporation. Prior to the start of the LT-ETS program at the beginning of Year 10, 7.4 acres of the existing footprint of the Decant Ponds located east of the 2A Leach stockpile will be prepared, and a 7-acre HDPE-liner installed for spray evaporation pond #1. An additional 3.5-acre area located immediately south of the existing raffinate tanks will be prepared, and a 3.2-acre HDPE-liner installed for spray evaporation pond #2. At EOY 9, the mechanical spray systems will be relocated from the leach stockpiles (Figure 2) to the two new HDPE-lined spray evaporation ponds (Spray Evaporation Ponds #1 and #2 on Figure 3). Additionally, the No. 3 PLS Overflow Pond will no longer be needed for surface evaporation of waters from the 3A collection systems and will be reclaimed in Year 9. For Years 10 through 14 forced evaporation of all process waters will occur from the spray systems installed at the two new evaporation ponds and from wetted surface evaporation from the surface impoundments and tanks listed in Table 3. The No. 3 PLS Overflow Pond will be replaced with a new 20,000 gallon polyethylene above-ground storage tank in Year 9 for transferring low TDS and sulfate waters from the 3A collection systems to the LT-ETS (Years 10 through 14) and TTS (Years 15 through 100).

Beginning in Year 15, all of the low TDS and sulfate waters will be conveyed to the TTS. The LT-ETS program will continue to utilize forced evaporation systems that were installed at the two new HDPE-lined spray evaporation ponds and wetted surface evaporation from the surface impoundments and tanks to maximize the evaporation rate of the high TDS and sulfate process waters. These waters will be collected and treated via evaporation over the 100-year treatment period to reduce the quantity of residual solids generated by alternative treatment methods such as chemical precipitation. The leach stockpile seepage contains the highest concentrations of sulfate and TDS of all water sources to be treated via evaporation following completion of the ST-ETS program. The LT-ETS will also be utilized to evaporate brine reject waters from the TTS membrane system beginning in Year 15 and continuing through Year 100 after closure. The existing water conveyance pipelines and associated pumping systems will be utilized to direct high TDS and sulfate concentration process waters.

The flow rates of the evaporation system will drop off over time as the stockpiles are reclaimed. Stockpile seepage flows in the toe collection systems will be reduced following reclamation of the leach stockpiles. The transition from uncovered to covered seepage rates is spread over a 20-year period with a linear rate decrease between Year 12 and 32. The estimated quantity of residual process solutions that will be handled as part of the LT-ETS is provided in Attachment A, and the LT-ETS schedule is summarized in Table 5. Capital and O&M cost estimates for the LT-ETS are provided in Attachment C and include construction of the two new HDPE-lined evaporation ponds, and any additional spray evaporation units, piping and pumps required and their O&M. The areas that will be utilized for the LT-ETS are shown on Figure 3 (Year 10 through 14) and Figure 4 (Year 15 through 100).

3.7 Salt Disposal Facility

Salts produced from the LT-ETS (Years 10 through 100) will be periodically removed from the two spray evaporation ponds and hauled to and stored at an HDPE-lined Salt Disposal Facility. The proposed Salt Disposal Facility will be constructed immediately north of spray evaporation pond #1 (Figure 4). Approximately 15 acres of existing Decant Pond area located east of the 2A Leach stockpile will be lined with 80-mil HDPE and an earthen berm will be constructed around the perimeter.

An estimated 1,265,300 cubic yards (cy) of salt will require storage at the Salt Disposal Facility during the 90-year LT-ETS operational period (Year 10 through 100). The total estimated amount of salts produced annually is summarized in Table 6. These values are based on the estimated water quality and flows associated with the combined process waters (Year 10 through 14) and high TDS and sulfate concentration waters (Year 15 through 100) treated via evaporation over the 90-year period where salt generated is disposed in the Salt Disposal Facility. As shown on Table 6, the amount of salt generation drops off in Year 15 when the TTS comes online and the LT-ETS begins to only treat the high TDS and sulfate concentration waters. The capacity of the disposal facility is adequate for salt produced for 90 years of operation of the LT-ETS. Capital and O&M cost estimates for the Salt Disposal Facility are provided in Attachment C and include construction and O&M of the 15-acre HDPE-lined Salt Disposal Facility. The cost basis for these components are included in Attachment B.

4.0 TTS AND ASSOCIATED SLUDGE DISPOSAL FACILITY

The proposed primary treatment processes and associated primary and ancillary equipment sizing for the TTS was based on the treatability studies conducted by Van Riper Consulting (2002 and 2008), Hazen Research (VRC, 2008), and HW Process Technologies (VRC, 2008). Construction of the TTS will be completed in Year 14 of the 100-year period, and operations will be started in Year 15.

A Sludge Disposal Facility will be constructed and associated with the TTS for the management of dewatered sludge from the HDS system (Figure 5). An overview of the TTS and the Sludge Disposal Facility is provided in the following sections along with flow and quality information for water to be treated in the TTS and used in the development of the capital and annual operations and maintenance costs. The conveyance system (pipeline and tank) and energy dissipation structure for treated water discharged from the TTS are also included in this section and the costs are included with the TTS costs in Attachment C.

4.1 System Design Basis

Beginning in Year 15 and continuing through Year 100, the remaining low TDS and sulfate water streams will be sent to the TTS facility for treatment. A summary table of the post-mining water management and water treatment flow rates for the TTS is included in Attachment A.

4.1.1 Water Treatment and Sludge Systems

Table 7 presents a summary of the flow and sulfate concentration sent to the TTS in Years 15, 25, 50, 75 and 100. The flows and concentrations are presented at intervals over the 85 years of TTS operation (Year 15 through 100) to demonstrate that the overall flow or sulfate concentration of the influent do not change significantly over that time period. Tables 8 and 9 present the flow and sulfate information over the same time intervals for the pretreated stream from the lime HDS system to the membrane system, and the influent to the HDS system. The membrane system is expected to see fairly consistent influent quality since the HDS system provides pretreatment for the membranes while the HDS system influent varies in a similar manner as the raw water influent to the TTS.

Estimated sludge volumes, from the HDS system, to be sent to the Sludge Disposal Facility were calculated from the projected sulfate concentrations. Table 10 presents the sludge mass predictions to be sent to the Sludge Disposal Facility; an estimated 1,635,108 cy of sludge (50% solids by weight) will require storage at the Sludge Disposal Facility during the 85-year TTS operation period.

4.2 TTS Water Treatment System

The Tyrone TTS water treatment system will include both membrane filtration and HDS lime precipitation systems located within the SX/EW Plant area (Figure 5). A block flow diagram of the proposed TTS is presented in Figure 6.

This conceptual treatment configuration optimizes capital and operating costs while meeting regulatory limits for discharge of treated effluent. The concept and process development of the HDS and membrane filtration treatment components and associated primary and ancillary equipment sizing is based on the treatability studies conducted by Van Riper Consulting (2002 and 2008), Hazen Research (VRC, 2008), and HW Process Technologies (VRC, 2008).

All low TDS and sulfate process water streams will be sent to the HDS system to increase the pH and remove metals and sulfate. The TTS is shown in Figure 6, which includes an HDS System, TSS Membrane, and TSS. A Micofiltration (MF) unit provides suspended solids removal to prevent fouling of the Reverse Osmosis (RO) membrane. Treated effluent (permeate) from the MF unit will be sent to the RO unit. The RO unit uses a series of semi-permeable membranes that removes dissolved monovalent and divalent (and higher valences) constituents including some metals and sulfate. The MF and RO reject streams will be sent to the LT-ETS.

Chemical precipitation is a conventional and widely used treatment for the removal of a portion of the sulfate concentration down to the gypsum solubility limit. With the addition of lime, the pH is adjusted to the range of approximately 10 to 11 in order to achieve the minimum solubility for the target compounds. The dissolved contaminant forms an insoluble precipitate, which is then removed from the water by clarification. A flocculent is added to increase the settling rate of precipitated solids. Acid will be added to the clarified process stream to reduce the pH to the target range (7.5 to 9) prior to discharge as shown in the block flow diagram in Figure 6.

Precipitated solids removed during clarification, will be further dewatered by a filter press. The treatment of the highest concentration sulfate solutions in the ETS reduces the sulfate load to the HDS plant reducing overall chemical requirements and the quantity of sludge produced. Based on operations of similar HDS systems and the Van Riper Consulting test work, it is expected that dewatering in a filter press will achieve approximately 50% solids by weight in the dewatered sludge. Dewatered sludge will be sent to the on-site Sludge Disposal Facility.

4.2.1 Membrane System

The membrane system is currently included to treat both the TTS influent and approximately 300 gpm of groundwater from a new groundwater interceptor well system (GIWS) located in the Main Pit (see Figure 5). The feasibility of intercepting groundwater upgradient of the Main Pit was previously evaluated by John Shomaker and Associates, Inc. (JSAI, 2003) and JSAI and Eddie Livingston (2005) and it was determined to be a viable option to reduce groundwater inflows into the Main Pit.

The membrane system will include 2 trains of MF and 2 trains of RO to provide system flexibility. Recovery for the membrane system is projected based on the treatability studies conducted by Van Riper Consulting and HW Process Technologies (VRC, 2002 and 2008), and adjusted based on projected influent sulfate concentrations for the individual treatment streams updated in 2019.

Based on the projected TTS water quality, it is assumed that it can be treated in a conventional membrane system using pretreatment by microfiltration and removal of dissolved constituents by RO similar to the system proposed in the last Tyrone Mine CCP Update (Golder, 2013). The recoveries and other information from the HW Process Technologies treatability study are assumed to be applicable to the more conventional membrane system (RO) with the MF pretreatment.

The influent water stream has moderate concentrations of scaling and fouling constituents (aluminum, iron, manganese, sulfate, hardness) and low pH, and so pretreatment to remove these constituents is included to allow higher recoveries in the RO system. The GIWS water is projected to have elevated concentrations of fouling constituents such as aluminum, iron and manganese based on previous analyses of the extracted water from the earlier groundwater interceptor pilot system (JSAI and Eddie Livingston, 2005). For this CCP Update, it is assumed that the low TDS and sulfate process water streams and the GIWS water will be pretreated using the HDS system prior to being sent for treatment through the membrane.

4.2.2 HDS System Assumptions

It is assumed that the low TDS and sulfate water streams and the GIWS water will be sent to an HDS system located at the SX/EW Plant area. Capital cost for the lime HDS system are included in Attachment C and were determined by obtaining new vendor quotes for major equipment and by using engineering experience based on recent construction of new HDS facilities for the Colorado Department of Public Health and Environment (CDPHE) for the Summitville Mine site (2009 construction) and the Central City/Clear Creek OU4 Water Treatment Plant (2018 construction). The basis of the capital costs for the lime HDS system are included in Attachment B.

Both the lime handling system and the sludge management systems have been resized to reflect lime usage and sludge production expected from the segregation of the high TDS and sulfate water streams in the LT-ETS. The CCP cost estimates for sludge dewatering will include a filter press to dewater the sludge to approximately 50% solids before disposal in the Sludge Disposal Facility located on approximately 25 acres of the top surface of the

3A Leach stockpile. The 50% dewatered solids value was provided by Van Riper Consulting based on experience with other sludges that were primarily calcium sulfate.

4.3 Sludge Disposal Facility

Dewatered sludge will be hauled to and stored at the Sludge Disposal Facility. The proposed Sludge Disposal Facility will cover an area of approximately 25 acres on the top surface of the 3A Leach stockpile, and the TTS will be located nearby within the SX/EW Plant area (Figure 5).

The sludge volume is calculated based on the results of HDS treatability studies conducted by Hazen Research under the direction of Van Riper Consulting (VRC, 2008). The quantities are scaled based on the projected flow and sulfate concentration. The predictions show consistently decreasing flow rates and changes in water chemistry, which decrease the rate of sludge production through the operational life of the treatment plant. The capacity of the disposal facility is adequate for sludge produced for 85 years of operation of lime/HDS treatment plant.

4.4 Discharge Pipeline and Structure

The treated effluent from the TTS will be conveyed in a new pipeline from the treatment plant to a selected discharge point located within the diversion channel tributary arroyo to Mangas Wash located west of the 3A Leach stockpile. The discharge system includes a steel transfer tank, a 14-inch DR-17 HDPE conveyance pipeline, and an energy dissipation structure constructed with articulated concrete block. The system costs are developed in the same manner as described in Section 5 below. The energy dissipation structure costs for the TTS effluent system are included in Attachment C and are based off of the energy dissipation costs that were originally developed by Telesto Solutions Incorporated (Telesto) for the 2019 Chino CCP site-wide financial assurance cost proposal (Freeport McMoRan Chino Mines Company, 2019). The basis of the costs estimate is provided in Attachment B.

5.0 WATER CONVEYANCE

Existing pumps, pipelines, tanks, and reservoirs will be utilized to the extent practical to convey the various process water sources to the ETS and/or TTS. Where new pipelines and pumps are required, the associated capital costs have been included. The basis for development of the capital cost estimates for the water conveyance systems are provided in Attachment B and the cost estimates are provided in Attachment C.

6.0 COST ESTIMATION

Capital and O&M cost estimates presented in Attachment C have been developed using similar methodology as previous CCP Updates for Chino and Tyrone. Costs have been updated as appropriate according to the sources used including vendor quotes, RS Means, State of New Mexico Department of Labor Rates, and Public Service Company of New Mexico rate schedules for costs gathered in late 2018 and early 2019. In addition, modifications to cost factors based on the agreement reached in December 2018 in the Financial Assurance (FA) Work Group and approved by the State of New Mexico in January 2019 have been incorporated. The costs are detailed in Attachment C and a separate Excel spreadsheet file included on the CD attached this report. The spreadsheet contains several worksheets which are organized by color with a set of worksheets prepared for each major system and a set of summary sheets. Cost-specific assumptions not discussed in previous sections are outlined in the following sections and provide additional background for how the capital and O&M cost estimates were developed. Additional details on the cost basis for the water management and treatment systems are provided in Attachment B.

6.1 Capital Cost Development

Equipment and material cost estimates have been developed based on the information presented in Sections 2.0 through 5.0. Quotes were obtained for equipment, materials, consumables and other cost items associated with the TTS, ETS, conveyance system, TTS discharge system, and sludge and salt disposal facilities. The backup equipment and material quotes are included in Attachment B. Equipment installation and site construction have been estimated based on craft personnel, labor hours, and prevailing wage rates. The 2019 prevailing wage rates for Heavy Industry were used for the TTS construction as follows:

- 2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution. For cost estimate purposes it was assumed that all construction labor would have to travel more than 90 miles so that applicable Subsistence, Zone, and Incentive Pay is included per the 2019 rates for each category of construction labor.

Other costs, including freight on process equipment and the TTS building, and commissioning, have been estimated as lump sums.

For the TTS, the specific treatment train and associated primary and ancillary equipment sizes have been calculated based on the treatability studies conducted by Van Riper Consulting (2002 and 2008), Hazen Research, Inc. (2007), and HW Process Technologies, Inc. (2007). The results of the treatability studies have been updated with 2019 water quality and flow projections for the individual treatment streams, and updated treatment trains have been developed by the Freeport-McMoRan Inc. water treatment group. Other cost elements have been based on engineering judgment, updated cost quotes, and previous Golder experience with treatment plant construction and equipment installation projects.

A similar strategy was used for development of the ST-ETS cost, the LT-ETS cost, the conveyance system, the Salt Disposal Facility associated with the ETS, and the Sludge Disposal Facility associated with the TTS.

It is assumed that indirect costs, for capital, is 30% of the estimated direct capital cost based on the 2018 FA Work Group meetings and agreement and the associated approval letter issued by the State of New Mexico in January 2019. Indirect costs include but are not limited to:

- Mobilization and demobilization;
- Contingency;
- Engineering redesign;
- Contractor profit and overhead;
- Project management fee; and
- State procurement fee.

6.2 Operations and Maintenance Cost Development

O&M cost estimates have been developed for the 100-year closure period. Costs are presented as current costs and include labor, reagents, maintenance, sampling and analysis costs, and electrical power for all treatment and management systems for which a capital cost was developed. The cost basis for these items is described in the following sections.

6.2.1 Labor Rates

Labor rates and markup for benefits for all categories of operations personnel were based on New Mexico Department of Labor's prevailing wage rate for Type "A" work as follows:

- 2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. All Operator groups. https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf
  - Base hourly wage listed in Table 11
  - The fringe rate for operators, supervisors and maintenance was set at $5.94/hour based on the New Mexico prevailing wage table for 'Type A' operators

Staffing levels were estimated based on Golder's experience and operations staff are assumed to be local. Assumptions include:

- Overtime – up to 10% of straight-time hours for supervisors and 15% for operators
- Overtime wages – 1.5 times the base rates

6.2.2 Reagents

Lime, flocculent, and acid will be used at the TTS for the HDS system, and anti-scalent and cleaning chemicals for the membrane system as discussed in Section 4.2. Assumptions include:

- Lime:
  - Lime consumption was calculated based on the Van Riper Consulting treatability study and metal hydroxide removal rates and adjusted based on the influent sulfate concentrations.
  - Lime cost was obtained from a current vendor price from L'hoist North America (2019) using a street price strategy without benefit of any FMI preferred pricing for bulk deliveries.
- Flocculent:
  - Flocculent consumption for solid–liquid separation and clarification was calculated based on previous engineering experience and adjusted based on the influent sulfate concentrations and associated sludge projections.
  - Flocculent cost was based on a late 2018 vendor quote obtained without benefit of FMI preferred pricing.
- Acid:
  - Acid consumption was calculated based on the Van Riper Consulting treatability study and adjusted based on the influent sulfate concentrations.
  - Acid cost was obtained from a 2019 street price from Univar.

6.2.3 Membrane System

The membrane system requires cleaning chemicals and anti-scalent to prevent membrane fouling and increase removal efficiency of the contaminants of concern.

- Membrane chemical quantity has been estimated based on previous engineering experience and conversations with chemical suppliers.
- Chemical costs have been obtained from a 2019 vendor price quote for a street price.

6.2.4 Maintenance

Replacement O&M and routine maintenance are both included as separate cost categories and both are based on a percentage of the total capital cost. The routine maintenance is set at 1.5% annually of the total capital cost for each component with the exception of the Sludge Disposal Facility and the Salt Disposal Facility. These two components of water treatment and management are not expected to require routine maintenance.

The replacement O&M is also a percentage of the total capital for each component except the ST-ETS, which is not expected to be replaced. The replacement O&M factor for the other components is set between 0.25% and 1.8% depending on the expected system life, initial cost, and whether new or used equipment was included. The replacement O&M is set at 1.5% for the TTS, at 1.8% for the LT-ETS and water conveyance systems, at 1% for the Sludge Disposal Facility, and at 0.25% for the Salt Disposal Facility.

6.2.5 Sampling and Analysis

The frequency of sampling and analysis associated with the water management and treatment system is as follows:

- Sampling is not required as part of the O&M of the ST-ETS. The only sampling required during the ST-ETS operational period is associated with the NPDES compliance points (two associated with NPDES Permit NMR05GB76);
- The high TDS and sulfate water sources will not need to be sampled as part of the O&M for the LT-ETS;
- TTS performance monitoring including (2) influent and (1) effluent discharge from water treatment plant: monthly beginning in Year 15 and continuing though Year 100;
- NPDES compliance points: quarterly from Year 1 through Year 12, semiannual from Year 13 through Year 32, and annual thereafter (through Year 100);
- Collection points for the low TDS and sulfate water streams to the TTS (1X1 Pond, 1A PLS Tank, 1B PLS Tank, Oak Grove Pond, and the new 20,000 gallon polyethylene AST replacement for the No. 3 PLS Overflow Pond): quarterly from Year 15 through Year 32 (transition period between un-reclaimed and reclaimed stockpile flows), and annual thereafter (through Year 100);
- Discharge from groundwater interceptor system (4 interceptor wells): quarterly from Year 15 through Year 32 (transition period between un-reclaimed and reclaimed stockpile flows), and annual thereafter (through Year 100). The GIWS will be sampled at the point that all 4 wells are combined into one pipeline; and
- Pits (3 sample points): quarterly from Year 15 through Year 32 (transition period between un-reclaimed and reclaimed stockpile flows), and annual thereafter (through Year 100).

Costs for sampling and analysis have been escalated from previous CCP updates and include shipping and materials based on an updated 2018 quote from a local analytical laboratory (Hall, 2018). Additional site-wide monitoring and sampling is included in the reclamation cost estimate developed by Telesto (2019).

6.2.6 Electrical Power Consumption

The unit cost for electric power is based on the most currently available Public Service Company of New Mexico Electrical Services 21st Revised Rate No. 4B Large Power Service - Time of Use Rate (Effective Date January 1, 2019). Specific cost backup details for the power consumption and rates are provided in Attachment B.

6.2.7 Sludge Disposal

Sludge volume has been projected based on the Van Riper Consulting treatability study and adjusted based on the influent sulfate concentrations. The sludge is expected to dewater to 50% solids by using a filter press, based on the experience of Van Riper Consulting. Costs for loading, hauling, unloading, and disposal have been based on material handling unit rates developed by Telesto (2019) and 2019 RS Means values on a quantity basis.

6.2.8 Salt Disposal

Salt volumes are based on the estimated concentration of the combined process water stream (Year 10 through 14) and high TDS and sulfate concentration waters captured in seepage collection, interceptor well systems, the brine reject waters from the TTS membrane system (Year 15 through 100), and the estimated evaporation rates between Years 10 and EOY 100 of the LT-ETS operational period. The total salt residual is calculated based on the TDS of the water evaporated and the total quantity evaporated annually with a 50% additional factor to account for waters of hydration expected during natural evaporation of salts. Costs for excavating, loading, hauling, unloading, and disposal have been based on material handling unit rates developed by Telesto (2019) and 2019 RS Means values on a quantity basis.

6.2.9 Indirect Costs

It is assumed that indirect O&M costs in total are 17.5% of the estimated direct O&M cost per the FA Work Group agreement on all O&M cost items. Indirect O&M costs include but not limited to:

- Contingency;
- Profit and overhead;
- Project management fee;
- Engineering redesign; and
- State procurement cost.

7.0 CLOSING

We trust the foregoing provides the information you need at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Golder Associates Inc.

Bridgette Hendricks
Senior Engineer

Todd Stein
Senior Hydrogeologist

KB/BH/TS/ap/js

https://golderassociates.sharepoint.com/sites/35255g/proposal project management/500_reporting/510_reports/512_finals/18106417.002.r.rev1/18106417-002-r-rev1-tyroneccpupdate-20200428.docx

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Tables

Table 1: Inventoried Process Waters at the Beginning of the Short-Term Evaporative Treatment System Operation

Parameter	Volume gallons
Total Residual Process Solutions	
Water In Pits[1]	**202,125,100**
Process Waters in Reservoirs and Impoundments	**17,612,200**
Average Circulated Inventory	**1,642,629,500**
Rounded Total	***1,862,366,800***
Water In Open Pits	
Location	Estimated Volume at Start of Evaporation Program (gallons)
Main, Gettysburg, and Copper Mountain	**202,125,049**
Rounded Total	***202,125,100***
Reservoirs and Impoundments (Process Water in Storage at Start of Evaporation Program)	
Location	Estimated Volume at Start of Evaporation Program (gallons)
1X1 Pond [2,3]	**1,139,400**
4C Drain [3]	**0**
2 PLS Pond [2,3]	**3,161,400**
North Racket PLS Pond [2,3]	**1,317,000**
SX/EW PLS Feed Pond [2,3]	**639,000**
Raffinate Tank 1 [2,3]	**238,000**
Raffinate Tank 2 [2,3]	**1,440,000**
5E Seepage Collection Pond [2,3]	**60,000**
5E Surge Pond [3]	**0**
No. 3 PLS Collection Pond [2,3]	**4,906,200**
No. 3 PLS Overflow Pond [2,3]	**0**
1A AST Overflow Pond [2,3]	**0**
1A PLS Tank [2,3]	**18,000**
1B PLS Overflow Pond [2,3]	**0**
1B PLS Tank [2,3]	**28,000**
Oak Grove Pond [2,3]	**228,000**
2A West PLS Tank [2,3]	**90,000**
2A East PLS Overflow (Pennington Pond) [2,3]	**0**
Land Bridge Booster [2,3]	**4,200,000**
6C-2 PLS Pond [2,3]	**144,000**
Gettysburg Highwall Tank [2,3]	**1,800**
1 AST Tank [2,3]	**1,400**
1 AST Overflow Pond [2,3]	**0**
Rounded Total	***17,612,200***
Reservoirs and Impoundments (Process Water added to Storage in First Year)	
Location	Estimated Volume of PLS Added (gallons)
5E Surge Pond [2,3]	**1,200,000**
No. 3 PLS Overflow Pond [2,3]	**4,029,000**
1A PLS Overflow Pond [2,3]	**1,954,800**
1B PLS Overflow Pond [2,3]	**3,111,600**
2A East PLS Overflow (Pennington Pond) [2,3]	**929,400**
1 AST Overflow Pond [2,3]	**84,000**
Rounded Total	***11,308,800***

Table 1: Inventoried Process Waters at the Beginning of the Short-Term Evaporative Treatment System Operation

Parameter	Volume gallons
Average Circulated Inventory (ACI)	
Initial Raffinate Flow (gpm)	**30,615**
Make-Up Water Requirement	**8%**
PLS from Stockpile Diminish	**10%**
PLS from Stockpile Diminish Duration (days)	**45**
Rounded Total	***1,642,629,500***

Notes:

[1] - Based on information provided Mandy Lilla on 5/31/19 in the file "190531_PitWaterInventory.xlsx". Represents the average combined storage within all the pits at Tyrone from January 2017 through December 2018.

[2] - Estimated reservoir volumes at start of evaporation program are assumed to be 60 percent of the reservoir capacities for impoundments and tanks. For overflow ponds, it is assumed that PLS will be added to the ponds at the start of the evaporation program from the PLS circuit (i.e., there is no PLS present in the overflow ponds during mine operations).

[3] - Based on information provided in the June 9, 2016 report from Daniel B. Stephens & Associates, Inc. titled Application Requirements for Discharge Permit at a Copper Mine Facility (20.6.7.11 NMAC), also commonly referred to as the “Master Document” .

Table 2: Surface Impoundment, Pond, and Tank Evaporation Schedule - Years 1 through 9

Location	Reservoir Surface Area[1] (acres)	Calculated Reservoir Water Surface Area[2] (acres)	Estimated Capacity (Gallons)	Estimated Reservoir Volume at Start of Evaporation Program[2] (gallons)	Average Annual Evaporation (gallons per year)[3]	Average Annual Evaporation (gallons per minute)[3]
1X1 Pond	0.75	0.45	1,899,000	1,139,400	612,071	1.16
4C Drain	0.00	0.00	0	0	0	0.00
2 PLS Pond[4]	1.05	0.63	5,269,000	3,161,400	856,900	1.63
North Racket PLS Pond	0.93	0.56	2,195,000	1,317,000	758,968	1.44
SX/EW PLS Feed Pond[4]	0.34	0.20	1,065,000	639,000	277,472	0.53
Raffinate Tank 1	0.08	0.08	397,000	238,200	108,813	0.21
Raffinate Tank 2	0.25	0.25	2,400,000	1,440,000	340,040	0.65
5E Seepage Collection Pond	0.10	0.06	100,000	60,000	81,609	0.16
5E Surge Pond	0.84	0.50	2,000,000	1,200,000	685,520	1.30
No. 3 PLS Collection Pond[4]	1.58	0.95	8,177,000	4,906,200	1,289,430	2.45
No. 3 PLS Overflow Pond[4]	1.52	0.91	6,715,000	4,029,000	1,240,464	2.36
1A AST Overflow Pond[4]	1.00	0.75	3,258,000	1,954,800	1,020,119	1.94
1A PLS Tank	0.01	0.01	30,000	18,000	13,602	0.03
1B PLS Overflow Pond	1.37	0.82	5,186,000	3,111,600	1,118,050	2.13
1B PLS Tank	0.02	0.02	47,000	28,200	27,203	0.05
Oak Grove Pond	0.25	0.15	380,000	228,000	204,024	0.39
2A West PLS Tank	0.01	0.01	150,000	90,000	13,602	0.03
2A East PLS Overflow (Pennington Pond)[4]	0.68	0.41	1,549,000	929,400	554,945	1.06
Land Bridge Booster	0.40	0.24	7,000,000	4,200,000	326,438	0.62
6C-2 PLS Pond	0.13	0.08	240,000	144,000	106,092	0.20
Gettysburg Highwall Tank	0.001	0.001	3,000	1,800	1,360	0.003
1 AST Tank	0.001	0.001	2,260	1,356	1,360	0.003
1 AST Overflow Pond	0.12	0.07	140,000	84,000	97,931	0.19
Total :	11.43	7.16	48,202,260	28,921,356	9,736,012	18.52

Notes:

[1] - Based on information provided in the June 9, 2016 report from Daniel B. Stephens & Associates, Inc. titled Application Requirements for Discharge Permit at a Copper Mine Facility (20.6.7.11 NMAC), also commonly referred to as the "Master Document" .

[2] - Estimated reservoir volumes at start of evaporation program are assumed to be 60 percent of the reservoir capacities for impoundments and tanks. For overflow ponds, it is assumed that PLS will be added to the ponds at the start of the evaporation program from the PLS circuit (i.e., there is no PLS present in the overflow ponds during mine operations).

[3] - Mean annual evaporation of 93.85 inches calculated from historical pan evaporation data from the Tyrone Mine (Tailing Dam #1, Tailing Dam #3, and No. 1A Stockpile). Mean annual evaporation for the surface impoundments was estimated at 65.7 inches by applying a pan coefficient of 0.70. Total evaporation from surface impoundments of 50.09 inches accounts for long-term (1897 to 2011) average annual precipitation of 15.61 inches reported for the Fort Bayard weather station.

[4] - Reservoir surface area from Google Earth

Table 3: Surface Impoundment, Pond, and Tank Evaporation Schedule - Years 10 through 14

Location	Reservoir Surface Area[1] (acres)	Calculated Reservoir Water Surface Area[2] (acres)	Estimated Capacity (Gallons)	Estimated Reservoir Volume at Start of Evaporation Program[2] (gallons)	Average Annual Evaporation (gallons per year)[3]	Average Annual Evaporation (gallons per minute)[3]
1X1 Pond	0.75	0.45	1,899,000	1,139,400	612,071	1.16
New Spray Evaporation Pond 1	7.00	5.60	19,668,800	15,735,040	7,616,886	14.49
New Spray Evaporation Pond 2	3.20	2.56	8,679,900	6,943,920	3,482,005	6.62
2 PLS Pond[4]	1.05	0.63	5,269,000	3,161,400	856,900	1.63
North Racket PLS Pond	0.93	0.56	2,195,000	1,317,000	758,968	1.44
SX/EW PLS Feed Pond[4]	0.34	0.20	1,065,000	639,000	277,472	0.53
Raffinate Tank 1	0.08	0.08	397,000	238,200	108,813	0.21
Raffinate Tank 2	0.25	0.25	2,400,000	1,440,000	340,040	0.65
5E Seepage Collection Pond	0.10	0.06	100,000	60,000	81,609	0.16
5E Surge Pond	0.84	0.50	2,000,000	1,200,000	685,520	1.30
No. 3 PLS Collection Pond[4]	1.58	0.95	8,177,000	4,906,200	1,289,430	2.45
1A AST Overflow Pond[4]	1.00	0.75	3,258,000	1,954,800	1,020,119	1.94
1A PLS Tank	0.01	0.01	30,000	18,000	13,602	0.03
1B PLS Overflow Pond	1.37	0.82	5,186,000	3,111,600	1,118,050	2.13
1B PLS Tank	0.02	0.02	47,000	28,200	27,203	0.05
Oak Grove Pond	0.25	0.15	380,000	228,000	204,024	0.39
2A West PLS Tank	0.01	0.01	150,000	90,000	13,602	0.03
2A East PLS Overflow (Pennington Pond)[4]	0.68	0.41	1,549,000	929,400	554,945	1.06
Land Bridge Booster	0.40	0.24	7,000,000	4,200,000	326,438	0.62
6C-2 PLS Pond	0.13	0.08	240,000	144,000	106,092	0.20
Gettysburg Highwall Tank	0.001	0.001	3,000	1,800	1,360	0.003
1 AST Tank	0.001	0.001	2,260	1,356	1,360	0.003
1 AST Overflow Pond	0.12	0.07	140,000	84,000	97,931	0.19
Total :	20.11	14.41	69,855,960	47,583,316	19,594,439	37.28

Notes:

[1] - Based on information provided in the June 9, 2016 report from Daniel B. Stephens & Associates, Inc. titled Application Requirements for Discharge Permit at a Copper Mine Facility (20.6.7.11 NMAC), also commonly referred to as the "Master Document" .

[2] - Estimated reservoir volumes at start of evaporation program are assumed to be 60 percent of the reservoir capacities for impoundments and tanks. New spray evaporation pond 1 and 2 are assumed to be filled to 80% of capacity throughout the long-term ETS operations.

[3] - Mean annual evaporation of 93.85 inches calculated from historical pan evaporation data from the Tyrone Mine (Tailing Dam #1, Tailing Dam #3, and No. 1A Stockpile). Mean annual evaporation for the surface impoundments was estimated at 65.7 inches by applying a pan coefficient of 0.70. Total evaporation from surface impoundments of 50.09 inches accounts for long-term (1897 to 2011) average annual precipitation of 15.61 inches reported for the Fort Bayard weather station.

[4] - Reservoir surface area from Google Earth.

Table 4: Surface Impoundment, Pond, and Tank Evaporation Schedule - Years 15 through 100

Location	Reservoir Surface Area[1] (acres)	Calculated Reservoir Water Surface Area[2] (acres)	Estimated Capacity (Gallons)	Estimated Reservoir Volume at Start of Evaporation Program[2] (gallons)	Average Annual Evaporation (gallons per year)[3]	Average Annual Evaporation (gallons per minute)[3]
1X1 Pond	0.75	0.45	1,899,000	1,139,400	612,071	1.16
New Spray Evaporation Pond 1	7.00	5.60	19,668,800	15,735,040	7,616,886	14.49
New Spray Evaporation Pond 2	3.20	2.56	8,679,900	6,943,920	3,482,005	6.62
5E Seepage Collection Pond	0.10	0.06	100,000	60,000	81,609	0.16
No. 3 PLS Collection Pond[4]	1.58	0.95	8,177,000	4,906,200	1,289,430	2.45
1A PLS Tank	0.01	0.01	30,000	18,000	13,602	0.03
1B PLS Tank	0.02	0.02	47,000	28,200	27,203	0.05
Oak Grove Pond	0.25	0.15	380,000	228,000	204,024	0.39
1 AST Tank	0.001	0.001	2,260	1,356	1,360	0.003
Total :	17.76	9.80	38,983,960	29,060,116	13,328,190	25.36

Notes:

[1] - Based on information provided in the June 9, 2016 report from Daniel B. Stephens & Associates, Inc. titled Application Requirements for Discharge Permit at a Copper Mine Facility (20.6.7.11 NMAC), also commonly referred to as the “Master Document” .

[2] - Estimated reservoir volumes at start of evaporation program are assumed to be 60 percent of the reservoir capacities for impoundments and tanks. New spray evaporation pond 1 and 2 are assumed to be filled to 80% of capacity throughout the long-term ETS operations.

[3] - Mean annual evaporation of 93.85 inches calculated from historical pan evaporation data from the Tyrone Mine (Tailing Dam #1, Tailing Dam #3, and No. 1A Stockpile). Mean annual evaporation for the surface impoundments was estimated at 65.7 inches by applying a pan coefficient of 0.70. Total evaporation from surface impoundments of 50.09 inches accounts for long-term (1897 to 2011) average annual precipitation of 15.61 inches reported for the Fort Bayard weather station.

[4] - Reservoir surface area from Google Earth.

Table 5: Evaporation Treatment Schedule

Year Following Closure	EOY	UNSAT-H Model Run 3 No Plants (Average Annual PE for Uncovered Stockpile in Tyrone Feasibility Study (Golder, 2007))			Evaporation from Drip Areas				Evaporation from 123 GPM Sprayers (SMI Mega PoleCat -25HP fan motor and 7.5 HP pump)				Evaporation from 25 GPM Sprayers (SMI 420F Evaporator -25HP fan motor and 2 HP pump)			Evaporation from 66 GPM Sprayers (SMI Super PoleCat - 25HP fan motor and 7.5 HP pump)			Evaporation from Reservoirs, Impoundments, and Tanks			Precipitation on Drip Areas		Precipitation on Spray Areas		Precipitation on Reservoirs, Impoundments, and Tanks		Total Evaporation	
		cm	in	ft	Drip Area (Acres)	acre-ft	gallons	gpm	No. of Spray Units (run time)	acre-ft	gallons	gpm	No. of Spray Units (run time)	acre-ft	gallons	No. of Spray Units (run time)	acre-ft	gallons	Surface Area (acres)	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons
1	2015	270.83	106.62	8.89	382	3,397.8	1,107,165,199	2,106	0.0	0.0	0	0	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	497.4	162,091,101	0.0	0	9.3	3,034,122	2,930.2	954,809,139
2	2016	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
3	2017	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
4	2018	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
5	2019	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
6	2020	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
7	2021	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
8	2022	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
9	2023	270.83	106.62	8.89	367	3,264.5	1,063,735,602	2,024	25.0	2,534.3	825,817,127	1,571	0	0.0	0	0	0.0	0	7.2	39.2	12,769,162	477.9	155,732,925	19.5	6,358,176	9.3	3,034,122	5,331.3	1,737,196,661
10	2024	270.83	106.62	8.89	0	0.0	0	0	25.0	2,534.3	825,817,127	1,571	0.00	0.0	0	0.00	0.0	0	6.2	34.2	11,142,244	0.0	0	19.5	6,358,176	8.1	2,647,544	2,540.9	827,953,643
11	2025	270.83	106.62	8.89	0	0.0	0	0	25.0	2,534.3	825,817,127	1,571	0.00	0.0	0	0.00	0.0	0	6.2	34.2	11,142,244	0.0	0	19.5	6,358,176	8.1	2,647,544	2,540.9	827,953,643
12	2026	270.83	106.62	8.89	0	0.0	0	0	25.0	2,534.3	825,817,127	1,571	0.00	0.0	0	0.00	0.0	0	6.2	34.2	11,142,244	0.0	0	19.5	6,358,176	8.1	2,647,544	2,540.9	827,953,643
13	2027	270.83	106.62	8.89	0	0.0	0	0	21.4	2,169.4	706,899,461	1,345	0.00	0.0	0	0.00	0.0	0	6.2	34.2	11,142,244	0.0	0	16.7	5,442,599	8.1	2,647,544	2,178.8	709,951,555
14	2028	270.83	106.62	8.89	0	0.0	0	0	21.0	2,128.8	693,686,387	1,320	0.00	0.0	0	0.00	0.0	0	6.2	34.2	11,142,244	0.0	0	16.4	5,340,868	8.1	2,647,544	2,138.5	696,840,212
15	2029	270.83	106.62	8.89	0	0.0	0	0	4.00	405.5	132,130,740	251	0.00	0.0	0	0.00	0.0	0	7.4	40.5	13,199,082	0.0	0	3.1	1,017,308	9.6	3,136,276	433.3	141,176,237
16	2030	270.83	106.62	8.89	0	0.0	0	0	4.00	405.5	132,130,740	251	0.00	0.0	0	0.00	0.0	0	7.4	40.5	13,199,082	0.0	0	3.1	1,017,308	9.6	3,136,276	433.3	141,176,237
17	2031	270.83	106.62	8.89	0	0.0	0	0	4.00	405.5	132,130,740	251	0.00	0.0	0	0.00	0.0	0	7.4	40.5	13,199,082	0.0	0	3.1	1,017,308	9.6	3,136,276	433.3	141,176,237
18	2032	270.83	106.62	8.89	0	0.0	0	0	3.90	395.4	128,827,472	245	0.00	0.0	0	0.00	0.0	0	7.5	40.8	13,306,116	0.0	0	3.0	991,875	9.7	3,161,709	423.4	137,980,002
19	2033	270.83	106.62	8.89	0	0.0	0	0	3.90	395.4	128,827,472	245	0.00	0.0	0	0.00	0.0	0	7.5	40.8	13,306,116	0.0	0	3.0	991,875	9.7	3,161,709	423.4	137,980,002
20	2034	270.83	106.62	8.89	0	0.0	0	0	3.80	385.2	125,524,203	239	0.00	0.0	0	0.00	0.0	0	7.5	41.2	13,413,150	0.0	0	3.0	966,443	9.8	3,187,142	413.6	134,783,768
21	2035	270.83	106.62	8.89	0	0.0	0	0	3.80	385.2	125,524,203	239	0.00	0.0	0	0.00	0.0	0	7.5	41.2	13,413,150	0.0	0	3.0	966,443	9.8	3,187,142	413.6	134,783,768
22	2036	270.83	106.62	8.89	0	0.0	0	0	3.75	380.2	123,872,569	236	0.00	0.0	0	0.00	0.0	0	7.5	41.3	13,466,667	0.0	0	2.9	953,726	9.8	3,199,858	408.7	133,185,651
23	2037	270.83	106.62	8.89	0	0.0	0	0	3.70	375.1	122,220,935	233	0.00	0.0	0	0.00	0.0	0	7.6	41.5	13,520,184	0.0	0	2.9	941,010	9.9	3,212,574	403.8	131,587,533
24	2038	270.83	106.62	8.89	0	0.0	0	0	3.70	375.1	122,220,935	233	0.00	0.0	0	0.00	0.0	0	7.6	41.5	13,520,184	0.0	0	2.9	941,010	9.9	3,212,574	403.8	131,587,533
25	2039	270.83	106.62	8.89	0	0.0	0	0	3.65	370.0	120,569,301	229	0.00	0.0	0	0.00	0.0	0	7.6	41.7	13,573,701	0.0	0	2.8	928,294	9.9	3,225,291	398.9	129,989,416
26	2040	270.83	106.62	8.89	0	0.0	0	0	3.60	364.9	118,917,666	226	0.00	0.0	0	0.00	0.0	0	7.6	41.8	13,627,218	0.0	0	2.8	915,577	9.9	3,238,007	394.0	128,391,299
27	2041	270.83	106.62	8.89	0	0.0	0	0	3.60	364.9	118,917,666	226	0.00	0.0	0	0.00	0.0	0	7.6	41.8	13,627,218	0.0	0	2.8	915,577	9.9	3,238,007	394.0	128,391,299
28	2042	270.83	106.62	8.89	0	0.0	0	0	3.55	359.9	117,266,032	223	0.00	0.0	0	0.00	0.0	0	7.7	42.0	13,680,735	0.0	0	2.8	902,861	10.0	3,250,723	389.1	126,793,182
29	2043	270.83	106.62	8.89	0	0.0	0	0	3.50	354.8	115,614,398	220	0.00	0.0	0	0.00	0.0	0	7.7	42.1	13,734,252	0.0	0	2.7	890,145	10.0	3,263,440	384.2	125,195,065
30	2044	270.83	106.62	8.89	0	0.0	0	0	3.45	349.7	113,962,764	217	0.00	0.0	0	0.00	0.0	0	7.7	42.3	13,787,769	0.0	0	2.7	877,428	10.1	3,276,156	379.3	123,596,947
31	2045	270.83	106.62	8.89	0	0.0	0	0	3.45	349.7	113,962,764	217	0.00	0.0	0	0.00	0.0	0	7.7	42.3	13,787,769	0.0	0	2.7	877,428	10.1	3,276,156	379.3	123,596,947
32	2046	270.83	106.62	8.89	0	0.0	0	0	3.40	344.7	112,311,129	214	0.00	0.0	0	0.00	0.0	0	7.8	42.5	13,841,286	0.0	0	2.7	864,712	10.1	3,288,873	374.4	121,998,830
33	2047	270.83	106.62	8.89	0	0.0	0	0	3.40	344.7	112,311,129	214	0.00	0.0	0	0.00	0.0	0	7.8	42.5	13,841,286	0.0	0	2.7	864,712	10.1	3,288,873	374.4	121,998,830
34	2048	270.83	106.62	8.89	0	0.0	0	0	3.40	344.7	112,311,129	214	0.00	0.0	0	0.00	0.0	0	7.8	42.5	13,841,286	0.0	0	2.7	864,712	10.1	3,288,873	374.4	121,998,830
35	2049	270.83	106.62	8.89	0	0.0	0	0	3.40	344.7	112,311,129	214	0.00	0.0	0	0.00	0.0	0	7.8	42.5	13,841,286	0.0	0	2.7	864,712	10.1	3,288,873	374.4	121,998,830
36	2050	270.83	106.62	8.89	0	0.0	0	0	3.35	339.6	110,659,495	211	0.00	0.0	0	0.00	0.0	0	7.8	42.6	13,894,803	0.0	0	2.6	851,996	10.1	3,301,589	369.5	120,400,713
37	2051	270.83	106.62	8.89	0	0.0	0	0	3.35	339.6	110,659,495	211	0.00	0.0	0	0.00	0.0	0	7.8	42.6	13,894,803	0.0	0	2.6	851,996	10.1	3,301,589	369.5	120,400,713
38	2052	270.83	106.62	8.89	0	0.0	0	0	3.35	339.6	110,659,495	211	0.00	0.0	0	0.00	0.0	0	7.8	42.6	13,894,803	0.0	0	2.6	851,996	10.1	3,301,589	369.5	120,400,713
39	2053	270.83	106.62	8.89	0	0.0	0	0	3.35	339.6	110,659,495	211	0.00	0.0	0	0.00	0.0	0	7.8	42.6	13,894,803	0.0	0	2.6	851,996	10.1	3,301,589	369.5	120,400,713
40	2054	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
41	2055	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
42	2056	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
43	2057	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
44	2058	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
45	2059	270.83	106.62	8.89	0	0.0	0	0	3.30	334.5	109,007,861	207	0.00	0.0	0	0.00	0.0	0	7.8	42.8	13,948,320	0.0	0	2.6	839,279	10.2	3,314,305	364.6	118,802,596
46	2060	270.83	106.62	8.89	0	0.0	0	0	3.25	329.5	107,356,227	204	0.00	0.0	0	0.00	0.0	0	7.8	43.0	14,001,837	0.0	0	2.5	826,563	10.2	3,327,022	359.7	117,204,478
47	2061	270.83	106.62	8.89	0	0.0	0	0	3.25	329.5	107,356,227	204	0.00	0.0	0	0.00	0.0	0	7.8	43.0	14,001,837	0.0	0	2.5	826,563	10.2	3,327,022	359.7	117,204,478
48	2062	270.83	106.62	8.89	0	0.0	0	0	3.25	329.5	107,356,227	204	0.00	0.0	0	0.00	0.0	0	7.8	43.0	14,001,837	0.0	0	2.5	826,563	10.2	3,327,022	359.7	117,204,478
49	2063	270.83	106.62	8.89	0	0.0	0	0	3.25	329.5	107,356,227	204	0.00	0.0	0	0.00	0.0	0	7.8	43.0	14,001,837	0.0	0	2.5	826,563	10.2	3,327,022	359.7	117,204,478
50	2064	270.83	106.62	8.89	0	0.0	0	0	3.25	329.5	107,356,227	204	0.00	0.0	0	0.00	0.0	0	7.8	43.0	14,001,837	0.0	0	2.5	826,563	10.2	3,327,022	359.7	117,204,478
51	2065	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
52	2066	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
53	2067	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
54	2068	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
55	2069	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
56	2070	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
57	2071	270.83	106.62	8.89	0	0.0	0	0	3.20	324.4	105,704,592	201	0.00	0.0	0	0.00	0.0	0	7.9	43.1	14,055,354	0.0	0	2.5	813,847	10.2	3,339,738	354.8	115,606,361
58	2072	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
59	2073	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
60	2074	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
61	2075	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
62	2076	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
63	2077	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
64	2078	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
65	2079	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
66	2080	270.83	106.62	8.89	0	0.0	0	0	3.15	319.3	104,052,958	198	0.00	0.0	0	0.00	0.0	0	7.9	43.3	14,108,871	0.0	0	2.5	801,130	10.3	3,352,454	349.9	114,008,244
67	2081	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
68	2082	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
69	2083	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
70	2084	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
71	2085	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
72	2086	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
73	2087	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
74	2088	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
75	2089	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
76	2090	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
77	2091	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127

Table 5: Evaporation Treatment Schedule

Year Following Closure	EOY	UNSAT-H Model Run 3 No Plants (Average Annual PE for Uncovered Stockpile in Tyrone Feasibility Study (Golder, 2007))			Evaporation from Drip Areas				Evaporation from 123 GPM Sprayers (SMI Mega PoleCat -25HP fan motor and 7.5 HP pump)				Evaporation from 25 GPM Sprayers (SMI 420F Evaporator -25HP fan motor and 2 HP pump)		
		cm	in	ft	Drip Area (Acres)	acre-ft	gallons	gpm	No. of Spray Units (run time)	acre-ft	gallons	gpm	No. of Spray Units (run time)	acre-ft	gallons
78	2092	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0
79	2093	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0
80	2094	270.83	106.62	8.89	0	0.0	0	0	3.10	314.3	102,401,324	195	0.00	0.0	0
81	2095	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
82	2096	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
83	2097	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
84	2098	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
85	2099	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
86	2100	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
87	2101	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
88	2102	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
89	2103	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
90	2104	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
91	2105	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
92	2106	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
93	2107	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
94	2108	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
95	2109	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
96	2110	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
97	2111	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
98	2112	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
99	2113	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
100	2114	270.83	106.62	8.89	0	0.0	0	0	3.05	309.2	100,749,690	192	0.00	0.0	0
Total		**27,083**	**10,662.43**	**888.5358**		**29,514**	**9,617,050,017**	**18,297**		**60,718**	**19,784,926,740.57**	**37,642.55**		**-**	**-**

Year Following Closure	EOY	Evaporation from 66 GPM Sprayers (SMI Super PoleCat - 25HP fan motor and 7.5 HP pump)			Evaporation from Reservoirs, Impoundments, and Tanks			Precipitation on Drip Areas		Precipitation on Spray Areas		Precipitation on Reservoirs, Impoundments, and Tanks		Total Evaporation	
		No. of Spray Units (run time)	acre-ft	gallons	Surface Area (acres)	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons	acre-ft	gallons
78	2092	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
79	2093	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
80	2094	0.00	0.0	0	7.9	43.5	14,162,389	0.0	0	2.4	788,414	10.3	3,365,171	345.0	112,410,127
81	2095	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
82	2096	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
83	2097	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
84	2098	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
85	2099	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
86	2100	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
87	2101	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
88	2102	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
89	2103	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
90	2104	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
91	2105	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
92	2106	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
93	2107	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
94	2108	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
95	2109	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
96	2110	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
97	2111	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
98	2112	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
99	2113	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
100	2114	0.00	0.0	0	8.0	43.6	14,215,906	0.0	0	2.4	775,697	10.4	3,377,887	340.1	110,812,010
Total			**-**	**-**		**4,212**	**1,372,597,501.97**	**4,321**	**1,407,954,499.61**	**467**	**152,329,181.28**	**1,001**	**326,147,302.01**	**88,654**	**28,888,143,077.85**

Table 6: Annual Rate of Salt Generation from Evaporative Treatment System (Years 10 Through 100)

Year Following Closure	Salt Generation (Tons/Year)	Salt Generation (cy/Year)
10	140,093	93,396
11	117,549	78,366
12	95,319	63,546
13	70,040	46,693
14	49,346	32,897
15	20,630	13,753
16	20,387	13,591
17	20,145	13,430
18	19,904	13,269
19	19,663	13,109
20	19,423	12,949
21	19,186	12,791
22	18,954	12,636
23	18,727	12,484
24	18,504	12,336
25	18,284	12,189
26	18,068	12,045
27	17,855	11,903
28	17,644	11,763
29	17,436	11,624
30	17,230	11,487
31	17,027	11,351
32	16,825	11,217
33	16,785	11,190
34	16,745	11,164
35	16,708	11,139
36	16,672	11,114
37	16,637	11,091
38	16,603	11,069
39	16,571	11,047
40	16,539	11,026
41	16,509	11,006
42	16,479	10,986
43	16,451	10,967
44	16,423	10,949
45	16,396	10,931
46	16,370	10,914
47	16,345	10,897
48	16,321	10,880
49	16,297	10,865
50	16,264	10,843
51	16,202	10,802
52	16,182	10,788
53	16,161	10,774
54	16,142	10,761

Table 6: Annual Rate of Salt Generation from Evaporative Treatment System (Years 10 Through 100)

Year Following Closure	Salt Generation (Tons/Year)	Salt Generation (cy/Year)
55	16,122	10,748
56	16,104	10,736
57	16,085	10,723
58	16,067	10,712
59	16,050	10,700
60	16,033	10,689
61	16,016	10,678
62	16,000	10,667
63	15,985	10,656
64	15,969	10,646
65	15,954	10,636
66	15,939	10,626
67	15,925	10,617
68	15,911	10,607
69	15,897	10,598
70	15,884	10,589
71	15,871	10,580
72	15,858	10,572
73	15,845	10,563
74	15,835	10,556
75	15,824	10,550
76	15,814	10,543
77	15,804	10,536
78	15,795	10,530
79	15,785	10,523
80	15,776	10,517
81	15,766	10,511
82	15,757	10,505
83	15,748	10,499
84	15,740	10,493
85	15,731	10,487
86	15,722	10,482
87	15,714	10,476
88	15,706	10,470
89	15,698	10,465
90	15,690	10,460
91	15,682	10,454
92	15,674	10,449
93	15,667	10,444
94	15,659	10,439
95	15,652	10,434
96	15,644	10,430
97	15,637	10,425
98	15,630	10,420
99	15,623	10,416
100	15,617	10,411

Table 7: Summary of Water Flow and Sulfate Concentrations for Influent Streams Sent to the TTS Treatment System

Year	Flow Rate (gpm)	Sulfate (mg/L)
15	1,189	2,811
25	1,109	2,706
50	1,013	2,538
75	966	2,483
100	944	2,433

Table 8: Summary of Water Flow and Sulfate Concentrations for Influent Stream Sent to the TTS Membrane Treatment System

Year	Flow Rate (gpm)	Sulfate (mg/L)
15	925	1,600
25	862	1,600
50	786	1,600
75	749	1,600
100	732	1,600

Table 9: Summary of Water Flow and Sulfate Concentrations for Influent Streams Sent to the TTS HDS System

Year	Flow Rate (gpm)	Sulfate (mg/L)
15	1,285	2,788
25	1,197	2,691
50	1,091	2,536
75	1,040	2.484
100	1,016	2,438

Table 10: Annual Rate of Sludge Generation from Water Treatment System

Year	Sludge, 50% (tons/year)	Sludge, 50% (cy/year)
15	32,844	24,329
25	29,526	21,871
50	25,363	18,788
75	23,680	17,541
100	22,703	16,817

Table 11: Labor Costs

Labor Category	Base Hourly Wage*
Plant Operator	$18.60
O&M Supervisor	$31.10
Maintenance Technician	$19.83

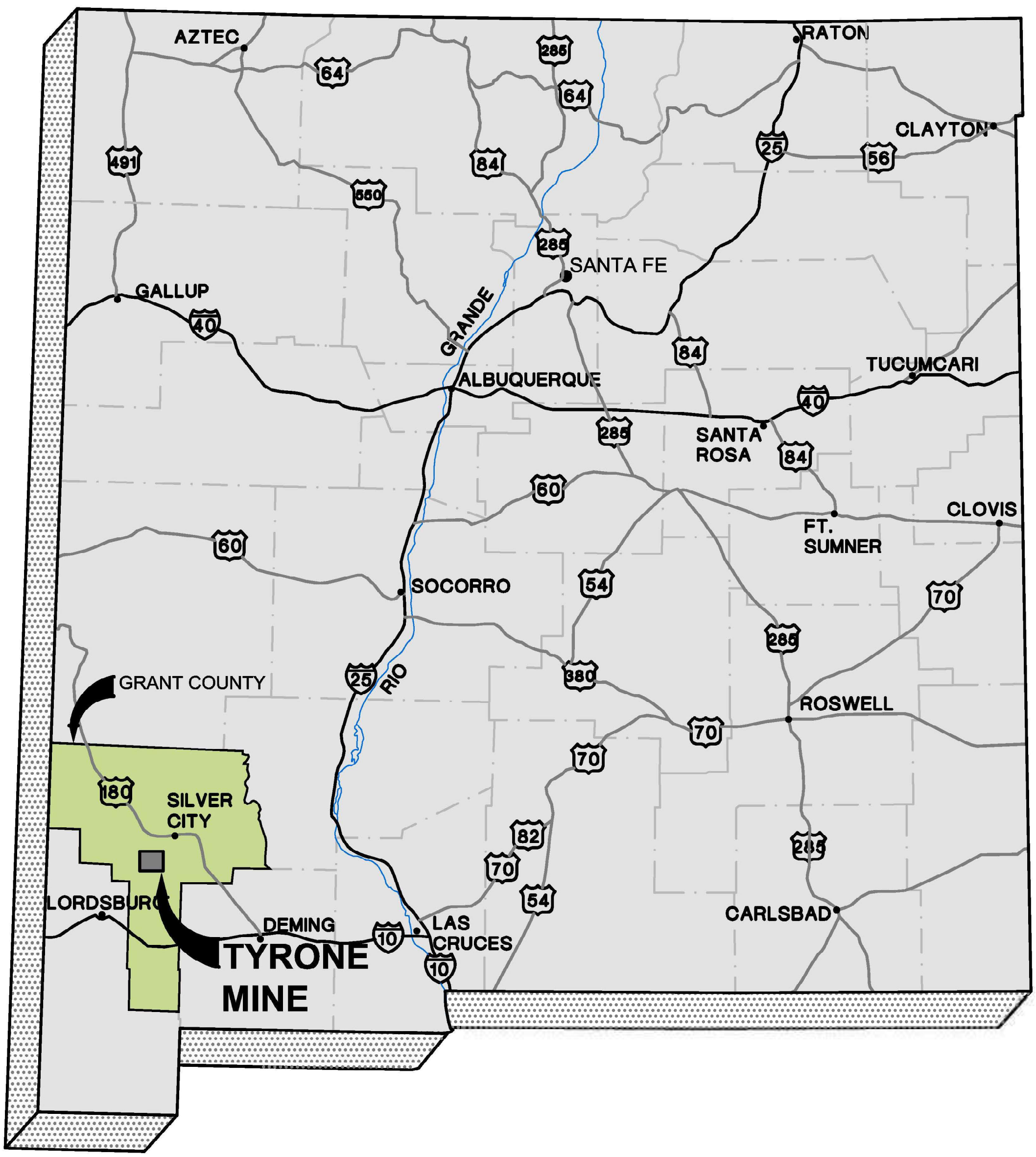
Notes:

*These salaries are based on 2019 prevailing wage rates in New Mexico.

Figures

STATE OF NEW MEXICO

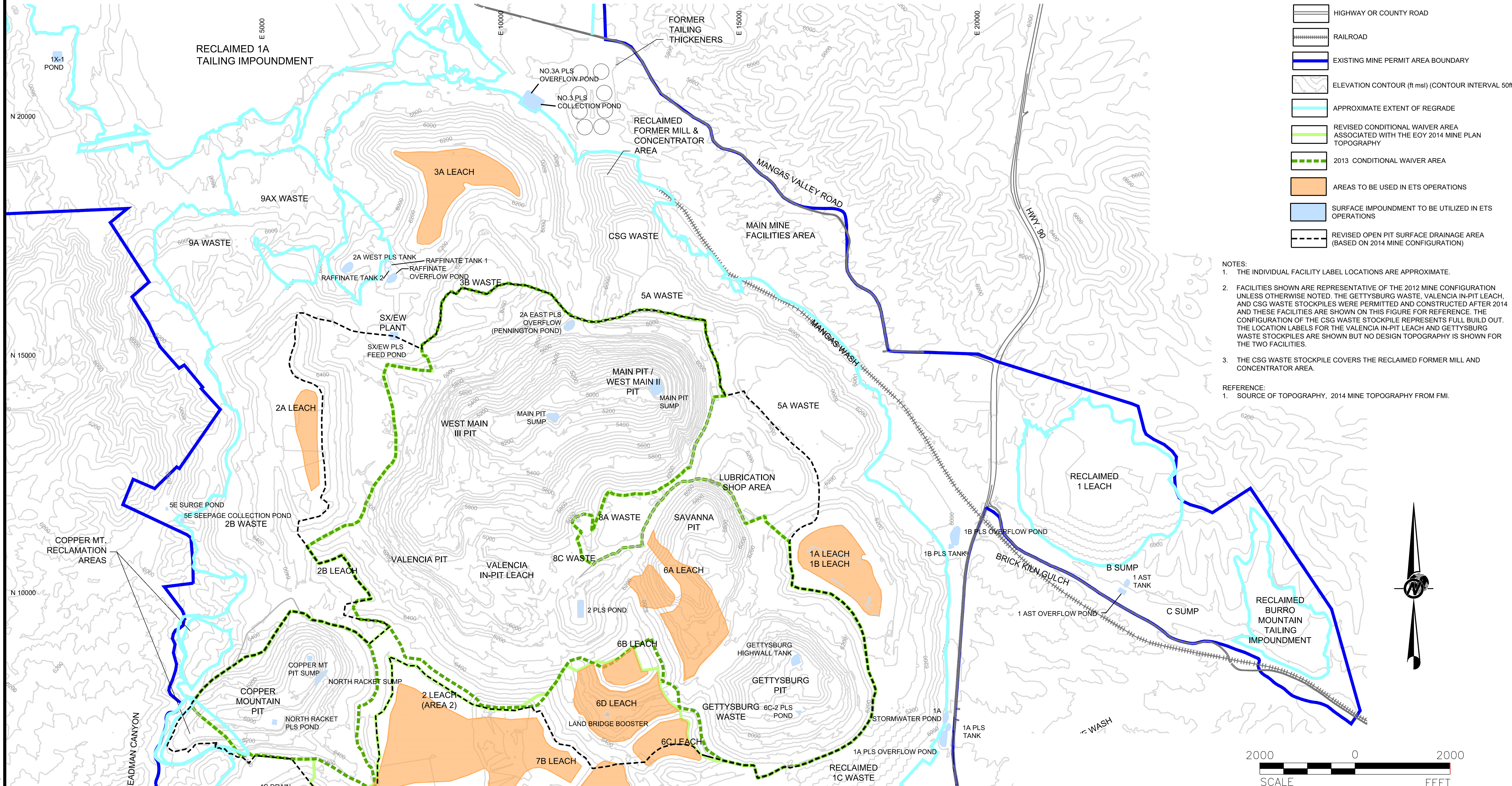
NOT TO SCALE



PROJECT	FREEPORT McMoRan TYRONE, INC. TYRONE CLOSURE/CLOSEOUT PLAN GRANT COUNTY, NEW MEXICO
TITLE	**MINE LOCATION MAP**

GOLDER	PROJECT No.		18106417	FILE No. 1-1 Mine Location
	DESIGN	TS	08/22/12	SCALE AS SHOWN REV. 0
	CADD	CM	04/10/13	
	CHECK	TS	04/10/13	**FIGURE 1**
	REVIEW	TS	04/10/13	

Drawing file: 1-1 Mine Location Map.dwg Apr 10, 2013 - 1:46pm



NOTES:

1. THE INDIVIDUAL FACILITY LABEL LOCATIONS ARE APPROXIMATE.
2. FACILITIES SHOWN ARE REPRESENTATIVE OF THE 2012 MINE CONFIGURATION UNLESS OTHERWISE NOTED. THE GETTYSBURG WASTE, VALENCIA IN-PIT LEACH, AND CSG WASTE STOCKPILES WERE PERMITTED AND CONSTRUCTED AFTER 2014 AND THESE FACILITIES ARE SHOWN ON THIS FIGURE FOR REFERENCE. THE CONFIGURATION OF THE CSG WASTE STOCKPILE REPRESENTS FULL BUILD OUT. THE LOCATION LABELS FOR THE VALENCIA IN-PIT LEACH AND GETTYSBURG WASTE STOCKPILES ARE SHOWN BUT NO DESIGN TOPOGRAPHY IS SHOWN FOR THE TWO FACILITIES.
3. THE CSG WASTE STOCKPILE COVERS THE RECLAIMED FORMER MILL AND CONCENTRATOR AREA.

REFERENCE:

1. SOURCE OF TOPOGRAPHY, 2014 MINE TOPOGRAPHY FROM FMI.

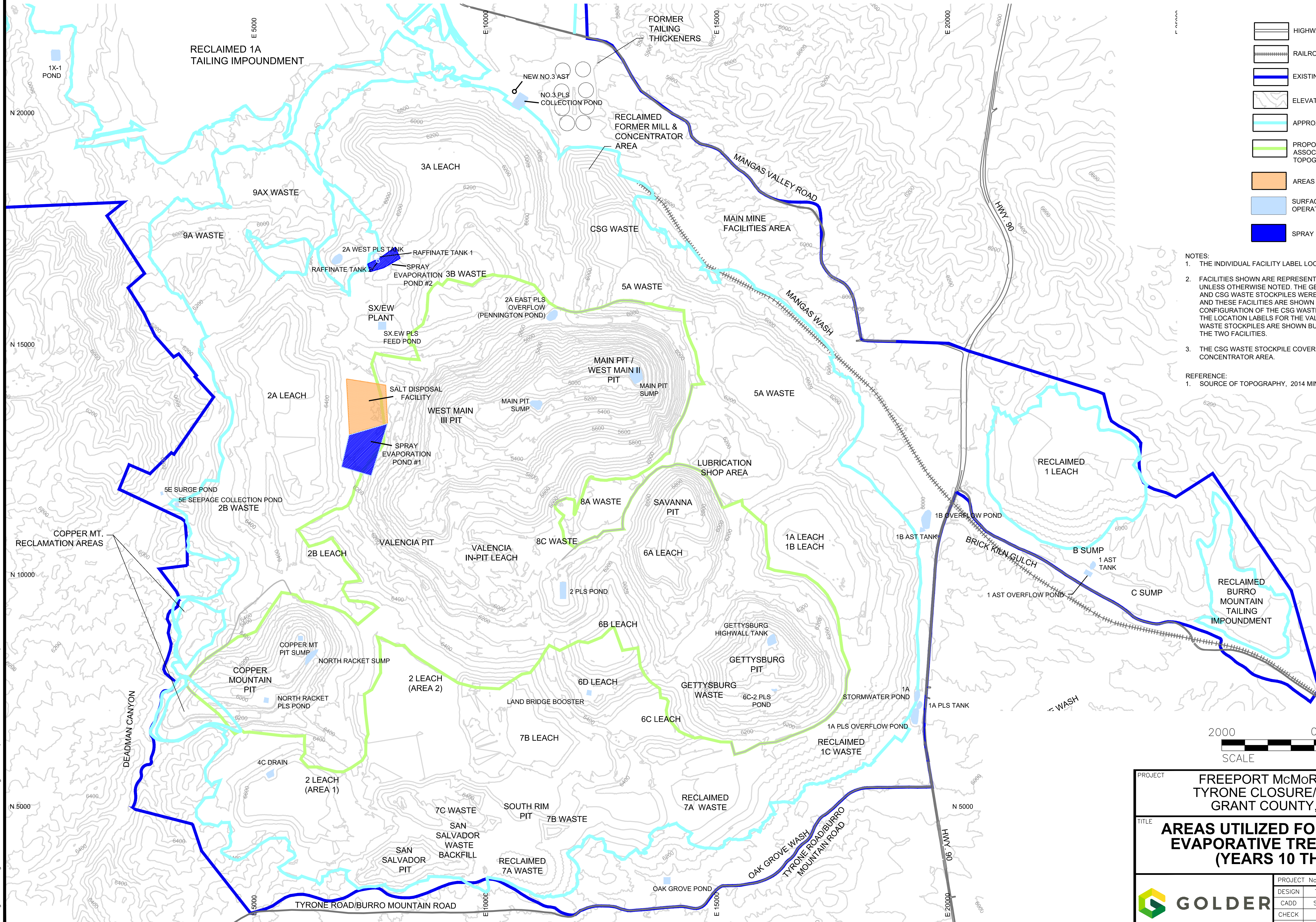
PROJECT
FREEPORT McMoRan TYRONE INC.
TYRONE CLOSURE/CLOSEOUT PLAN
GRANT COUNTY, NEW MEXICO

TITLE
AREAS UTILIZED FOR THE SHORT-TERM EVAPORATIVE TREATMENT SYSTEM (YEARS 1 THROUGH 9)

GOLDER

PROJECT No.		18106417	FILE No.	Tech Memo Fig01
DESIGN	TS	04/08/20	SCALE AS SHOWN	REV. 1
CADD	SIB	04/08/20	FIGURE 2	
CHECK				
REVIEW				

Drawing file: Fig02-Years1to9.dwg Apr 28, 2020 - 8:13am



HIGHWAY OR COUNTY ROAD
RAILROAD
EXISTING MINE PERMIT AREA BOUNDARY
ELEVATION CONTOUR (ft msl) (CONTOUR INTERVAL 50ft)
APPROXIMATE EXTENT OF REGRADE
PROPOSED REVISED CONDITIONAL WAIVER AREA ASSOCIATED WITH THE EOY 2014 MINE PLAN TOPOGRAPHY
AREAS TO BE USED IN ETS OPERATIONS
SURFACE IMPOUNDMENT TO BE UTILIZED IN ETS OPERATIONS
SPRAY EVAPORATION POND

NOTES:
1. THE INDIVIDUAL FACILITY LABEL LOCATIONS ARE APPROXIMATE.
2. FACILITIES SHOWN ARE REPRESENTATIVE OF THE 2012 MINE CONFIGURATION UNLESS OTHERWISE NOTED. THE GETTYSBURG WASTE, VALENCIA IN-PIT LEACH, AND CSG WASTE STOCKPILES WERE PERMITTED AND CONSTRUCTED AFTER 2014 AND THESE FACILITIES ARE SHOWN ON THIS FIGURE FOR REFERENCE. THE CONFIGURATION OF THE CSG WASTE STOCKPILE REPRESENTS FULL BUILD OUT. THE LOCATION LABELS FOR THE VALENCIA IN-PIT LEACH AND GETTYSBURG WASTE STOCKPILES ARE SHOWN BUT NO DESIGN TOPOGRAPHY IS SHOWN FOR THE TWO FACILITIES.
3. THE CSG WASTE STOCKPILE COVERS THE RECLAIMED FORMER MILL AND CONCENTRATOR AREA.

REFERENCE:
1. SOURCE OF TOPOGRAPHY, 2014 MINE TOPOGRAPHY FROM FMI.

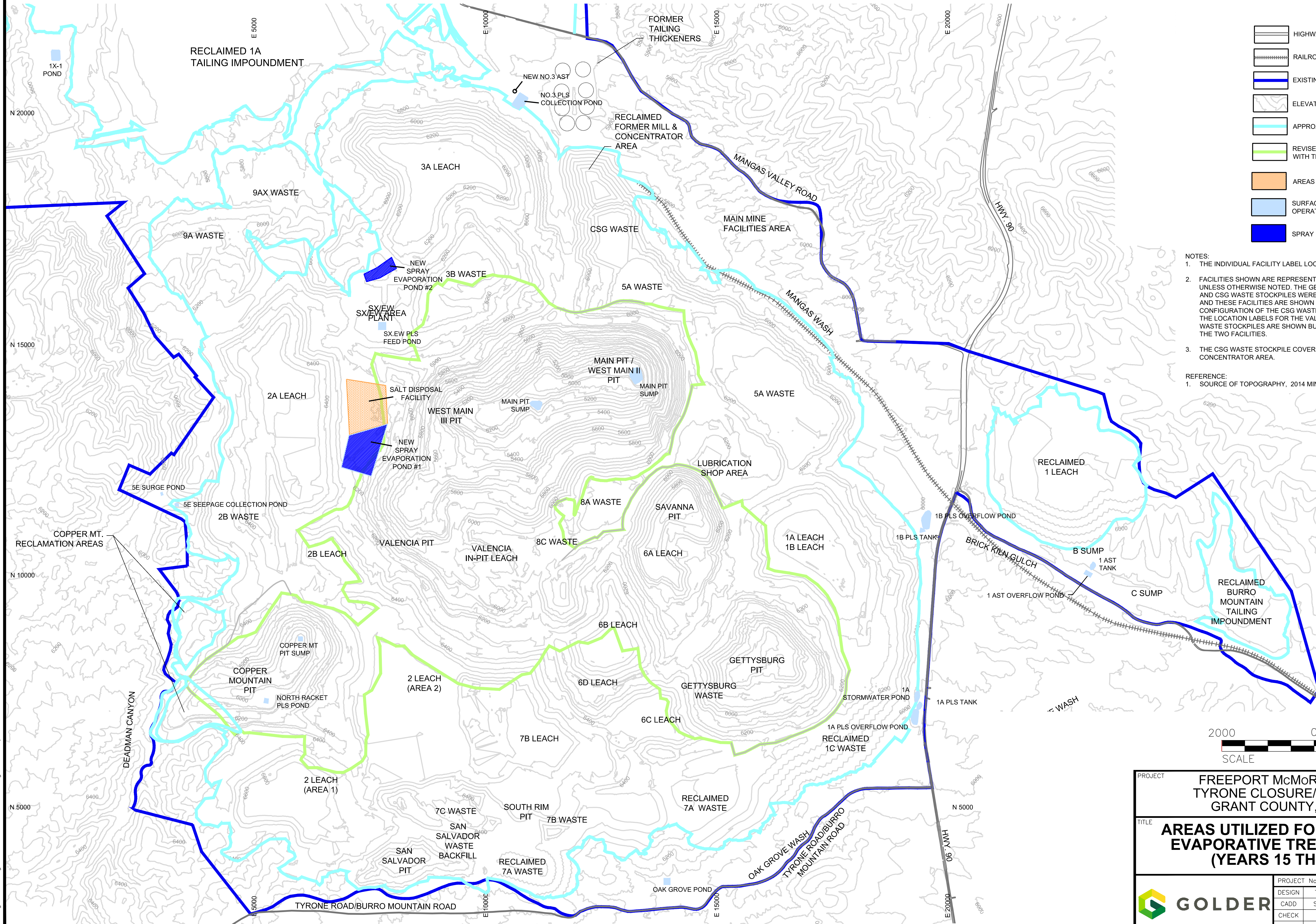
PROJECT
FREEPORT McMoRan TYRONE INC.
TYRONE CLOSURE/CLOSEOUT PLAN
GRANT COUNTY, NEW MEXICO

TITLE
AREAS UTILIZED FOR THE LONG-TERM EVAPORATIVE TREATMENT SYSTEM (YEARS 10 THROUGH 14)

GOLDER

PROJECT No.		18106417	FILE No.	Fig03-Years10to14
DESIGN	TS	04/08/20	SCALE AS SHOWN	REV. 1
CADD	SIB	04/08/20	FIGURE 3	
CHECK				
REVIEW				

Drawing file: Fig03-Years10to14.dwg Apr 27, 2020 - 4:38pm



HIGHWAY OR COUNTY ROAD
RAILROAD
EXISTING MINE PERMIT AREA BOUNDARY
ELEVATION CONTOUR (ft msl) (CONTOUR INTERVAL 50ft)
APPROXIMATE EXTENT OF REGRADE
REVISED CONDITIONAL WAIVER AREA ASSOCIATED WITH THE EOY 2014 MINE PLAN TOPOGRAPHY
AREAS TO BE USED IN ETS OPERATIONS
SURFACE IMPOUNDMENTS TO BE UTILIZED IN ETS OPERATIONS
SPRAY EVAPORATION POND

NOTES:
1. THE INDIVIDUAL FACILITY LABEL LOCATIONS ARE APPROXIMATE.
2. FACILITIES SHOWN ARE REPRESENTATIVE OF THE 2012 MINE CONFIGURATION UNLESS OTHERWISE NOTED. THE GETTYSBURG WASTE, VALENCIA IN-PIT LEACH, AND CSG WASTE STOCKPILES WERE PERMITTED AND CONSTRUCTED AFTER 2014 AND THESE FACILITIES ARE SHOWN ON THIS FIGURE FOR REFERENCE. THE CONFIGURATION OF THE CSG WASTE STOCKPILE REPRESENTS FULL BUILD OUT. THE LOCATION LABELS FOR THE VALENCIA IN-PIT LEACH AND GETTYSBURG WASTE STOCKPILES ARE SHOWN BUT NO DESIGN TOPOGRAPHY IS SHOWN FOR THE TWO FACILITIES.
3. THE CSG WASTE STOCKPILE COVERS THE RECLAIMED FORMER MILL AND CONCENTRATOR AREA.

REFERENCE:
1. SOURCE OF TOPOGRAPHY, 2014 MINE TOPOGRAPHY FROM FMI.

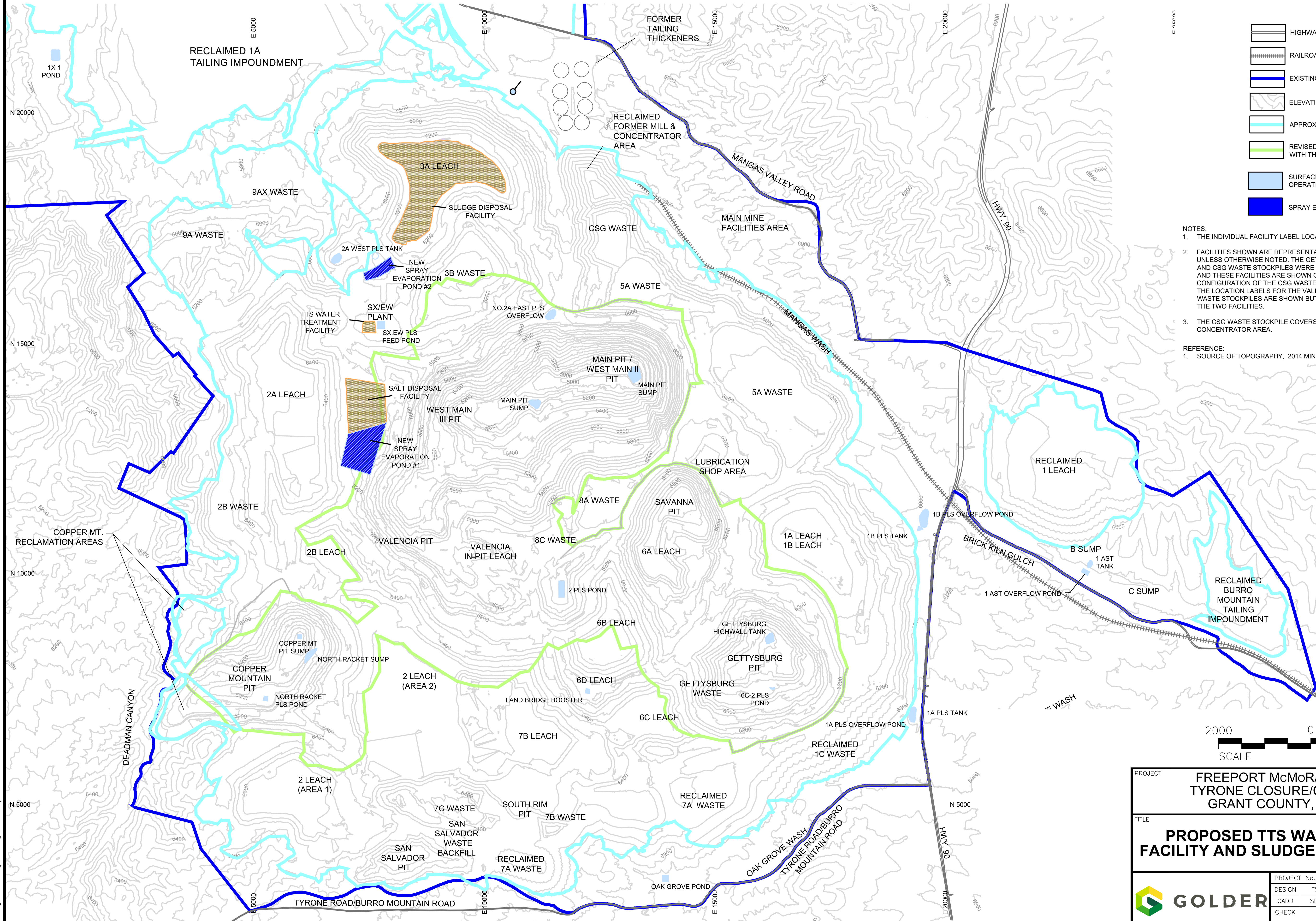
PROJECT
FREEPORT McMoRan TYRONE INC.
TYRONE CLOSURE/CLOSEOUT PLAN
GRANT COUNTY, NEW MEXICO

TITLE
AREAS UTILIZED FOR THE LONG-TERM EVAPORATIVE TREATMENT SYSTEM (YEARS 15 THROUGH 100)

GOLDER

PROJECT No.		18106417	FILE No. Fig04-Years15to100	
DESIGN	TS	04/07/20	SCALE AS SHOWN	REV. 1
CADD	SIB	04/07/20	**FIGURE 4**	
CHECK				
REVIEW				

Drawing file: Fig04-Years15to100.dwg Apr 28, 2020 - 8:36am



HIGHWAY OR COUNTY ROAD
RAILROAD
EXISTING MINE PERMIT AREA BOUNDARY
ELEVATION CONTOUR (ft msl) (CONTOUR INTERVAL 50ft)
APPROXIMATE EXTENT OF REGRADE
REVISED CONDITIONAL WAIVER AREA ASSOCIATED WITH THE EOY 2014 MINE PLAN TOPOGRAPHY
SURFACE IMPOUNDMENTS TO BE UTILIZED IN TTS OPERATIONS
SPRAY EVAPORATION POND

NOTES:
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2. FACILITIES SHOWN ARE REPRESENTATIVE OF THE 2012 MINE CONFIGURATION UNLESS OTHERWISE NOTED. THE GETTYSBURG WASTE, VALENCIA IN-PIT LEACH, AND CSG WASTE STOCKPILES WERE PERMITTED AND CONSTRUCTED AFTER 2014 AND THESE FACILITIES ARE SHOWN ON THIS FIGURE FOR REFERENCE. THE CONFIGURATION OF THE CSG WASTE STOCKPILE REPRESENTS FULL BUILD OUT. THE LOCATION LABELS FOR THE VALENCIA IN-PIT LEACH AND GETTYSBURG WASTE STOCKPILES ARE SHOWN BUT NO DESIGN TOPOGRAPHY IS SHOWN FOR THE TWO FACILITIES.
3. THE CSG WASTE STOCKPILE COVERS THE RECLAIMED FORMER MILL AND CONCENTRATOR AREA.

REFERENCE:
1. SOURCE OF TOPOGRAPHY, 2014 MINE TOPOGRAPHY FROM FMI.

2000 0 2000
SCALE FEET

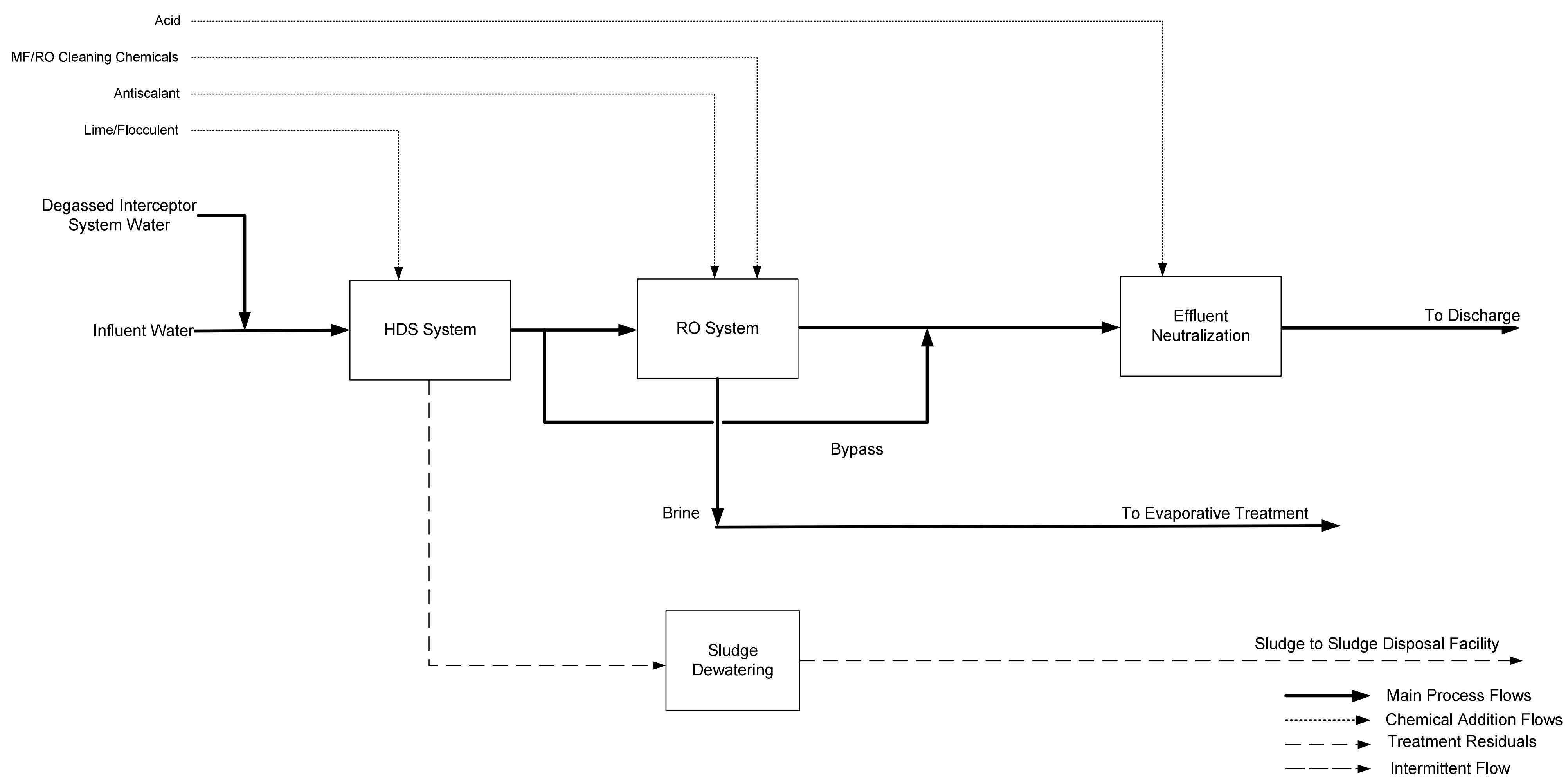
PROJECT
FREEPORT McMoRan TYRONE INC.
TYRONE CLOSURE/CLOSEOUT PLAN
GRANT COUNTY, NEW MEXICO

TITLE
PROPOSED TTS WATER TREATMENT FACILITY AND SLUDGE DISPOSAL FACILITY

GOLDER

PROJECT No.		18106417	FILE No.	Fig05
DESIGN	TS	04/07/20	SCALE AS SHOWN	REV. 1
CADD	SIB	04/07/20		
CHECK			**FIGURE 5**	
REVIEW				

Drawing file: Fig05.dwg Apr 28, 2020 - 8:29am



GOLDER

Denver, Colorado

CLIENT/PROJECT

Freeport-McMoRan
Tyrone Mine

TITLE

WATER TREATMENT SYSTEM BLOCK FLOW DIAGRAM (YEARS 15 THROUGH 100)

DRAWN	EAT	DATE	June 11, 2019	JOB NO.	18106417
CHECKED	BH	SCALE	Not to Scale	DWG. NO.	N/A
REVIEWED	TS	FILE NO.		FIGURE NO.	6

ATTACHMENT A

Summary Table of Post Mining Process Water Management and Water Treatment Flow Rates

Post Mining Process Water Management and Water Treatment Flow Rates - Evaporative Treatment System and Water Treatment Plant Operations
100-Year Water Handling Plan with Water Treatment Plan
Tyrone 2013 Closure/Closeout Plan (Updated April 2020)

End of Year	Year Following Closure	Evaporation Schedule				System Inflows - Impacted Water									Water Treatment Schedule			
		Evaporation System Water Flow Rates			Storage	Pit Water In-flows						Stockpile Water In-flows			Total Impacted Water Flows	Water Treatment Schedule		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
		Evaporation System Flow Rate (gpm)	Evaporation System Water Loss (gallons per year)	Impacted Water Included In Evaporation System Flow Rate (gpm)	Water in Storage at the End of Year (gallons)	Main Pit Groundwater Inflow (gpm)	Gettysburg Pit Groundwater Inflow (gpm)	Copper Mountain Pit Groundwater Inflow (gpm)	Main Pit Storm Water Run-on Inflow (gpm)	Gettysburg Pit Storm Water Run-on Inflow (gpm)	Copper Mt. Pit Storm Water Run-on Inflow (gpm)	Storm Water Run-Off Outside Waiver Area (gpm)	Flow from Higher TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Flow from Lower TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Combined Impacted Water from Mine Sources Flow Rate (gpm)	Flow Rate to Water Treatment Plant (gpm)	RO Brine Effluent from WTP to ETS (gpm)	Total Water Flow Rate to Beneficial Use (gpm)
2015	1	32,222	954,809,139	1,629	1,752,451,561	1,092	61	55	75	6	8	159	60	112	1,629	-	-	-
2016	2	28,886	1,737,196,661	1,616	864,624,500	1,083	61	51	75	6	8	159	60	112	1,616	-	-	-
2017	3	25,557	1,737,196,661	1,611	-	1,075	60	47	75	6	8	159	68	112	1,611	-	-	-
2018	4	22,221	1,737,196,661	1,599	-	1,066	60	44	75	6	8	159	68	112	1,599	-	-	-
2019	5	18,877	1,737,196,661	1,578	-	1,058	59	42	75	6	8	159	66	104	1,578	-	-	-
2020	6	15,533	1,737,196,661	1,558	-	1,050	59	40	75	6	8	159	65	95	1,558	-	-	-
2021	7	12,270	1,737,196,661	1,619	-	1,042	58	39	75	6	8	159	64	168	1,619	-	-	-
2022	8	8,927	1,737,196,661	1,599	-	1,034	57	38	75	6	8	159	62	159	1,599	-	-	-
2023	9	5,584	1,737,196,661	1,580	-	1,027	57	36	75	6	8	159	61	151	1,580	-	-	-
2024	10	2,371	827,953,643	1,561	-	1,019	56	35	75	6	8	159	60	142	1,561	-	-	-
2025	11	1,541	827,953,643	1,541	-	1,012	55	34	75	6	8	159	58	133	1,541	-	-	-
2026	12	1,522	827,953,643	1,522	-	1,004	55	32	75	6	8	159	57	125	1,522	-	-	-
2027	13	1,279	729,618,570	1,279	-	939	54	31	68	7	8	-	54	116	1,279	-	-	-
2028	14	1,259	729,618,570	1,259	-	932	53	30	68	7	8	-	52	108	1,259	-	-	-
2029	15	255	141,176,237	255	-	925	53	29	68	7	8	-	51	99	1,240	1,189	204	985
2030	16	252	141,176,237	252	-	918	52	28	68	7	8	-	50	99	1,230	1,180	202	978
2031	17	250	141,176,237	250	-	911	51	27	68	7	8	-	49	99	1,221	1,172	201	971
2032	18	247	137,980,002	247	-	904	50	26	68	7	8	-	48	99	1,211	1,163	199	964
2033	19	245	137,980,002	245	-	897	49	25	68	7	8	-	47	99	1,201	1,154	197	956
2034	20	242	134,783,768	242	-	890	49	23	68	7	8	-	46	99	1,192	1,146	196	950
2035	21	240	134,783,768	240	-	884	48	22	68	7	8	-	45	99	1,182	1,137	195	942
2036	22	238	133,185,651	238	-	878	47	21	68	7	8	-	44	99	1,174	1,130	193	936
2037	23	235	131,587,533	235	-	872	46	20	68	7	8	-	43	99	1,165	1,122	192	930
2038	24	233	131,587,533	233	-	867	46	20	68	7	8	-	42	99	1,158	1,116	191	925
2039	25	231	129,989,416	231	-	862	45	19	68	7	8	-	41	99	1,150	1,109	190	919
2040	26	229	128,391,299	229	-	858	44	18	68	7	8	-	41	99	1,143	1,102	189	914
2041	27	227	128,391,299	227	-	853	44	17	68	7	8	-	40	99	1,136	1,096	188	909
2042	28	225	126,793,182	225	-	849	43	16	68	7	8	-	39	99	1,130	1,091	187	905
2043	29	223	125,195,065	223	-	845	43	16	68	7	8	-	38	99	1,124	1,086	186	901
2044	30	221	123,596,947	221	-	842	42	15	68	7	8	-	37	99	1,118	1,081	185	897
2045	31	220	123,596,947	220	-	838	41	14	68	7	8	-	36	99	1,112	1,076	184	892
2046	32	218	121,998,830	218	-	835	41	14	68	7	8	-	35	99	1,107	1,072	183	889
2047	33	217	121,998,830	217	-	831	40	13	68	7	8	-	35	99	1,103	1,068	182	886
2048	34	216	121,998,830	216	-	828	40	13	68	7	8	-	35	99	1,098	1,063	182	882
2049	35	216	121,998,830	216	-	825	40	12	68	7	8	-	35	99	1,094	1,059	181	878
2050	36	215	120,400,713	215	-	823	39	12	68	7	8	-	35	99	1,091	1,056	180	876
2051	37	214	120,400,713	214	-	820	39	11	68	7	8	-	35	99	1,087	1,052	180	873
2052	38	214	120,400,713	214	-	817	38	11	68	7	8	-	35	99	1,083	1,048	179	869
2053	39	213	120,400,713	213	-	815	38	10	68	7	8	-	35	99	1,080	1,045	179	867
2054	40	213	118,802,596	213	-	812	37	10	68	7	8	-	35	99	1,077	1,042	178	864
2055	41	212	118,802,596	212	-	810	37	9	68	7	8	-	35	99	1,073	1,038	177	861
2056	42	212	118,802,596	212	-	807	37	9	68	7	8	-	35	99	1,070	1,035	177	858
2057	43	211	118,802,596	211	-	805	36	8	68	7	8	-	35	99	1,067	1,032	176	856
2058	44	211	118,802,596	211	-	803	36	8	68	7	8	-	35	99	1,064	1,029	176	853
2059	45	210	118,802,596	210	-	801	36	8	68	7	8	-	35	99	1,062	1,027	175	852
2060	46	210	117,204,478	210	-	799	35	7	68	7	8	-	35	99	1,059	1,024	175	849
2061	47	209	117,204,478	209	-	797	35	7	68	7	8	-	35	99	1,056	1,021	174	847
2062	48	209	117,204,478	209	-	795	35	7	68	7	8	-	35	99	1,054	1,019	174	845

End of Year	Year Following Closure	Evaporation Schedule				System Inflows - Impacted Water									Water Treatment Schedule			
		Evaporation System Water Flow Rates			Storage	Pit Water In-flows						Stockpile Water In-flows			Total Impacted Water Flows	Water Treatment Schedule		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
		Evaporation System Flow Rate (gpm)	Evaporation System Water Loss (gallons per year)	Impacted Water Included In Evaporation System Flow Rate (gpm)	Water in Storage at the End of Year (gallons)	Main Pit Groundwater Inflow (gpm)	Gettysburg Pit Groundwater Inflow (gpm)	Copper Mountain Pit Groundwater Inflow (gpm)	Main Pit Storm Water Run-on Inflow (gpm)	Gettysburg Pit Storm Water Run-on Inflow (gpm)	Copper Mt. Pit Storm Water Run-on Inflow (gpm)	Storm Water Run-Off Outside Waiver Area (gpm)	Flow from Higher TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Flow from Lower TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Combined Impacted Water from Mine Sources Flow Rate (gpm)	Flow Rate to Water Treatment Plant (gpm)	RO Brine Effluent from WTP to ETS (gpm)	Total Water Flow Rate to Beneficial Use (gpm)
2063	49	208	117,204,478	208	-	793	34	6	68	7	8	-	35	99	1,051	1,016	173	843
2064	50	208	117,204,478	208	-	791	34	6	68	7	8	-	35	99	1,048	1,013	173	840
2065	51	206	115,606,361	206	-	789	34	5	68	7	8	-	35	95	1,041	1,006	172	835
2066	52	206	115,606,361	206	-	787	33	5	68	7	8	-	35	95	1,039	1,004	171	833
2067	53	206	115,606,361	206	-	786	33	5	68	7	8	-	35	95	1,037	1,002	171	831
2068	54	205	115,606,361	205	-	784	33	5	68	7	8	-	35	95	1,034	999	171	829
2069	55	205	115,606,361	205	-	783	33	4	68	7	8	-	35	95	1,032	997	170	827
2070	56	205	115,606,361	205	-	781	32	4	68	7	8	-	35	95	1,030	995	170	825
2071	57	204	115,606,361	204	-	780	32	4	68	7	8	-	35	95	1,028	993	170	824
2072	58	204	114,008,244	204	-	778	32	3	68	7	8	-	35	95	1,026	991	169	822
2073	59	204	114,008,244	204	-	777	32	3	68	7	8	-	35	95	1,025	990	169	821
2074	60	203	114,008,244	203	-	776	32	3	68	7	8	-	35	95	1,023	988	169	820
2075	61	203	114,008,244	203	-	774	31	3	68	7	8	-	35	95	1,021	986	168	818
2076	62	203	114,008,244	203	-	773	31	2	68	7	8	-	35	95	1,019	984	168	816
2077	63	202	114,008,244	202	-	772	31	2	68	7	8	-	35	95	1,018	983	168	816
2078	64	202	114,008,244	202	-	770	31	2	68	7	8	-	35	95	1,016	981	167	814
2079	65	202	114,008,244	202	-	769	31	2	68	7	8	-	35	95	1,014	979	167	812
2080	66	202	114,008,244	202	-	768	30	1	68	7	8	-	35	95	1,013	978	167	811
2081	67	201	112,410,127	201	-	767	30	1	68	7	8	-	35	95	1,011	976	167	810
2082	68	201	112,410,127	201	-	766	30	1	68	7	8	-	35	95	1,010	975	166	809
2083	69	201	112,410,127	201	-	765	30	1	68	7	8	-	35	95	1,008	973	166	807
2084	70	201	112,410,127	201	-	764	30	1	68	7	8	-	35	95	1,007	972	166	806
2085	71	200	112,410,127	200	-	763	29	0	68	7	8	-	35	95	1,006	971	166	806
2086	72	200	112,410,127	200	-	762	29	0	68	7	8	-	35	95	1,004	969	165	804
2087	73	200	112,410,127	200	-	761	29	0	68	7	8	-	35	95	1,003	968	165	803
2088	74	200	112,410,127	200	-	760	29	0	68	7	8	-	35	95	1,002	967	165	802
2089	75	199	112,410,127	199	-	759	29	0	68	7	8	-	35	95	1,001	966	165	802
2090	76	199	112,410,127	199	-	758	29	0	68	7	8	-	35	95	1,000	965	165	801
2091	77	199	112,410,127	199	-	757	29	0	68	7	8	-	35	95	999	964	164	800
2092	78	199	112,410,127	199	-	756	28	0	68	7	8	-	35	95	997	962	164	798
2093	79	199	112,410,127	199	-	755	28	0	68	7	8	-	35	95	996	961	164	797
2094	80	199	112,410,127	199	-	755	28	0	68	7	8	-	35	95	995	960	164	796
2095	81	198	110,812,010	198	-	754	28	0	68	7	8	-	35	95	995	960	164	797
2096	82	198	110,812,010	198	-	753	28	0	68	7	8	-	35	95	994	959	164	796
2097	83	198	110,812,010	198	-	752	28	0	68	7	8	-	35	95	993	958	163	795
2098	84	198	110,812,010	198	-	751	28	0	68	7	8	-	35	95	992	957	163	794
2099	85	198	110,812,010	198	-	750	27	0	68	7	8	-	35	95	991	956	163	793
2100	86	198	110,812,010	198	-	750	27	0	68	7	8	-	35	95	990	955	163	792
2101	87	197	110,812,010	197	-	749	27	0	68	7	8	-	35	95	989	954	163	792
2102	88	197	110,812,010	197	-	748	27	0	68	7	8	-	35	95	988	953	163	791
2103	89	197	110,812,010	197	-	747	27	0	68	7	8	-	35	95	987	952	162	790
2104	90	197	110,812,010	197	-	747	27	0	68	7	8	-	35	95	986	951	162	789
2105	91	197	110,812,010	197	-	746	27	0	68	7	8	-	35	95	986	951	162	789
2106	92	197	110,812,010	197	-	745	27	0	68	7	8	-	35	95	985	950	162	788
2107	93	197	110,812,010	197	-	745	27	0	68	7	8	-	35	95	984	949	162	787
2108	94	196	110,812,010	196	-	744	26	0	68	7	8	-	35	95	983	948	162	787
2109	95	196	110,812,010	196	-	743	26	0	68	7	8	-	35	95	982	947	162	786

End of Year	Year Following Closure	Evaporation Schedule				System Inflows - Impacted Water									Water Treatment Schedule			
		Evaporation System Water Flow Rates			Storage	Pit Water In-flows						Stockpile Water In-flows			Total Impacted Water Flows	Water Treatment Schedule		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
		Evaporation System Flow Rate (gpm)	Evaporation System Water Loss (gallons per year)	Impacted Water Included In Evaporation System Flow Rate (gpm)	Water in Storage at the End of Year (gallons)	Main Pit Groundwater Inflow (gpm)	Gettysburg Pit Groundwater Inflow (gpm)	Copper Mountain Pit Groundwater Inflow (gpm)	Main Pit Storm Water Run-on Inflow (gpm)	Gettysburg Pit Storm Water Run-on Inflow (gpm)	Copper Mt. Pit Storm Water Run-on Inflow (gpm)	Storm Water Run-Off Outside Waiver Area (gpm)	Flow from Higher TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Flow from Lower TDS/Sulfate Toe Collections and GW Interceptor Systems (gpm)	Combined Impacted Water from Mine Sources Flow Rate (gpm)	Flow Rate to Water Treatment Plant (gpm)	RO Brine Effluent from WTP to ETS (gpm)	Total Water Flow Rate to Beneficial Use (gpm)
2110	96	196	110,812,010	196	-	743	26	0	68	7	8	-	35	95	982	947	161	786
2111	97	196	110,812,010	196	-	742	26	0	68	7	8	-	35	95	981	946	161	785
2112	98	196	110,812,010	196	-	741	26	0	68	7	8	-	35	95	980	945	161	784
2113	99	196	110,812,010	196	-	741	26	0	68	7	8	-	35	95	980	945	161	784
2114	100	196	110,812,010	196	-	740	26	0	68	7	8	-	35	95	979	944	161	783

Notes:

This table presents the water solution volumes and flow rates associated with a 100-year water handling plan. Identifed are:

a. System in-flow components of impacted water that must be handled and flow rates of the components,

b. Schedule for reduction of water in storage through operation of an evaporation system,

c. A schedule of water treatment plant operating rates that correspond to impacted water in-flow rates that require treatment

(1) - During the mining and copper leaching operations approximately 30,615 gpm of water is circulated through the copper production system (Average raffinate flow rate from January 2017 through December 2018). After cessation of the mining operation, the leaching operation will stop. However continued operation of the existing leach drip system as an evaporation system in combination with new spray systems will deplete the leach system water contained in storage. The flow rate of the evaporation system can be as high as the flow rate during leaching operations and it will be reduced as the water in storage is depleted. Data Provided by FMI in "2011-2018 Raff Flow.xlsx"

(2) - "Evaporation Sytem Water Water Loss" (EWL) is based on daily potential evaporation from UNSAT-H Model Run 3 No Plants, and associated area under drip system. Spray evaporation based on daily evaporation chart for Model 1210 evaporator systems provided by Duane Thompson of Minetek on June 28, 2012. Fifth degree polynomial fit through data set and mechanical spray system flow rates applied to evaporation chart. Evaporation from PLS surface impoundments and tanks is also included as well as the average annual precipitation (15.61 inches) on the stockpile areas under drip and the surface impoundments/tanks, and spray areas. A pan coefficient of 0.7 was applied to pan evaporation data for surface impoundment evaporation estimates. Drip System only in Year 1 with 382 acres under drip. Requires a 25 spray system operating for Years 2 through 12, 22 spray system operating for Years 13 and 14, and 4 spray system operating between Years 15 and the end of Year 100. Drip areas (Year 1: 382 acres; Years 2 through 9: 367 acres).

(3) - For Years 1 through 14, Total Combined Impacted Water In-flow (column-14) will be included in the short-term evaporation system. For Years-15 through Year-100, high TDS and sulfate water streams will be treated in the long-term evaporative system, and the low TDS and sulfate water streams will be treated at the Water Treatment Plant.

(4) - Water in Storage at the end of a year in the schedule. Initial "Water in Storage" (WIS) = Water in PLS impoundments/tanks (18,119,418 gal.) - PLS added to empty overflow ponds (11,308,800 gal.) + water in pits (202,125,049 gal.) + "Average Circulated Inventory" (ACI). ACI is calculated based on experience with leach operations which show that when raffinate application is stopped, PLS flow rates from stockpiles diminish to 10% of the full application flow rate in 45 days. Make-up water requirement = 8% of Raffinate Flow Rate during leaching (Therefore 92% of the Raffinate Flow Rate reports to PLS.). For an initial raffinate flow rate of 30,615 gallons per minute (average measured raffinate flow rates between January 2017 and the end of December 2018), the ACI is calculated as follows: ((30,615 gpm x 92%) x 60 min/hr x 24 hr/day x 45 day drain-down cycle) x 0.90 = 1,642,629,456 gallons. And the initial water in storage can be calculated as follows: Initial "Water in Storage" = (18,119,418 - 11,308,800 + 202,125,049 + 1,642,629,456) gallons = 1,851,565,123 gallons (1,851,565,200 gal. rounded).

(5) - Sources of water in-flow to the system related to the Main Pit groundwater inflows and the estimated flow rates based on DBS&A Stage 2 Abatement Plan GW flow model updated with 2014 base case mine plan configuration and associated regrade plan. Estimated flows provided by DBS&A on 1/18/2019 "Pit GW Inflow Estimates_Golder_DBSA.xlsx"

(6) - Sources of water in-flow to the system related to the Gettysburg Pit groundwater inflows and the estimated flow rates based on DBS&A Stage 2 Abatement Plan GW flow model updated with 2014 base case mine plan configuration and associated regrade plan. Estimated flows provided by DBS&A on 1/18/2019 "Pit GW Inflow Estimates_Golder_DBSA.xlsx"

(7) - Sources of water in-flow to the system related to the Copper Mountain Pit groundwater inflows and the estimated flow rates based on DBS&A Stage 2 Abatement Plan GW flow model updated with 2014 base case mine plan configuration and associated regrade plan. Estimated flows provided by DBS&A on 1/18/2019 "Pit GW Inflow Estimates_Golder_DBSA.xlsx"

(8) - Sources of water in-flow to the system related to the Main Pit storm water run-on and the estimated average flow rates for both 2014 base-case (uncovered stockpile surfaces Years 1 through 12) and post closure periods (covered stockpile surfaces Years 13 though 100). Includes storm water run-on in Savanna Pit which is assumed to be pumped into Main Pit. Appendix E to Stage DBS&A Stage 2 Abatement Plan (Golder, July 2012) . Final updated 2014 EOY and Regrade stockpile areas provided by MWH on 8/3/2012.

(9) - Sources of water in-flow to the system related to the Gettysburg Pit storm water run-on and the estimated average flow rates for both 2014 base-case (uncovered stockpile surfaces Years 1 through 12) and post closure periods (covered stockpile surfaces Years 13 though 100). Appendix E to Stage DBS&A Stage 2 Abatement Plan (Golder, July 2012). Final updated 2014 EOY and Regrade stockpile areas provided by MWH on 8/3/2012.

(10) - Sources of water in-flow to the system related to the Copper Mountain Pit storm water run-on and the estimated average flow rates for both 2014 base-case (uncovered stockpile surfaces Years 1 through 12) and post closure periods (covered stockpile surfaces Years 13 though 100). Appendix E to Stage DBS&A Stage 2 Abatement Plan (Golder, July 2012). Final updated 2014 EOY and Regrade stockpile areas provided by MWH on 8/3/2012.

(11) - Sources of water in-flow to the system related to storm water run-off outside pit watershed areas and the estimated average flow rates for both 2014 base-case operational and post closure periods. Assumed all stockpiles are covered by year 12 and surface water runoff will be directed to natural drainages at this point. Appendix E to Stage DBS&A Stage 2 Abatement Plan (Golder, July 2012). Final updated 2014 EOY and Regrade stockpile areas provided by MWH on 8/3/2012.

(12) - Sources of water in-flow to the system from the high TDS (>10,000 mg/L) and high sulfate (>7,500 mg/L) stockpile toe collections and groundwater interceptor systems and the estimated average flow rate of each source. The high TDS and sulfate waters from these sources will be included in the short-term evaporative treatment system for Years 1 through 14, and will be included in the long-term evaporative treatment system for Years 15 through 100. Flow and water quality estimates for the individual stockpile toe collections and groundwater interceptor systems provided by DBS&A in the file "Seep WQ and Flows Initial Projections_DBSA 2019_Update.xlsx".

(13) - Sources of water in-flow to the system from the low TDS (<10,000 mg/L) and low sulfate (<7,500 mg/L) stockpile toe collections and groundwater interceptor systems and the estimated average flow rate of each source. The low TDS and sulfate waters from these sources will be included in the short-term evaporative treatment system for Years 1 through 14, and will be included in the Water Treatment Plant flow stream for Years 15 through 100. Flow and water quality estimates for the individual stockpile toe collections and groundwater interceptor systems provided by DBS&A in the file "Seep WQ and Flows Initial Projections_DBSA 2019_Update.xlsx".

(14) - Combined Impacted Water In-Flow Rate (CIW) is total of in-flows columns, column-5 through column-13.

(15) - Flow Rate to Water Treatment Plant is the flow rate that is the basis for determining the WTP operating cost.

(16) - RO Brine Effluent from the membrane system at the Water Treatment Plant that will be included in the long-term evaporative treatment system between Years 15 through Year 100.

(17) - Treated water flow rate going to beneficial use.

Flows to the Evaporative Treatment Systems (short-term and long-term ETS's)

Flows to the Water Treatment Plant (Tyrone Treatment System)

ATTACHMENT B

Equipment and Material Quotes and Cost Backup Details

ATTACHMENT B1

ETS Equipment Backup

Tab 1: Water Management Variables Evaporative Treatment and Water Conveyance Systems

Description	Variable
RSMeans NM Discount Rate	0.847
Steel Tank Life Expectancy (yr)	50
Lined Pond Life Expectancy (yr)	30
Pump Life Expectancy (yr)	20
HDPE Pipeline Life Expectancy (yr)	100
Reclamation Start Year (End of Year 2014)	0
Reclamation Finished (End of Year 2031)	17
Vegetation Established Assume stormwater released	12
Short-Term Evaporative Treatment System Start Year (Beginning of Year 2015)	1
Short-Term Evaporative Treatment System Finish Year (End of Year 2023)	9
Long-Term Evaporative Treatment System Start Year (Beginning of Year 2024)	10
Long-Term Evaporative Treatment System Finish Year (End of Year 2114)	100

Tab 2: LONG-TERM EVAPORITION TREATMENT SYSTEM - CAPEX
Rev. 1

Created by: Antonio Herilalaina
Checked by: Wade Wang
Approved by: JP Wu
Revised by: Todd Stein (4/14/2020)

Pipelines CAPEX and Replacement Schedule

From	To	Length (ft)	Max Flow (gpm)	Replacement Material	Nom. Replacement Pipe Size (in)	Replacement Pipe Schedule	Existing Pipeline	Material and Installation Cost	Total Installed Direct Cost	Comments	Assumed Age at Start of LT-ETS (Yr 10)	1st Relacement Year	2nd Relacement Year	3rd Relacement Year	4th Relacement Year	5th Relacement Year
Process Water Sources to LT ETS																
No. 3 Stockpile Interceptor Barrier Trenches	No. 3 PLS Collection Pond	3880	5.39	HDPE PE4710	2	17	Yes	$6.45	$25,026.00	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	20	90	NA	NA	NA	NA
No. 3 Stockpile New Canyon 6 Area Collection	No. 3 PLS Collection Pond	900	1.56	HDPE PE4710	2	17	Yes	$6.45	$5,805.00		20	90	NA	NA	NA	NA
No. 3 PLS Collection Pond	Spray Evap Pond #1	7625	6.95	HDPE PE4710	2	9	Yes	$6.45	$49,181.25		20	90	NA	NA	NA	NA
Oak Grove Interceptor Barrier Trenches	1 AST Tank	4784	19.69	HDPE PE4710	2	17	Yes	$6.45	$30,856.80	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	20	90	NA	NA	NA	NA
1 AST Tank	1B PLS Tank	3958	19.69	HDPE PE4710	2	9	No	$6.45	$25,529.10		0	NA	NA	NA	NA	NA
No. 1B Stockpile Seep Collections	1B PLS Tank	600	8.86	HDPE PE4710	2	17	Yes	$6.45	$3,870.00		20	90	NA	NA	NA	NA
1 AST Tank	1B PLS Tank	6500	2.2	HDPE PE4710	2	17	Yes	$6.45	$41,925.00		20	90	NA	NA	NA	NA
1B PLS Tank	Spray Evap Pond #1	21839	30.75	HDPE PE4710	2	9	No	$6.45	$140,861.55		0	NA	NA	NA	NA	NA
5E Seepage Collection Pond	Spray Evap Pond #1	13110	13.44	HDPE PE4710	2	17	No	$6.45	$84,559.50	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	0	NA	NA	NA	NA	NA
Brine Reject from TTS	Spray Evap Pond #1	2320	204	HDPE PE4710	4	17	No	$6.70	$15,544.00	RS Means bare costs for materials and installation (Line No. 331413350100)	0	NA	NA	NA	NA	NA
							Total Piping:		**$423,158**							

Tab 2: LONG-TERM EVAPORITION TREATMENT SYSTEM - CAPEX
Rev. 1

Created by: Antonio Herilalaina
Checked by: Wade Wang
Approved by: JP Wu
Revised by: Todd Stein (4/14/2020)

Pumps

From	To	Quantity	Design Flow Rate (gpm)	Total Head (ft)	Assumed Motor Rating, hp	Material Cost	Total Material	Installation Cost	Total Installed Direct Cost	Comments	Assumed Age at Start of LT-ETS (Yr 10)	1st Relacement Year	2nd Relacement Year	3rd Relacement Year	4th Relacement Year	5th Relacement Year
No. 3 Stockpile Interceptor Barrier Trenches Flow	No. 3 PLS Collection Pond	10	5	50	0.5	$7,500	$75,000	$6,269	$81,269	Sump pump estimate based on historical database of actual pump costs on various Golder projects. Unit hours required to install each pump were taken from Estimator Piping Man-Hour Manual Book, based on pump horse power. $85/hr was used for labor rate.	0	30	50	70	90	NA
No. 3 Stockpile New Canyon 6 Area Collection Flow	No. 3 PLS Collection Pond	2	5	200	0.5	$7,500	$15,000	$6,269	$21,269		0	30	50	70	90	NA
No. 3 PLS Collection Pond	Spray Evap Pond #1	1	10	610	2	$10,000	$10,000	$6,269	$16,269		0	30	50	70	90	NA
Oak Grove Interceptor Barrier Trenches	1 AST Tank	3	10	50	0.5	$7,500	$22,500	$6,269	$28,769		0	30	50	70	90	NA
1 AST Tank	1B PLS Tank	1	50	141	5	$10,000	$10,000	$6,269	$16,269		0	30	50	70	90	NA
No. 1B Stockpile Seep Collections	1B PLS Tank	2	10	50	0.5	$7,500	$15,000	$6,269	$21,269		0	30	50	70	90	NA
1 AST Tank	1B PLS Tank	1	10	90	2	$10,000	$10,000	$6,269	$16,269		0	30	50	70	90	NA
1B PLS Tank	Spray Evap Pond #1	1	80	510	5	$10,000	$10,000	$6,269	$16,269		0	30	50	70	90	NA
5E Seepage Collection Pond	Spray Evap Pond #1	1	50	500	5	$10,000	$10,000	$6,269	$16,269		0	30	50	70	90	NA
5E Collections	5E Seepage Collection Pond	2	10	20	0.5	$7,500	$15,000	$6,269	$21,269		0	30	50	70	90	NA

Total Pumps:	**$255,194**
ALLOWANCE FOR MINOR MECHANICAL, ELECTRICAL, INSTRUMENTATION, AND UNDEFINED SCOPE (5%):	**$33,917.60**
TOTAL DIRECT COST:	**$712,270**
TOTAL CONSTRUCTION COST:	**$713,000**

Pump Life Expectancy – 20 years
HDPE Pipeline Life Expectancy – 100 years
Second quarter 2019 RS Means used for pipe costs.
NA - Not applicable

Tab 3: LONG-TERM EVAPORITION TREATMENT SYSTEM - CAPEX
Rev. 1

Created by: Todd Stein
Date: 4/14/2020

Reservoirs and Tanks CAPEX and Replacement Schedule

Reservoir/Tank ID	Current Size (ac)	New/Replacement Size (ac)	New/Replacement Size (sf)	New/Replacement Cost	Assumed Age at Start of LT-ETS (Yr 10)	CAPEX	1st Relacement Year	2nd Relacement Year	3rd Relacement Year
New Spray Evaporation Pond #1	7.4	7.4	322,344	$ 481,078	0	$ 481,078	40	70	NA
New Spray Evaporation Pond #2	3.5	3.5	152,460	$ 228,462	0	$ 228,462	40	70	NA
Raffinate Tank 1	0.08	0.08	100,000 gal	$ -	20	Will be removed at the EOY 14 (no longer needed) so costs not included	NA	NA	NA
Raffinate Tank 2	0.25	0.25	100,000 gal	$ -	20		NA	NA	NA
5E Seepage Collection Pond	0.1	0.1	4,356	$ 6,447	20		20	50	80
5E Surge Pond	0.84	0.84	36,590	$ 54,154	20		20	50	80
No. 3 PLS Collection Pond	1.58	1.58	68,919	$ 102,000	20		20	50	80
1A PLS Tank	0.01	0.01	20,000 gal	$ 32,000	20		40	90	NA
1B PLS Tank	0.02	0.02	100,000 gal	$ 239,572	20		40	90	NA
1 AST Tank	0.001	0.001	20,000 gal	$ 32,000	20		40	90	NA
Total for Complete System:				**$ 1,175,713**		**$ 709,540**			

Notes:

Heavy Duty Plastic Tank Life Expectancy (yr)	50
Steel Tank Life Expectancy (yr)	50
Lined Pond Life Expectancy (yr)	30

Norwesco 20,000 Gallon Heavy Duty Vertical Liquid Storage Tank July 2019 online quote ($24,000 = assumed $3,000 shipping and $5,000 installation. Total = $32,000)

80 mil Geomembrane Liner $ 1.48 $/SF — Second Quarter 2019 RS Means 310519531100-310519531300 (1500 sf daily output), Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 80 mil thick, per S.F.

NA - Not applicable

Tab 4: EVAPORATION TREATMENT SYSTEM - CAPEX
Rev. 1

Created by: Todd Stein
Date: 7/23/2019

Mechanical Spray Systems CAPEX and Replacement Schedule

Description	Quantity	Design Flow Rate (gpm)	Assumed Motor and Fan Rating, hp	Material Cost	Installation Cost	Total Installed Direct Cost	Comments	Assumed Age at Start of ST-ETS (Yr 1)	Assumed Age at Start of LT-ETS (Yr 10)	1st Relacement Year	2nd Relacement Year	3rd Relacement Year	4th Relacement Year
Short-Term ETS Spray Systems (SMI Mega Polecat)[a]	25	123	60	$52,500	$18,800	$1,331,300	a	0	10	NA	NA	NA	NA
Long-Term ETS Spray Systems (SMI Mega Polecat)[b]	4	123	60	$55,125	$6,510	$227,010	b	0	10	20	40	60	80
TOTAL CONSTRUCTION COST:						**$1,558,310**							

Notes:
[a]SMI Quote Dated 10/4/18, includes $52,500 per Mega Polecat unit, $18,800 for supplier system setup (9 days total). Submersible pump not required, will use existing Raff distribution system. Total not including freight.
[b]SMI Quote Dated 10/4/18, includes $52,500 per Mega Polecat unit, $6200 for supplier system setup (2 days total). Includes 5% allowance for undefined scope. Total not including freight.
NA - Not applicable

Tab 5: ELECTRICITY RATE CALCULATIONS
Rev. 1

Created by: Antonio Herilalaina
Checked by: Wade Wang
Approved by: Todd Stein
Date: 7/23/2019

Table 1. ETS and Water Conveyance System Operational Electricity Rate Calculations (Years 1 through 14)

Assume a load of ### kW 1617.5
Assume a demand of 100% of the kW 1617.5

On-Peak kWh	429792.9	388200.0	429792.9	415928.6	429792.9	415928.6	429792.9	429792.9	415928.6	429792.9	415928.6	429792.9
Off-Peak kWh	773627.1	698760.0	773627.1	748671.4	773627.1	748671.4	773627.1	773627.1	748671.4	773627.1	748671.4	773627.1
Total kWh for the month	1203420	1086960	1203420	1164600	1203420	1164600	1203420	1203420	1164600	1203420	1164600	1203420
On-Peak cost	$ 10,199.1	$ 9,212.1	$ 10,199.1	$ 9,870.1	$ 10,199.1	$ 12,569.2	$ 12,988.2	$ 12,988.2	$ 9,870.1	$ 10,199.1	$ 9,870.1	$ 10,199.1
Off peak cost	$ 12,141.8	$ 10,966.8	$ 12,141.8	$ 11,750.1	$ 12,141.8	$ 11,750.1	$ 12,141.8	$ 12,141.8	$ 11,750.1	$ 12,141.8	$ 11,750.1	$ 12,141.8
demand charge	$ 26,672.6	$ 26,672.6	$ 26,672.6	$ 26,672.6	$ 26,672.6	$ 38,318.6	$ 38,318.6	$ 38,318.6	$ 26,672.6	$ 26,672.6	$ 26,672.6	$ 26,672.6
Customer charge	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3
Total bill (not including fuel adjustment & taxes)	$ 49,598.7	$ 47,436.7	$ 49,598.7	$ 48,878.0	$ 49,598.7	$ 63,223.2	$ 64,033.8	$ 64,033.8	$ 48,878.0	$ 49,598.7	$ 48,878.0	$ 49,598.7
Average cost (not including fuel adjustment & taxes) $/kWh	$ 0.041	$ 0.044	$ 0.041	$ 0.042	$ 0.041	$ 0.054	$ 0.053	$ 0.053	$ 0.042	$ 0.041	$ 0.042	$ 0.041

Avg ($/kWh) **0.045**

Table 2. TTS, ETS, and Water Conveyance System Operational Electricity Rate Calculations (Years 15 through 100)

Assume a load of ### kW 706.6
Assume a demand of 100% of the kW 706.6

On-Peak kWh	187753.7	169584.0	187753.7	181697.1	187753.7	181697.1	187753.7	187753.7	181697.1	187753.7	181697.1	187753.7
Off-Peak kWh	337956.7	305251.2	337956.7	327054.9	337956.7	327054.9	337956.7	337956.7	327054.9	337956.7	327054.9	337956.7
Total kWh for the month	525710.4	474835.2	525710.4	508752	525710.4	508752	525710.4	525710.4	508752	525710.4	508752	525710.4
On-Peak cost	$ 4,455.4	$ 4,024.3	$ 4,455.4	$ 4,311.7	$ 4,455.4	$ 5,490.8	$ 5,673.9	$ 5,673.9	$ 4,311.7	$ 4,455.4	$ 4,311.7	$ 4,455.4
Off peak cost	$ 5,304.1	$ 4,790.8	$ 5,304.1	$ 5,133.0	$ 5,304.1	$ 5,133.0	$ 5,304.1	$ 5,304.1	$ 5,133.0	$ 5,304.1	$ 5,133.0	$ 5,304.1
demand charge	$ 11,651.8	$ 11,651.8	$ 11,651.8	$ 11,651.8	$ 11,651.8	$ 16,739.4	$ 16,739.4	$ 16,739.4	$ 11,651.8	$ 11,651.8	$ 11,651.8	$ 11,651.8
Customer charge	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3	$ 585.3
Total bill (not including fuel adjustment & taxes)	$ 21,996.7	$ 21,052.2	$ 21,996.7	$ 21,681.8	$ 21,996.7	$ 27,948.5	$ 28,302.6	$ 28,302.6	$ 21,681.8	$ 21,996.7	$ 21,681.8	$ 21,996.7
Average cost (not including fuel adjustment & taxes) $/kWh	$ 0.042	$ 0.044	$ 0.042	$ 0.043	$ 0.042	$ 0.055	$ 0.054	$ 0.054	$ 0.043	$ 0.042	$ 0.043	$ 0.042

Avg ($/kWh) **0.045**

Notes:
Based on Public Service Company of New Mexico Electrical Services 21st Revised Rate No. 4B Large Power Service - Time of Use Rate (Effective Date January 1, 2019)

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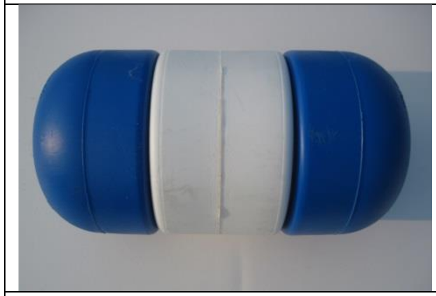
Todd,

Thank you for your time and discussions about the Chino Mine in New Mexico. As discussed, please find the below offers for a variety of equipment we can provide for the project:

A. Equipment and Pricing Kid PoleCat Evaporator with Standalone Controls

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI Kid Polecat Evaporator with 480V/60Hz 7.5 HP (5.6 kW) fan motor, painted steel fan housing with stainless steel inlet screen, stainless steel spray manifold with 1-1/2 inch male stainless steel cam and groove fitting and 16 Teflon spiral tip nozzles (rated 35 gpm at 100 psi or 133 lpm at 6.9 bar), mounted on 3-wheel galvanized steel chassis with tow bar, manual hand crank jack for adjusting fan inclination from 0-45°, 40° oscillation, control panel with manual controls, 150ft* of 10/4 SEOOW power cord and no plug.	1	Each	22,908.00	$22,908.00

A. Equipment and Pricing Kid PoleCat Evaporator with Standalone Controls (continued)

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Continued: Package includes upgrades from manual controls to standalone automated operation, weather control panel, weather device with temperature, relative humidity, wind speed and wind direction, and control panel upgrades for automatic control. System will automatically shut down for high winds or unfavorable wind direction. Low temperature set point to keep the system idle during freezing temperatures and user settable humidity so the system does not operate when raining or for high humidity. *Automation pricing subject to change if SMI pump is not chosen.				
	2 HP (1.5 kW) 480V/60Hz 304 stainless steel self-priming submersible pump in PVC sleeve to cool pump, plastic pontoon float system with stainless steel framework, junction box for terminating pump leads with Kellems grip for strain relief, 1.5 in. x 100ft water feed hose from pump to Evaporator, 100 ft of 10/4 SEOOW pump power cord with Hubbell HBL2431SW twist lock plug with water tight safety shroud to connect to Hubbell receptacle 2430SW mounted on the bottom of the Evaporator control panel.	1	Each	3,950.00	$3,950.00
	Plastic power cord floats (1 per 3.3m of cable)	10	Each	14.75	$147.50
	SMI Automation technician on-site 1 day for automation, machine and system training, supervision and startup including expenses. The machines will be	1	Each	4,400.00	$4,400.00

A. Equipment and Pricing Kid PoleCat Evaporator with Standalone Controls (continued)

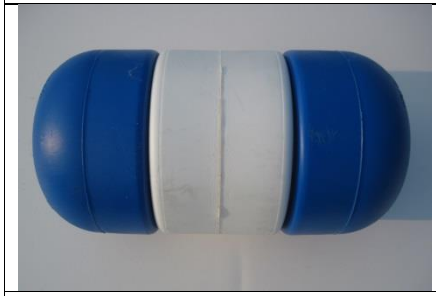
	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Continued: commissioned to verify fan, pump, and controls operate correctly and that each machine can be controlled and interfaced from the weather control panel. Wind set points will be input to the software for shutting down the equipment when conditions are not favorable for evaporation and to minimize drift. SMI Automation technician will also inspect for proper machine installation and spacing, wiring of machines to machine control panels on panel shelters. Equipment must be installed and have power to the system before the Automation technician arrives. Additional consecutive days $1,800.00/per day. Recommended 1 day per 4 evaporators.				
Total F.O.B. Midland, MI for Kid PoleCat with Standalone Controls					**$31,405.50**

* Additional power cord above the 150 ft/machine is $2.35/ft

B. Equipment and Pricing Super PoleCat Evaporator with Standalone Controls

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI Super Polecat Evaporator with 480V/60Hz 25 HP (18.7 kW) fan motor, painted steel fan housing with stainless steel inlet screen, stainless steel spray manifold with 2-way stainless steel ball valve for flow regulation , 1-1/2 inch male stainless steel cam and groove fitting on water inlet and 30 Teflon spiral tip nozzles (rated 66 gpm at 100 psi or 250 lpm at 6.9 bar), mounted on 3-wheel galvanized steel A-frame chassis with anchor jacks and tow bar, manual hand crank jack for adjusting fan inclination from 0-45°, no oscillation, control panel with manual controls, 150ft* of 8/4 type W power cord and no plug.	1	Each	26,984.00	$26,984.00

B. Equipment and Pricing Super PoleCat Evaporator with Standalone Controls (continued)

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Continued: Package includes upgrades from manual controls to standalone automated operation, weather control panel, weather device with temperature, relative humidity, wind speed and wind direction, and control panel upgrades for automatic control. System will automatically shut down for high winds or unfavorable wind direction. Low temperature set point to keep the system idle during freezing temperatures and user settable humidity so the system does not operate when raining or for high humidity.				
	7.5HP (5.6 kW) 480V/60Hz 304 stainless steel self-priming submersible pump in PVC sleeve to cool pump, plastic pontoon float system with stainless steel framework, junction box for terminating pump leads with Kellems grip for strain relief, 1.5 in. x 100ft water feed hose from pump to Evaporator, 100 ft of 10/4 SEOOW pump power cord with Hubbell HBL2431SW twist lock plug with water tight safety shroud to connect to Hubbell receptacle 2430SW mounted on the bottom of the Evaporator control panel.	1	Each	6,500.00	$6,500.00
	Plastic power cord floats (1 per 3.3m of cable)	10	Each	14.75	$147.50
	SMI Automation technician on-site 1 day for automation, machine and system training, supervision and startup including expenses. The machines will be commissioned to verify fan, pump, and controls operate correctly and that each machine can be controlled and interfaced from the weather control panel.	1	Each	4,400.00	$4,400.00

B. Equipment and Pricing Super PoleCat Evaporator with Standalone Controls (continued)

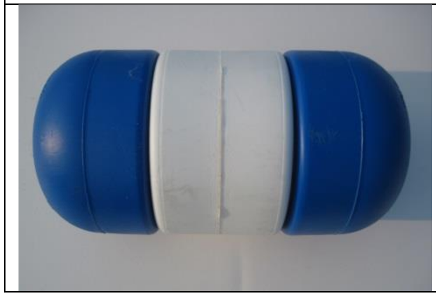
	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Continued: Wind set points will be input to the software for shutting down the equipment when conditions are not favorable for evaporation and to minimize drift. SMI Automation technician will also inspect for proper machine installation and spacing, wiring of machines to machine control panels on panel shelters. Equipment must be installed and have power to the system before the Automation technician arrives. Additional consecutive days $1,800.00/per day. Recommended 1 day per 4 evaporators.				
Total F.O.B. Midland, MI for SPC with Manual Controls					**$38,031.50**

* Additional power cord above the 150 ft/machine is $4.85/ft

C. Equipment and Pricing Mega PoleCat Evaporator with Standalone Controls

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI Mega Polecat with 480V/60Hz 60HP (45 kW) fan motor, painted steel fan housing with stainless steel inlet screen, 2-1/2 inch large diameter stainless steel spray manifold with 1-1/2 inch 2-way stainless steel ball valve for flow regulation, 1-1/2 inch male stainless steel cam and groove fitting on water inlet and 30 Teflon spiral tip nozzles (rated 123 gpm at 100 psi or 466 lpm at 6.9 bar), mounted on galvanized enclosure and skid mount with integrated fork pockets for easy transport on-site, electric head jack for adjusting fan inclination from 0-45°, 359 degree oscillation with center water feed, control panel with PLC, Wye-Delta start and HMI touch screen interface for machine control, 150ft* of 4/4 type W power cord and no plug and no on-board pump.	1	Each	52,490.50	$52,490.50

C. Equipment and Pricing Mega PoleCat Evaporator with Standalone Controls

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Continued: Package includes upgrades from manual controls to standalone automated operation, weather control panel, weather device with temperature, relative humidity, wind speed and wind direction, and control panel upgrades for automatic control. System will automatically shut down for high winds or unfavorable wind direction. Low temperature set point to keep the system idle during freezing temperatures and user settable humidity so the system does not operate when raining or for high humidity.				
	30HP (22.4 kW) 480V/60Hz 304 stainless steel self-priming submersible pump in PVC sleeve to cool pump, plastic pontoon float system with stainless steel framework, junction box for terminating pump leads with Kellems grip for strain relief, 2.5 in. x 100ft water feed hose from pump to Evaporator and 10 hose floats, 100 ft of 8/4 tray pump power cord with Hubbell HBL460P5W pin and sleeve plug to connect to Hubbell HBL460R5W receptacle mounted on the bottom of the Evaporator control panel.	1	Each	23,023.50	$23,023.50
	Plastic power cord floats (1 per 3.3m of cable)	10	Each	14.75	$147.50

C. Equipment and Pricing Mega PoleCat Evaporator with Standalone Controls

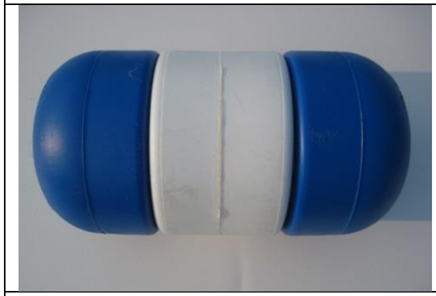
	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI Automation technician on-site 1 day for automation, machine and system training, supervision and startup including expenses. The machines will be commissioned to verify fan, pump, and controls operate correctly and that each machine can be controlled and interfaced from the weather control panel. Wind set points will be input to the software for shutting down the equipment when conditions are not favorable for evaporation and to minimize drift. SMI Automation technician will also inspect for proper machine installation and spacing, wiring of machines to machine control panels on panel shelters. Equipment must be installed and have power to the system before the Automation technician arrives. Additional consecutive days $1,800.00/per day. Recommended 1 day per 4 evaporators.	1	Each	4,400.00	$4,400.00
Total F.O.B. Midland, MI for Mega PoleCat with Standalone Controls					**$80,061.50**

* Additional power cord above the 150 ft/machine is $9.27/ft for 4/4 type W and $10.78/ft for 2/4 type W

D. Equipment and Pricing 420F Evaporator with Standalone Controls

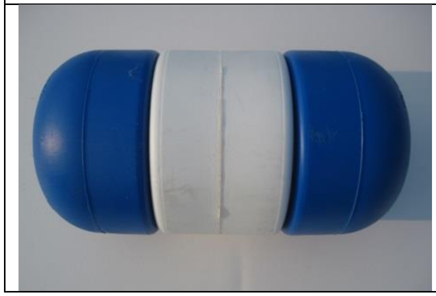
	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI 420F standalone automated Evaporator with 480V/60Hz 25 HP (18.7 kW) fan motor, vibration switch, stainless steel motor enclosure, water manifold and propeller, mounted on galvanized steel support and plastic pontoon float system with 480V/60Hz 2 HP (1.5 kW) stainless steel submersible pump, automatic control panel with PLC, and VFD controls, and 300ft* of 18/7 & 10/7 custom and 10/4 SEOOW pump cord.	1	Each	33,200.00	$33,200.00

D. Equipment and Pricing 420F Evaporator with Standalone Controls (continued)

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	Weather control panel, weather devices (includes wind speed, wind direction, humidity and temperature)	1	Each	1,500.00	$1,500.00
	Plastic power cord floats (1 per 3.3m of cable)	50	Each	14.75	$737.50
	SMI Automation technician on-site 1 day for automation, machine and system training, supervision and startup including expenses. The machines will be commissioned to verify fan, pump, and controls	1	Each	4,400.00	$4,400.00
Total F.O.B. Midland, MI for 420F with Standalone Controls					**$39,837.50**

*Additional cord above 300 ft/420F Evaporator at $8/ft

E. Equipment and Pricing 420B Evaporator with Standalone Controls

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI 420B standalone fully automatic Evaporator with 480V/60Hz 25 HP (18.7 kW) fan motor, vibration switch, stainless steel motor enclosure, water manifold and propeller, mounted on galvanized steel boom, upright and platform assembly and concrete counterweight. Automatic control panel with PLC, custom urethane coated jack for raising/lowering the boom, non-metallic junction box mounted to the boom for connecting 200ft* 18/7 & 10/7 custom power cord to the machine control panel. 1.5kW (2HP) 480V/60Hz stainless steel submersible pump in PVC sleeve to cool pump, plastic pontoon float system with stainless steel framework, junction box for terminating pump leads with Kellems grip for strain relief, 1.5 in. x 100ft water feed hose from pump to Evaporator, 300ft** of 10/4 SEOOW pump power cord from pump back to the machine control panel.	1	Each	39,265.00	$39,265.00
	Weather control panel, weather devices (includes wind speed, wind direction, humidity and temperature)	1	Each	1,500.00	$1,500.00
	Plastic power cord floats (1 per 3.3m of cable)	10	Each	14.75	$147.50

E. Equipment and Pricing 420B Evaporator with Standalone Controls (continued)

	Description	Qty.	Unit	USD($)/unit	Total USD($)
	SMI Automation technician on-site 1 day for automation, machine and system training, supervision and startup including expenses. The machines will be commissioned to verify fan, pump, and controls operate correctly and that each machine can be controlled and interfaced from the weather control panel. Wind set points will be input to the software for shutting down the equipment when conditions are not favorable for evaporation and to minimize drift. SMI Automation technician will also inspect for proper machine installation and spacing, wiring of machines to machine control panels on panel shelters. Equipment must be installed and have power to the system before the Automation technician arrives. Additional consecutive days $1,800.00/per day. Recommended 1 day per 4 evaporators.	1	Each	4,400.00	$4,400.00
Total F.O.B. Midland, MI for 420F with Standalone Controls					**$45,312.50**

*Additional 10/7 & 18/7 custom cord above 150 ft/420B Evaporator at $5.65/ft

1. Delivery and Conditions

Pricing is F.O.B. Midland, Michigan. SMI equipment to carry a 6-month warranty on any defective parts and workmanship. Customer is responsible for applicable taxes.

Visit www.evapor.com for Terms and Conditions.

2. Payment Terms

50% due with signed contract
50% + Freight due Net on invoice after delivery

Terms are based upon receiving satisfactory credit references.

3. Customer Responsibilities

1. 480V 3-phase equipment power source
2. All wiring of equipment.
3. All permits.
4. All installation, construction, site engineering and preparation.
5. All fencing, signage and equipment protection
6. All lifting equipment for Evaporators.
7. All Civil Engineering work for the site.
8. Regulatory compliance and permits.
9. Evaporator/Pump shore anchoring including foundation blocks and positioning cables and cable clamps and thimbles.
10. Mounting control panels.
11. Mounting weather devices.

SMI also offers annual evaporation system service agreements per requirements. Please call me at 775-772-6983 if you have any questions. We look forward to hearing from you soon and working with you on this project.

Best Regards,

Nic Horgan
SMI – West
Ph 775 772 6983
nic@evapor.com
www.evapor.com

ATTACHMENT B2

TTS Equipment Quotes

Golder Acid Mine Drainage

Engineer

GOLDER

Lakewood, Colorado
Contact: Elizabeth Travis
(303) 980-0540
Elizabeth_Travis@golder.com

WESTECH

Represented by

WATER TECHNOLOGY GROUP
A COGENT COMPANY

Golden, Colorado
Contact: Will McHale
(303) 584-9000 / (303) 656-5498
wmchale@cogentcompanies.co

The Fairchild Company
Tempe, Arizona
Contact: Voni Rice
(480) 345-4570 / (602) 363-8448
Voni.rice@fairchildcompany.com

Furnished by

Kib Huefner
khuefner@westech-inc.com

George Laird
glaird@westech-inc.com

Proposal No.: 1910329
Date: May 31, 2019

SYSTEM CERTIFICATION ISO 9001 SGS

Cover Letter

May 31, 2019

Ms. Elizabeth Travis
Environmental Process Engineer
44 Union Boulevard, Suite 300
Lakewood, Colorado 80228
303-980-0540
Elizabeth_Travis@golder.com

Dear Zee,

Thank you for inviting us to propose a system to treat the water at this mine in New Mexico. You have requested treatment for 1600 gpm using HDS clarifier, a filter presses, and a UF/RO system. Attached is the process flow diagram highlighting the equipment we are supplying. The same PFD shows equipment we are not providing in lighter lines.

Please call us with any questions. We look forward to helping you and your client in these 2 mine wastewater treatment applications.

Thanks,
Kib Huefner
Regional Sales Manager
WesTech Engineering
3665 South West Temple
Salt Lake City, Utah 84115
801-290-1229
khuefner@westech-inc.com

Table of Contents

Process Equipment Scope of Services

Item A – WesTech Clarifier Mechanism, Model CLS25L

General Scope of Supply		
Description	**Dimension/Capacity**	**Unit**
Number of Clarifiers	1	Each
Application	TSS & TDS Removal	-
Clarifier Diameter	80	ft.
Tank Side Wall Depth	14	ft.
Design Flow Rate	1,600	gallons/min

<table>
<tr><th colspan="4">Detailed Scope of Supply</th></tr>
<tr><th>Item</th><th>Description</th><th>Unit/Size</th><th>Material</th></tr>
<tr><td>Bridge Structures</td><td>Truss Design</td><td>-</td><td rowspan="2">Mild Steel</td></tr>
<tr><td>Bridge Walkway Type</td><td>Half Span</td><td>-</td></tr>
<tr><td>Grating</td><td>1 1/4</td><td>in</td><td>HDG Steel</td></tr>
<tr><td>Handrail</td><td>1-1/2, 2-Rail, Pipe</td><td>-</td><td>Steel</td></tr>
<tr><td>Rake Arm Type</td><td>Truss</td><td>-</td><td rowspan="2">Mild Steel</td></tr>
<tr><td>Rake Arms Quantity</td><td>2 Long Arms</td><td>Each</td></tr>
<tr><td>Tank Bottom Slope</td><td>1.75: 12</td><td>-</td><td>-</td></tr>
<tr><td>Center Shaft Diameter</td><td>16</td><td>in</td><td>Mild Steel</td></tr>
<tr><td>Discharge Cone Diameter</td><td>8</td><td>ft.</td><td>Mild Steel</td></tr>
<tr><td>Feedwell Type</td><td>Standard</td><td>-</td><td rowspan="4">Mild Steel</td></tr>
<tr><td>Feedwell Method</td><td>Tangential Feed</td><td>-</td></tr>
<tr><td>Feedwell Diameter</td><td>8</td><td>ft.</td></tr>
<tr><td>Feedwell Height</td><td>7</td><td>ft.</td></tr>
<tr><td>Feed Pipe</td><td>16</td><td>in</td><td>Mild Steel</td></tr>
<tr><td>Bolts & Fasteners</td><td></td><td>-</td><td>304 SS/A325</td></tr>
</table>

WesTech

Drive Unit

Description	Dimension/Capacity	Unit
Drive Type	Shaft	-
Duty-rated Torque	150,000	ft·lbs
Rake Speed	0.072	RPM
Rake Power	3	hp
Motor RPM/Voltage/Hz/Phase	1800 / 460 / 60 / 3	RPM / V / Hz / Phase
Lift Height	24	in
Lift Capacity	15	ton
Lift Power	1.5	hp
Lift Motor RPM/Voltage/Hz/Phase	1800 / 460 / 60 / 3	RPM / V / Hz / Phase
Alarm Cutouts	30%	Alarm
	50%	Raise Rake
	85%	Motor Cutout
	100%	Full Scale
Main Gear & Pinions Lubrication	Oil bath	**Unit**
Main Bearing & Reducers Lubrication	Grease	-

Controls and Instrumentation

Description	Type	Output Signal	Notes
Control Panel Type	NEMA 4X	Alarm	Painted Steel
Remote Torque Transmitter	Loadcell	4-20 mA	Indication/Recording
Remote Rake Lift Transmitter	Laser Sensor	4-20 mA	

Surface Coatings

Coating Area	Sandblast SSPC	Paint Type	Brand	Product #	Total DFT	Coats
Submerged Coating	SP10	Epoxy	Tnemec	N69	3-7	2
Non-Submerged	SP6	Epoxy	Tnemec	N69	3-7	2
Non-Submerged Second Coat	N/A	Urethane	Tnemec	1074U	2-5	1
Drive First Coat	SP6	Epoxy	Tnemec	N140-1255	3-9	1
Drive Second Coat	N/A	Urethane	Tnemec	1074U	2-5	1

WesTech Trips to Installation Site

Number of Trips	-	0
Time per Trip	Days	0

MudMax™ Mud Level Sensor (OPTION)

In place of an ultrasonic bed level sensor we propose the use of WesTech's MudMax™ Bed Level Instrument. It introduces an entirely new, more reliable, and lower maintenance approach to continuously monitoring sludge bed level in a thickener. The MudMax™ allows monitoring of the entire 360-degree profile at various bed heights.

Optimizing performance is best achieved with an automated and repeatable measurement. The MudMax™ replaces standard "single-point" measurement of the bed, increasing accuracy and vision of mud level in real time. Optimizing thickener performance is one of many benefits of automation. With the high degree of accuracy and consistency the MudMax™ delivers, the operator can anticipate upstream and downstream plant demands.

The Solution to Real-Time Mud Level Monitoring

WesTech's Patented MudMax™ system directly measures bed level and provides real-time feedback as it moves through the mud with the rake arm. This Patented instrument uses sensors that span the zone targeted for optimal bed level.

Accurate definition of the sludge bed is determined by mathematically extrapolating between sensors. The methodology has been tested extensively and confirmed in minerals industry thickener environments. The bed level sensors transmit real-time data wirelessly to a receiver mounted on the thickener bridge. From the receiver panel a 4 – 20 mA signal relays the information to the customer's distributed control system (DCS). This consistent and continuous data is then used to determine the solid bed level, which will enable automation of the system.

MudMax™ Instrumentation

Instrumentation			
Description	**Type**	**Output Signal**	**Notes**
MudMax™	Pressure Transducers	4-20 mA	Time, Rake Angle, and Bed Pressure
Remote Transmitter	-	4-20 mA	Antenna Mounted on Walkway

Bolted On-Grade Anchor Ring HDS Clarifier Tank, Model TKC11B

General Design Criteria	
Description	**Description**
Quantity	1
Size	80 ft x 14 ft
Material of construction	Carbon Steel Bolted Flat Panel
Floor	Sloped 1.75:12 Concrete Floor (Concrete/concrete design are not by WesTech)
Design Flow	1680 gpm
Launder	Peripheral launder with drop out box
Weir	Included
Access	Ladder Included, Fall Arrest System Provided by Others
Nozzles	(1) Feed, (1) Overflow
Manway	(1) 30” Manway
Grounding Lugs	2
Design Style	Bolted
Sealant	Manus Bond 75-AM and EPDM for panel construction
Shop Coatings	Fusion Bonded Epoxy Coated
Field Erection	By Others
Governing Codes	API650, ASTM, ASME, AISC, AWWA D-101 etc. as the basis in establishing its own design, fabrication, quality criteria, standards, practices, methods and tolerances for tanks. Corrosion allowance not required nor included on tank.
Nozzle Loads	External pipes must be fully supported; nozzles not designed for load bearing.

Item B – Three 200 ft^3 Electric/Hydraulic Automatic Filter Presses

General Process Information and Scope of Supply		
Description	**Dimension / Capacity / Units**	**Material / Comments**
Application	Mining	Wastewater Treatment
Design Parameters*		
Slurry Feed	250-400 gpm	Average 24-hour Rate
Solids Concentration	10-15 wt%	-
Cycles and Cycle Time	24 cycles/day	1 hr/cycle
Size of Filter Plates	1500mm x 1500mm	Polypropylene
Max. Operating Pressure	100 psig	-
Frame Construction	Side Bar	Steel

** Slurry testing is required to verify equipment selection and performance.*

Additional Information and Details on the Scope of Supply

Detailed Unit Scope of Supply – Unit Basis		
Description	**Dimension / Capacity / Units**	**Material / Comments**
Filtration Surface Area	4123 ft^2	-
Number of Filter Plates	103 Plates	1500mm x 1500mm
Plate Construction	Polypropylene	Recessed – Non-Gasketed
Cake Thickness	32 mm	-
Filter Cloths	103 cloths (one set each unit)	Polypropylene, Multifilament
Type of Closure	Automatic	Electric / Hydraulic
Plate Shifter	Automatic	Electric, Servomotors
Drip Trays	Automatic	Hydraulic, Steel Frame/304L Covers
Filtrate Manifold & Valves	Automatic Valves	304L SS Pipe & Valves
Feed Style	Center Feed	Dual Feed Flange Option Included
Filtrate Porting	4-Ports	-
Paint	-	Manufacturer’s Standards
Control Panels	AB CompactLogix PLC	6” Operating Interface, NEMA 4X
Safety Package	Safety Curtains, both sides	Includes E-stop Lanyards, full length

Estimated Utility Requirements – Unit Basis		
Description	**Capacity / Units**	**Material / Comments**
Control Panel	-	460V/3Ph/60Hz
Hydraulic Power Unit	10 hp	460V/3Ph/60Hz
Pneumatic (Air)		
Instruments etc.	~15 scfm at 100 psig	Intermittent
Cake Blow	~400 scfm at 60 psig	For 10 minutes/cycle
Core Blow	~80 scfm at 80 psig	For 1 minutes/cycle

Approximate Dimensions and Weight – Unit Basis		
Description	**Units**	**Capacity**
Press Dimensions (L x W x H)	inches	408 x 84 x 86
Press weight (Empty Weight)	lbs	52,500

WESTECH

Item C – Ultrafiltration System Model Number UFT82A

Design Overview		
Description	**Unit**	**Dimension/Capacity**
Application	-	Mine Water Treatment
WesTech System Model	-	UFT82A, Membrane Filtration System
Membrane Module	-	Toray HFU-2020N
Gross Influent Flow Rate	gpm	700 – 1,200
Net Product Flow Rate	gpm	675 – 1,155
Redundancy and Unit Quantity	-	2 x 50%, (2) total units
Approximate Dimensions	Per Unit	18’-2” L x 3’-6” W x 11’-4” H
Number of Modules	Per Unit	20 installed, 22 capacity

WesTech is a leader in innovative membrane filtration system technology, including VersaFilter™ open-platform systems, AltaPac™ packaged systems, retrofit engineering solutions, intelligent controls and performance analysis technology. Systems are skid-mounted and factory-tested for ease of installation, straightforward operation, and long-term reliability. Major equipment and valves are pre-configured for efficient and error-free commissioning. Controls are fully-automated and completed by in-house electrical engineers and process automation experts.

In addition to UF/MF equipment, WesTech is one of the only membrane system suppliers that offers pre- and post-treatment equipment for an integrated, complete process with consolidated equipment support. Notably, WesTech has more pretreatment equipment to UF/MF systems than any supplier.

Our membrane filtration team has provided more than 100 membrane systems throughout North America with UF/MF installations in excess of 6,945 gpm. As a company, WesTech has 530 employees, 190 degreed engineers, and more than 15,000 process equipment installations throughout the world. This significant experience translates into reliable, time-tested equipment.

WesTech

Process Description

The preliminary system design consists of two (2) membrane filtration units each sized treat 400 to 700 gpm in order to meet the specified feed flow requirement of 700 gpm to 1,200 gpm. Each unit has capacity for up to 22 modules, with 20 installed.

The filtration process is an outside/in, pressure-driven process to remove suspended solids and turbidity, and to achieve 4-log reduction of pathogens like *Giardia* and *Cryptosporidium*. Raw water from the upstream pretreatment clarifier is directly fed to the membrane system. VFD-controlled feed pumps (VFDs by others) direct the source water to a 200 µm pre-strainer for removal of larger debris.

Filtrate is sent to the backwash supply tank. Backwashing is used to remove accumulated foulants by reversed inside/out flow at an interval of 20 - 60 minutes with air scour for increased agitation. A drain or filter-to-waste step is used to remove any additional accumulated material. Membrane integrity testing is conducted automatically once every 24 hours. The pressure decay test (PDT) is capable of detecting a single fiber break.

Maintenance cleans (MCs)/chemically-enhanced backwashes (CEBs) and clean-in-place (CIP) procedures are automated chemical cleaning processes used to recover membrane permeability. MCs/CEBs are typically performed with NaOCl once per day to once per week. The automated clean-in-place procedure is designed to occur no more frequently than once per month, is conducted with either NaOCl or acid, and is initiated when membrane permeability decreases to a specified value.

Following chemical cleaning procedures, the membrane units are drained by gravity or a pressurized drain-to-waste, and waste is subsequently sent to the discharge location. A rinse step and backwashing are used to remove residual chemical prior to resuming production. If desired, chemical cleaning waste can be captured and neutralized prior to discharge.

Design Information

Water Quality

WesTech UF/MF systems will consistently produce high purity treated water even with variation in the feed source due to a small nominal pore size in an absolute barrier configuration.

Feed Water Quality*

Description	Unit	Concentration
Source	-	Mine Water
pH		10
Temperature	°C	20
Turbidity	NTU	< 10
Total Suspended Solids	mg/L	< 10
Total Organic Carbon	mg/L	< 3
Iron	mg/L	≤ 0.04
Manganese	mg/L	≤ 0.01

**Values are assumed and should be verified. It should be noted that the use of charged polymeric flocculant aids increases risk of irreversible membrane fouling and should be discussed with WesTech, and this risk is applicable to all polymeric MF/UF membrane manufacturers. The presence of oil and grease in the source water should also be avoided.*

Treated Water Quality

Description	Unit	Concentration
Turbidity	NTU	≤ 0.10 NTU 95% of the time with a maximum turbidity of 0.3 NTU
Total Suspended Solids	mg/L	< 1
Silt Density Index	-	≤ 3
Giardia Removal Credits*	-	≥ 4 log (99.99%)
Cryptosporidium Removal Credits*	-	≥ 4 log (99.99%)
Virus Removal*	-	≥ 1.0 log removal (90.00%)
Certification Standards		NSF 61, NSF 419, CDDW, Title 22, UL 508A Listed

** Challenge-testing certification is provided by independent evaluation through the California Division of Drinking Water and NSF/ANSI 419. Typical removal levels exceed the certification level and are often on the order of 6-log. Additionally, the UF membranes achieve 1.5 log removals of viruses, though virus removal certification is only recognized up to 1.0 log by CDDW for any membrane filter.*

Complete Process Design Summary

Detailed Design Summary		
Parameter	**AES**	**SI**
Number of Units in System	2	
Number of Units in Operation	2	
WesTech System Model	UFT82A, WesTech Ultrafiltration	
Installed Modules per Unit	20	
Total Module Capacity per Unit	22	
Module Model	Toray HFU-2020N	
Membrane Area per Module	775 ft^2	72 m^2
Membrane Area in Operation	31,000 ft^2	2,880 m^2
Design Temperature	68.0 °F	20.0 °C
Production Cycle Time	30 min	
Flux Rates		
Instantaneous Flux at Design Temp.	61.6 gfd	104.6 lmh
Normalized Flux (20°C) at Design Temp.	61.6 gfd	104.6 lmh
Flow Rates		
Instantaneous Flow Rate	1,326 gpm	301 m^3/hr
Average Gross Flow Rate	1,200 gpm	273 m^3/hr
Average Net Filtrate	1,155 gpm	262 m^3/hr
Backwash Flow Rate	729 gpm	166 m^3/hr
Approx. Net Filtrate Production per Day	1,663,590 gpd	6,297 m^3/day
Backwash Waste Volume per Day	31,509 gpd	119 m^3/day
Influent Used for Rinsing/Draining per Day	32,897 gpd	125 m^3/day
Water Recovery	96.3 %	
Estimated Maintenance Clean Frequency	Daily to Weekly	
Estimated Clean-In-Place Frequency	30 days	

Scope of Supply Information

Scope of Supply – Ultrafiltration System			
Item	**Quantity**	**Description**	**Brand (or equal)**
Membrane Modules	20/unit 40/system	Hollow-fiber, outside-in UF, PVDF/TIPS, 0.01 µm	Toray
Skid Frames	2 x 50%	Welded carbon steel, baked powder-coat	-
Manifold and Supply Piping	-	Schedule 80 PVC, HDPE 8” feed/filtrate connections	-
Feed Pump	2 x 50%	-	Goulds
Backwash Pump	1 x 100%	-	Goulds
Pre-strainer	2 x 50%	200 micron, automatic backwashing	Forsta
Compressed Air System	1 x 100%	Compressor, receiver, oil filter, and dryer	Quincy
Turbidimeter	1 common feed 1/unit filtrate 3 total	TU5300 sc TU5300 sc	Hach Hach
Flow Meters	1/unit 2 total	Bi-directional magnetic flow meter with transmitter	Siemens
Pressure Instrumentation	-	Transmitters, switches, gauges	Wika, Ashcroft
Valves / Actuators	-	Manual and actuated valves	Bray
Electrical Controls	1 Master Panel* 2 Local Panels	NEMA 4, 480 V, 3 ph, PLC, HMI	-
Tanks	By WesTech	Backwash HDPE with level measurement	-

**Master Panel will also control the Reverse Osmosis System*

Scope of Supply – Clean-in-Place System			
Item	**Quantity**	**Description**	**Brand (or equal)**
Skid Frames	1	Welded carbon steel, baked powder-coat	-
Manifold and Supply Piping	-	Schedule 80 PVC 6” CIP supply/return connections	-
Recirculation Pump	1 x 100%	Frame mounted, close-coupled end suction centrifugal	Goulds
Heater	2	12 kW	Chromalox
Chemical Metering Pumps			
Sodium Hypochlorite	1 x 100%	CIP/MC process	ProMinent
Citric Acid	1 x 100%	CIP/MC process	ProMinent
Instrumentation			
pH Sensor/Transmitter	1	-	GF Signet
Temperature Transmitter	1	-	Dwyer
Flow Switch	1	-	Dwyer
Pressure Instrumentation	-	Transmitters, switches, gauges	Wika, Ashcroft
Valves / Actuators	-	Manual and actuated valves	Bray
Electrical Controls	1 CIP Panel	NEMA 4, 480 V, 3 ph	-
Tank	By WesTech	Off-skid HDPE with level measurement	Norwesco

Item D – Reverse Osmosis System Model Number ROT83B

Design Overview		
Description	**Unit**	**Dimension/Capacity**
Application	-	Mine Water Treatment
WesTech System Model	-	ROT83B, Reverse Osmosis System
Membrane Manufacturer	-	Toray
Net Product Flow Rate	gpm	499 – 866
Gross Influent Flow rate	gpm	665 – 1,155
Anticipated Recovery	%	75
Redundancy and Unit Quantity	-	3 x 33%, (3) total units
Approximate Dimensions	Per Skid	To Be Determined
Array	-	7:3 7M

WesTech is an experienced and reliable provider of nanofiltration/reverse osmosis (NF/RO) systems including new installations, retrofit and support of existing systems, and packaged systems. Systems are designed for ease of installation, straightforward operation, and long-term reliability. WesTech systems are provided as skid-mounted, factory-tested units to minimize field assembly. Major equipment and valving is pre-configured on the skids for efficient and error-free commissioning. Controls are fully-automated and completed by in-house electrical engineers and process automation experts.

Our membrane filtration team has provided more than 100 membrane systems throughout North America with NF/RO installations in excess of 4,800 gpm. As a company, WesTech has 530 employees, 190 degreed engineers, and more than 15,000 process equipment installations throughout the world. This significant experience translates into reliable, time-tested equipment.

Process Description

The system consists of three (3) membrane filtration units each sized to treat a feed capacity of 222 – 385 gpm for an overall treated capacity 665 – 1,155 gpm. Each unit is designed as a single-pass, two-stage system in a 7:3 7M configuration with 70 elements per skid installed. The overall system recovery is targeted as 75%.

Reverse osmosis technology uses semi-permeable membranes for removal of dissolved contaminants, such as TDS, chlorides, and hardness from water. The basic principle of RO involves application of high pressure to counteract natural osmotic pressure to drive water from a more concentrated, feed solution to a pure water permeate. Dissolved impurities are removed during this process.

The process utilizes cross-flow filtration to remove dissolved contaminants from the feed stream, producing a purified water stream (permeate) and a high-solute waste stream (concentrate). Feed water quality will determine the amount of permeate capable of being recovered from feed water. Raw water from the upstream ultrafiltration system is transferred to the feed tank. VFD-controlled feed pumps (VFDs by others) direct the source water to a 5-µm cartridge filter for removal of larger debris. VFD-controlled high-pressure pumps (VFDs by others) boost the feed pressure provided by the feed pumps and drive water through the membranes.

Clean-in-place (CIP) procedures are automated chemical cleaning processes used to recover membrane permeability. The automated clean-in-place procedure is conducted with either sodium hydroxide or hydrochloric acid. A CIP is initiated when normalized permeate flow decreases by ≥10%, normalized salt passage increases by ≥10%, or normalized differential pressure increases by ≥15%.

Following chemical cleaning procedures, the membrane units are flushed to remove residual chemical prior to resuming production. If desired, chemical cleaning waste can be captured and neutralized prior to discharge.

Design Information

Water Quality

Projected Water Quality				
Description	**Unit**	**Feed**	**Concentrate**	**Permeate**
Source	-	Ultrafiltration Filtrate	-	-
Silt Density Index	-	< 3	-	-
Calcium	mg/L	530	2,113	2.36
Magnesium	mg/L	25	99.65	0.11
Sodium	mg/L	120.6	477.5	1.61
Potassium	mg/L	70	276.4	1.21
Barium	mg/L	0.3	1.2	0.001
Strontium	mg/L	1.5	5.98	0.007
Sulfate	mg/L	1,500	5,974	8.5
Chloride	mg/L	150	595.1	1.61
Fluoride	mg/L	0.6	2.34	0.02
Boron	mg/L	0.02	0.06	0.005
Silica	mg/L	0.5	1.98	0.008
TDS	mg/L	2,404	9,567	15.7
Temperature	°C	20	20	20
pH	-	10	10.2	9.3

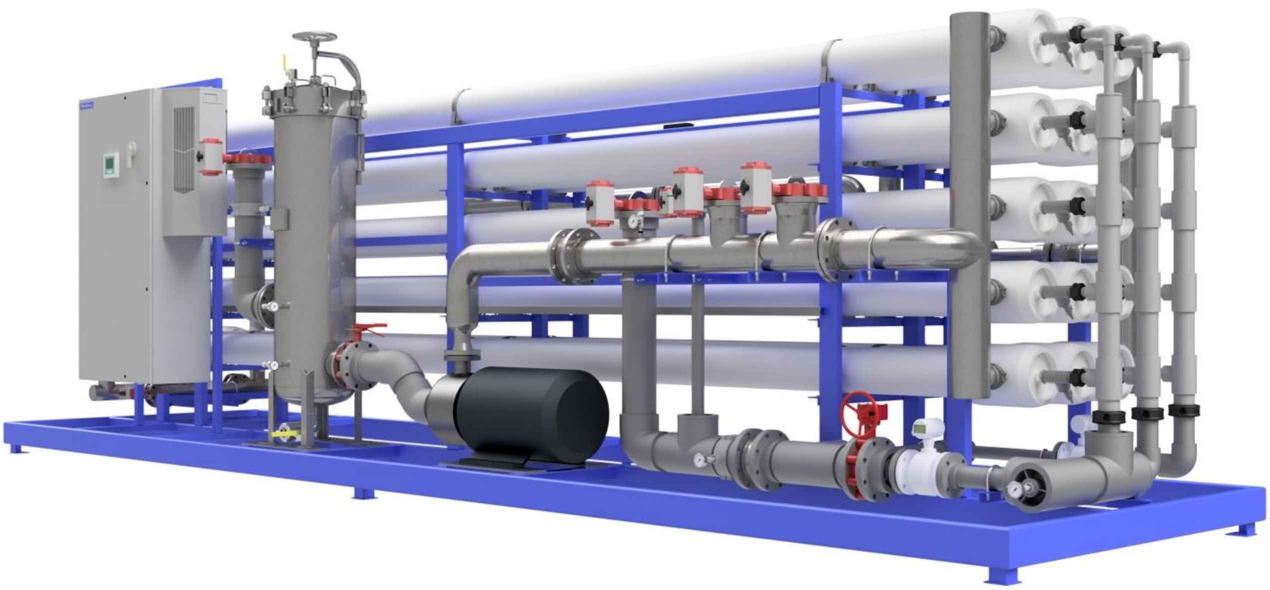
**Values are assumed and should be verified. Permeate water quality values are projected estimates, not guaranteed values. Water quality may be improved or hampered by changes in the water quality and fluctuations in dissolved constituent concentrations. It should be noted that the use of upstream charged polymeric flocculant aids increases risk of irreversible membrane fouling and should be discussed with WesTech, and this risk is applicable to all polymeric membranes. The presence of oil and grease in the source water should also be avoided.*

The recovery of the system is preliminarily designed as 75%, but may be improved or hampered by changes in the water quality and fluctuations in dissolved constituent concentrations, like TDS. The RO system has a nominal rejection rate of 95 – 99% of dissolved materials including hardness and TDS.

Complete Process Design Summary

Detailed Design Summary

Parameter	AES	SI
Number of Skids and Redundancy	3 x 33%	
Array Configuration	7:3 7M; Single Pass / Two-Stage	
Membrane Element	Toray TMG20D-400	
Elements per Skid	70	
Membrane Area per Element / Diameter	400 ft^2 / 8 in	
Total Membrane Area Installed	84,000 ft^2	7,807 m^2
Design Temperature	68 °F	20 °C
Average Flux Rate	14.8 gfd	25.2 lmh
Operating Flow Rates		
Feed Flow Rate	1,155 gpm	262.5 m^3/hr
Permeate Flow Rate	866 gpm	196.8 m^3/hr
Concentrate Flow Rate	289 gpm	65.7 m^3/hr
Approx. Total Net Permeate Production per Day	1,247,040 gpd	4,723 m^3/day
Approx. Total Concentrate Volume per Day	416,160 gpd	1,577 m^3/day
Overall System Recovery	75 %	75 %
Projected Feed Pressure	121.1 psig	8.3 bar



WesTech

Scope of Supply Information

Scope of Supply – Reverse Osmosis System			
Item	**Quantity**	**Description**	**Brand (or equal)**
Membrane Elements	70/unit 210/system	Spiral wound, thin-film composite, polyamide	Toray
Skid Frames	3 x 33%	Welded carbon steel, baked powder-coat	-
Manifold and Supply Piping	-	Low Pressure: Sch 80 PVC High Pressure: 316 SS	-
Element Housings	10/unit	FRP	Codeline
Feed / Transfer Pump	3 x 33%	End-suction centrifugal	Goulds
High Pressure Pump	1/unit	Multi-stage; *note that pressure to the high-pressure pump must be 30 psi or greater*	Goulds
Cartridge Filters and Vessels	1/unit	Stainless steel	Fil-Trek
Compressed Air System	By Others	Plant air is available for valve actuation	-
Instrumentation			
Conductivity Sensor	2/unit	Feed/permeate	GF Signet
ORP Sensor/Trans.	1	Combined feed	GF Signet
pH Sensor/Trans.	1	Combined feed	GF Signet
Temperature Trans.	1	Combined feed	Dwyer
Flow Meters	2/unit 6 total	Magnetic flow meter Feed / concentrate	Siemens
Pressure Instrumentation	-	Transmitters, switches, gauges	Wika
Valves / Actuators	-	Manual and actuated valves	Bray
Electrical Controls	Master Panel* 3 Local Panels	NEMA 4, Allen-Bradley PLC NEMA 4, Allen-Bradley Flex I/O	-
Tanks	By WesTech	Feed, Permeate HDPE with level measurement	-
Feed Chemical Addition			
Antiscalant Pump	1 x 100%	-	ProMinent
Sodium Bisulfite Pump	1 x 100%	-	ProMinent

**Master Panel shared with Ultrafiltration System*

WesTech

Scope of Supply – Clean-in-Place System

Item	Quantity	Description	Brand (or equal)
Skid Frames	1	Welded carbon steel, baked powder-coat	-
Manifold and Supply Piping	-	Schedule 80 PVC	-
Recirculation Pump	1 x 100%	End-suction centrifugal	Goulds
Cartridge Filters	1 x 100%	5 micron pore size	Fil-Trek
Heater	2	12 kW	Chromalox
Chemical Metering Pumps			
Acid	1 x 100%	CIP process	ProMinent
Alkaline	1 x 100%	CIP process	ProMinent
Instrumentation			
pH Sensor/Transmitter	1	-	GF Signet
Temperature Transmitter	1	-	Dwyer
Flow Switch	1	-	IFM Efector
Pressure Instrumentation	-	Transmitters, switches, gauges	Wika, Ashcroft
Valves / Actuators	-	Manual and actuated valves	Bray
Electrical Controls	1 CIP Panel	NEMA 4, 480 V 3 ph	-
Tank	By WesTech	Off-skid; HDPE with level meas.	Norwesco

Item E - Bolted On-Grade Anchor Ring HDS Mix Tank with Mechanical Mixer for One Train in Series, Model TKC11B

Tank List

Name	Tank Qty	Volume (working)	Volume (total)	Dia. x Height	Retention Time
HDS Mix Tank	2	50,400 gal / tank*	54,017 gal / tank	20'x23'	30 minutes per tank @ 1680 gpm

**Mixer design is for a constant water level in tank with a 2' freeboard.*

General Design Criteria

Description	Description
Quantity	2
Size	20 ft x 23 ft
Material of construction	Carbon Steel Bolted Flat Panel
Floor	Flat Concrete Floor (Concrete/concrete design are not by WesTech)
Design Flow	1680 gpm
Mixer Bridge	Steel bridge with 2-rail steel handrail and grating
Mixer	Top Mounted Mechanical Mixer Wetted Carbon Steel Ends are Rubber Coated
Mixer Controls	Local Start/Stop Pushbutton station VFD provided by Others
Access to Mixer Bridge	Ladder Included, Fall Arrest System Provided by Others
Down-comer Outlet Pipe	Included
Baffles	Vertical mix baffles on tank wall
Nozzles, per Tank	(1) Inlet, (1) Outlet, (1) Drain
Manway	(2) 30" Manway
Design Style	Bolted
Sealant	Manus Bond 75-AM and EPDM for panel construction
Shop Coatings	Fusion Bonded Epoxy Coated
Field Erection	By Others
Governing Codes	API650, ASTM, ASME, AISC, AWWA D-101 etc. as the basis in establishing its own design, fabrication, quality criteria, standards, practices, methods and tolerances for tanks. Corrosion allowance not required nor included on tank.
Nozzle Loads	External pipes must be fully supported; nozzles not designed for load bearing.

Shipment: Tank, bridge and mixer ship separately.

WESTECH

Item F – Sludge storage or Filter Press Feed Tank

Bolted On-Grade Anchor Ring HDS Mix Tank with Mechanical Mixer for One Train in Series, Model TKC11B

Tank List

Name	Tank Qty	Volume (working)	Volume (total)	Dia. x Height	Retention Time
HDS Mix Tank	1	50,400 gal / tank*	54,017 gal / tank	20’x23’	Approximately 3 filter press volumes

**Mixer design is for a constant water level in tank with a 2’ freeboard.*

WesTech has used the same sizing for this tank as that used for the two HDS mix tanks. Golder requested three filter presses and this volume should feed three separate presses depending on the sludge concentration to reduce engineering.

Item G - FRP Densification Tank with Mechanical Mixer on Legs, Model TKE40

Tank List

Name	Tank Qty	Volume (working)	Volume (total)	Dia. x Height	Retention Time
Densification Tank	1	8400 gal*	9400 gal	10’x16’	5 minutes @ 1690 gpm

**Mixer design is for a constant water level in tank with 1.5’ freeboard.*

Tank General Scope of Supply

Tank Type	Circular, Flat Bottom Tank on 8’ high elevated legs to gravity feed into the HDS Mix Tank
Resin	Standard Polyester a CoNAP/MEKP cure
Corrosion Allowance	Nominal corrosion barrier thickness of 100 mils
SG of contents	1.05
Anchors	Not Included
Tank Material of Construction	FRP, based on RTP-1 standards. Non-Stamped
Top	Open
Access to Top of Tank	Ladder Included, OSHA Approved Fall Arrest System by Others
Mixer Bridge	Steel bridge with 2-rail steel handrail and grating
Mixer	Top Mounted Mechanical Mixer Wetted Carbon Steel Ends are Rubber Coated

Mixer Controls	Local Start/Stop Pushbutton Station VFD provided by Others
Baffles	Vertical mix baffles on tank wall
Down-comer Outlet Pipe	Included
Nozzles	(1) Inlet, (1) Outlet, (1) Drain
Nozzle Loads	External pipes must be fully supported; nozzles not designed for load bearing.

Shipment: Tank and mixer ship separately.

Items Not Included in WesTech's Base Scope of Supply

- Electrical controls and wiring not described above
- Piping, valves, or fittings
- Lubricants
- Unloading or storage
- Erection or assembly
- Weir, scum baffle, & supports
- Concrete

Clarifications

- Slurry testing is required to verify equipment selection and performance.
- Any item not listed above to be furnished by others.
- Cake discharge handled by others.
- Pneumatic air supplied by others.
- Cloth wash system not included.
- Membrane squeeze system not included.
- Feed pumps not included.
- Platform not included.
- Cake dumpsters not included.
- Concrete sump (if required) is by others.
- The information provided above is for budgetary purposes only. The equipment sizes listed may vary depending on the final design criteria and flows.
- All information provided in this proposal is preliminary in nature and will be finalized during the detail engineering phase of this project.
- WesTech used an assumed feed water quality to provide an effluent water quality projection from the reverse osmosis system. WesTech also assumed three (3) reverse osmosis units would be required to meet the specified treatment range. WesTech can look into the possibility of reducing the number of RO trains but will need a feed water quality analysis in order to perform projections for the different flow scenarios.
- USA Tariffs and Current Trade Laws: All prices are based on current USA and North America tariffs and trade laws/agreements at time of bid. Any changes in costs due to USA Tariffs and trade laws/ agreements will be passed through to the purchaser at cost.

Commercial Budget Proposal

Proposal Name: Golder Mine Water Treatment   Proposal Number: 1910329

Date: May 31, 2019

1. Bidder's Contact Information

Company Name	WesTech Engineering, Inc.
Contact Name	Kib Huefner
Phone	801.265.1000
Email	khuefner@westech-inc.com
Address: Number/Street	3665 S West Temple
Address: City, State, Zip	Salt Lake City, UT 84115

2. Pricing

Currency	US Dollars
Scope of Supply	
Item A – One 80'x14' Flocculating Clarifier (CLS25L) & Bolted AC Tank (TKC11B)	$377,200
Item B – Three 200 ft^3 Automatic Filter Presses, Model PFA63C	$1,058,000
Item C – Ultrafiltration System, Model UFT82A	$562,200
Item D – Reverse Osmosis System, Model ROT83B	$783,500
Item E – Two 20'x23' HDS Mix Tanks with Mechanical Mixer for One Train, TKC11B	$258,000
Item F – One 20'x23' Sludge Holding Tank (Filter press feed) TKC11B	$143,200
Item G – One 10'x6' FRP Densification Tank with Mechanical Mixer on Legs, TKE40	$88,400
	$3,270,500
Taxes (sales, use, VAT, IVA, IGV, duties, import fees, etc.)	**NOT INCLUDED**
Optional MudMax	**$56,000**

Prices are for a period not to exceed 30 days from date of proposal.

Field Service

Included Field Service	None
Daily Rate	$1,200

Prices do not include field service unless noted, but it is available at the daily rate plus expenses. The customer will be charged for a minimum of three days for time at the jobsite. Travel will be billed at the daily rate. Any canceled charges due to the customer's request will be added to the invoice. The greater of visa procurement time or a two week notice is required prior to trip departure date.

3. Payment Terms

PO Acceptance	10%

Submittals Approved	15%
Major Materials in Shop	35%
Notification of Ready to Ship	40%

All payments are net 30 days. Partial shipments are allowed. Other terms per WesTech proforma invoice.

4. Schedule

Submittals, after PO receipt	6 weeks
Ready to Ship, after Submittal approval (Clarifier, Tank, UF, RO)	20 weeks
Ready to Ship, after Submittal approval (Filter Press)	24 weeks
Start-up & Commissioning	4 weeks

5. Freight

Not included – Approximate number of trucks	3 for UF Equipment 3 for RO Equipment

Terms & Conditions: This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

Paint: If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces is not by WesTech.

One-Year Warranty

WesTech equipment is backed by WesTech's reputation as a quality manufacturer, and by many years of experience in the design of reliable equipment.

Equipment manufactured or sold by WesTech Engineering, Inc., once paid for in full, is backed by the following warranty:

For the benefit of the original user, WesTech warrants all new equipment manufactured by WesTech Engineering, Inc. to be free from defects in material and workmanship, and will replace or repair, F.O.B. its factories or other location designated by it, any part or parts returned to it which WesTech's examination shall show to have failed under normal use and service by the original user within one (1) year following initial start-up, or eighteen (18) months from shipment to the purchaser, whichever occurs first.

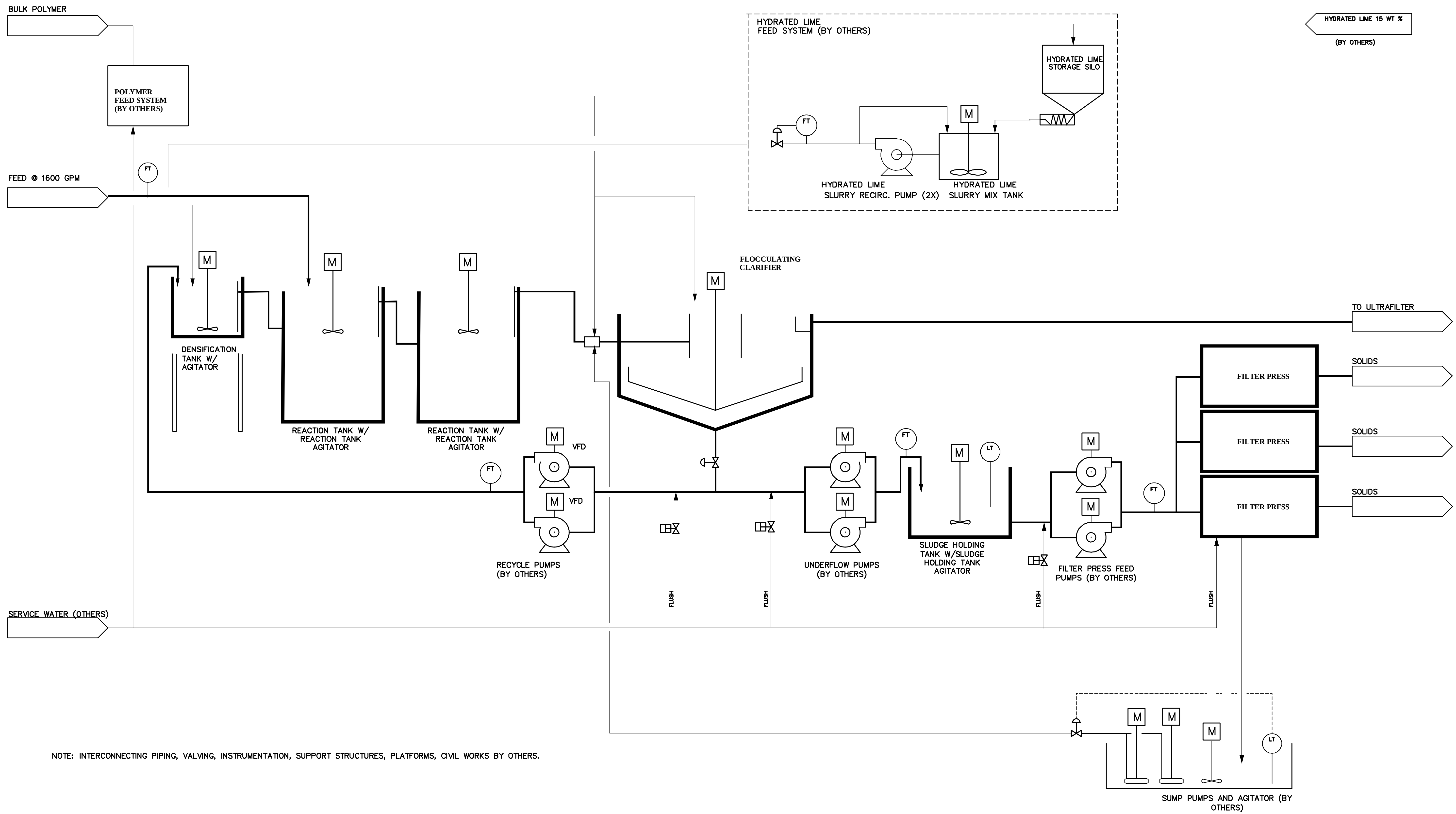
Such repair or replacement shall be free of charge for all items except for those items such as resin, filter media and the like that are consumable and normally replaced during maintenance, with respect to which, repair or replacement shall be subject to a pro-rata charge based upon WesTech's estimate of the percentage of normal service life realized from the part. WesTech's obligation under this warranty is conditioned upon its receiving prompt notice of claimed defects, which shall in no event be later than thirty (30) days following expiration of the warranty period, and is limited to repair or replacement as aforesaid.

This warranty is expressly made by WesTech and accepted by purchaser in lieu of all other warranties, including warranties of merchantability and fitness for particular purpose, whether written, oral, express, implied, or statutory. WesTech neither assumes nor authorizes any other person to assume for it any other liability with respect to its equipment. WesTech shall not be liable for normal wear and tear, corrosion, or any contingent, incidental, or consequential damage or expense due to partial or complete inoperability of its equipment for any reason whatsoever.

This warranty shall not apply to equipment or parts thereof which have been altered or repaired outside of a WesTech factory, or damaged by improper installation, application, or maintenance, or subjected to misuse, abuse, neglect, accident, or incomplete adherence to all manufacturer's requirements, including, but not limited to, Operations & Maintenance Manual guidelines & procedures.

This warranty applies only to equipment made or sold by WesTech Engineering, Inc.

WesTech Engineering, Inc. makes no warranty with respect to parts, accessories, or components purchased by the customer from others. The warranties which apply to such items are those offered by their respective manufacturers.



NOTE: INTERCONNECTING PIPING, VALVING, INSTRUMENTATION, SUPPORT STRUCTURES, PLATFORMS, CIVIL WORKS BY OTHERS.

REV	DESIGN	P&ID	DOC.	DATE	DESIGN	P&ID	DOC.	DATE	BY	DATE	DESCRIPTION
											PRELIMINARY PFD
DETAIL REVIEW					DESIGN VERIFICATION				APPROVAL		

PROJECT:

PREPARED FOR: GOLDER

ENGINEER:

PREPARED BY: WESTECH ENGINEERING, INC.
SALT LAKE CITY, UTAH

PROCESS FLOW DIAGRAM

DESCRIPTION
HDS PROCESS

MODEL
SIZE

DRAWING NUMBER	PROJECT NUMBER	REV.
PFD01	1910329	△

June 3, 2019

Zee Travis
Golder Associates Inc.
44 Union Boulevard, Sute 300.
Lakewood, CO 80228

Dear Zee:

Thank you for your interest in our line of Belding Fiberglass Tanks and Brawn Mixers. Pricing for your Tyrone Mine Project is as follows. Mixers are quoted based on waterlike SG and viscosity.

Floc Tank

1- 7,670 gallon Fiberglass Tank, flat bottom, open top, single wall, 144”ID x 108” tall with 2” fill fitting, 2” outlet fitting, 2” level fitting, 3” overflow fitting, carbon steel mixer bridge, four (4) mixing baffles.

$17,000 plus freight

1- 3BTO2-42 mixer assembly with 2 HP 230/460V 3 phase TEFC motor gear reduced to 42 RPMs, 2” x 108” shaft, single 48” A35 impeller, fixed plate mount and 304 SS wetted parts. Minimum liquid level in tank with mixer operating is 36” (based on the mixer mounting at 120”).

$9,000 plus freight

Neutralization Tank

1- 27,122 gallon Fiberglass Tank, flat bottom, open top, single wall, 168”ID x 292” tall with 4” fill fitting, 4” outlet fitting, 4” level fitting, 6” overflow fitting, carbon steel mixer bridge, four (4) mixing baffles.

$40,000 plus freight

1- 6BTO7.5-35 mixer assembly with 7.5 HP 230/460V 3 phase TEFC motor gear reduced to 35 RPMs, 3.5” x 270” shaft, dual 64” A35 impeller, fixed plate mount and 304 SS wetted parts. Minimum liquid level in tank with mixer operating is 72” (based on the mixer mounting at 312”).

$9,000 plus freight

Discharge Tank

1- 46,045 gallon Fiberglass Tank, flat bottom, closed dome top, single wall, 168"ID x 480" straight side x 508" overall height, with 24" top manway, 6" fill fitting, 6" outlet fitting, 6" level fitting, 6" overflow fitting and 8" U-vent.

$48,000 plus freight

Sludge Storage Tank

1- 11,086 gallon Fiberglass Tank, cone bottom, closed dome top, single wall, 144"ID x 134" straight side x 246" overall height, with 24" top manway, 4" fill fitting, 4" outlet fitting, 4" level fitting, 6" overflow fitting, 6" U-vent and shop[painted carbon steel tank stand.

$33,000 plus freight

Filter Tank

1- 3,090 gallon Fiberglass Tank, flat bottom, closed dome top, single wall, 96"ID x 100" straight side x 116" overall height, with 24" top manway, 2" fill fitting, 2" outlet fitting, 2" level fitting, 3" overflow fitting and 3" U-vent.

$10,000 plus freight

Process Water Tank

1- 3,090 gallon Fiberglass Tank, flat bottom, closed dome top, single wall, 72"ID x 175" straight side x 187" overall height, with 24" top manway, 2" fill fitting, 2" outlet fitting, 2" level fitting, 3" overflow fitting and 3" U-vent.

$10,000 plus freight

Notes:

- Prices quoted are firm for 30 days.
- Lead-time is 13-17 weeks after drawing approval.
- All sales are subject to Tank Equipment Terms & Conditions W.A.C. which can be viewed on our website at www.tankequipment.com. Some orders may be subject to a down payment and/or progress payments

Please let me know if I can answer any questions or be of further assistance.

Sincerely,

Matt Licknosky
Tank Equipment, Inc.
Office: 303-833-9200
Direct: 303-962-7814
Email: matt@tankequipment.com

TECHNICAL HANDBOOK EMW®

Heavy Duty Slurry Pump

WILFLEY®

Wilfley Sealing Technology

No Flush Water Required

WILFLEY SEALING TECHNOLOGY

Wilfley Sealing Technology is the premier sealing solution for the toughest pumping applications and has proven to be a superior alternative to conventional sealing systems like mechanical seals and compression packing. It has been the foundation for every Wilfley pump design, dating back to the ground-breaking Model A slurry pump in 1919.

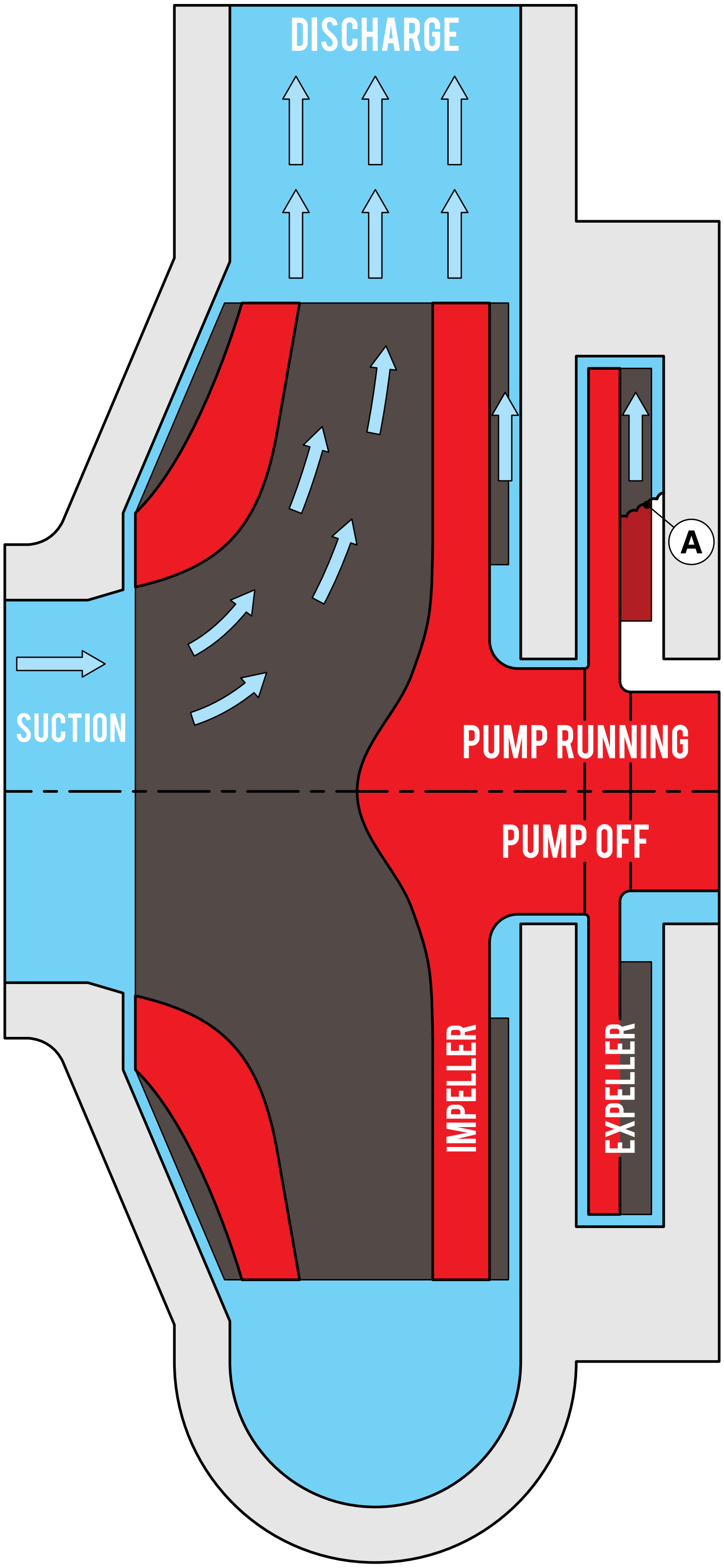
DYNAMIC SEAL & STATIC SEAL

Wilfley Sealing Technology provides **leak free** operation at all times by partnering a dynamic seal (page 2) with a static seal (page 3). The dynamic seal prevents leakage while the pump is running and the static seal prevents leakage while the pump is off.

The harmony between the dynamic and static seal is what makes Wilfley Sealing Technology excel beyond conventional seals.

Wilfley Expellers

WILFLEY DYNAMIC EXPELLER SEAL



FEATURES & BENEFITS:

- A superior alternative to compression packing / mechanical seals and their associated flush systems
- Excellent solids / slurry handling capabilities
- Product dilution is eliminated
- Operational abuse tolerant, e.g. cavitation and vibration
- Reduces maintenance costs and maximizes production time through increased mean time between maintenance (MTBM)
- Exceptional dry running capability

HOW THE WILFLEY DYNAMIC EXPELLER SEAL WORKS:

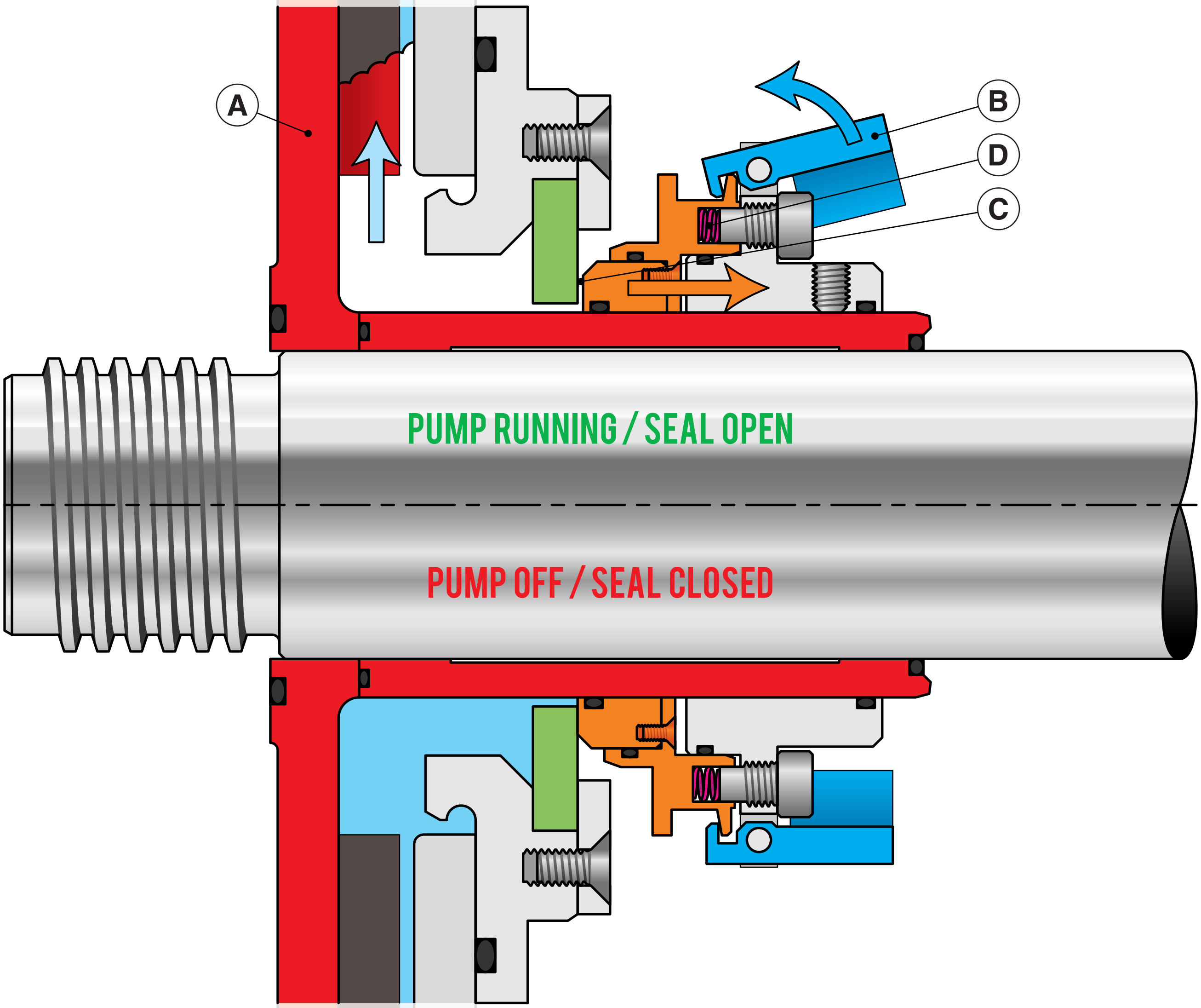
- The positively-driven expeller has specially designed vanes that act directly on the pump fluid
- A liquid partition **(A)** is established during pump operation by centrifugal forces generated by the expeller
- This liquid partition effectively isolates the pump fluid from the shaft
- The governor-actuated SolidLock® static seal manages all fluid containment during idle conditions

WILFLEY SolidLock® STATIC SEAL

HOW THE SolidLock® SEAL WORKS:

At start up, the expeller **(A)** generates hydraulic forces that evacuate the pump fluid away from the seal faces. As this happens, centrifugal force moves weights **(B)** outwards to open seal faces **(C)** and prevent any rubbing contact.

At shut down, the liquid partition dissipates and the pumped fluid is pushed towards the seal faces. Isolated springs **(D)** force the seal faces to close before any of the pump fluid can escape.

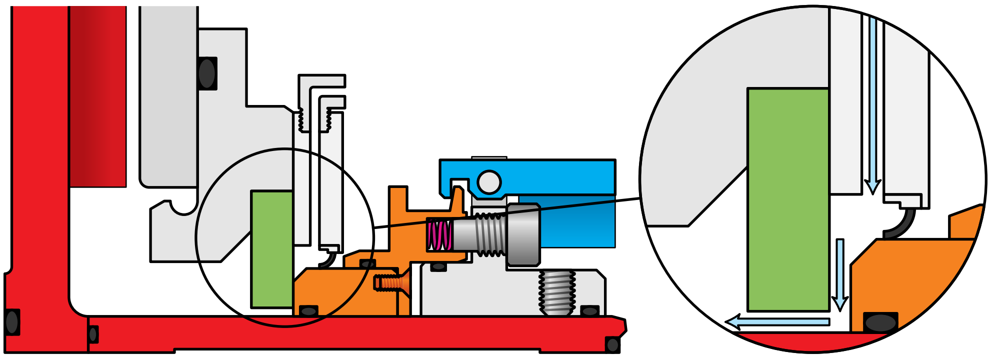


FEATURES & BENEFITS:

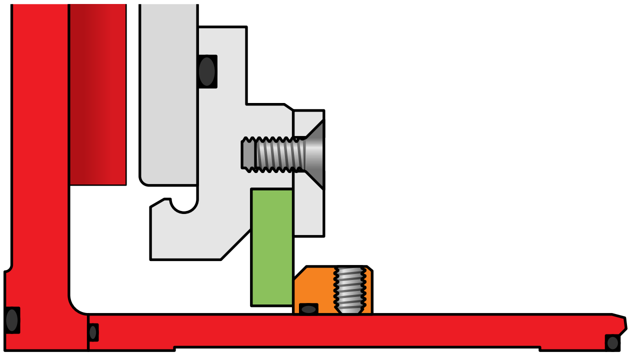
- **Leak free operation** - Precise and controlled opening and closing of the seal faces
- **Reliable and repeatable seal actuation** - The spring force is specifically set for your application and can be easily adjusted in the field if necessary
- **Easy to install / maintain** - Simple and effective design, no special tools needed

EMW® SLURRY PUMP SEALING OPTIONS

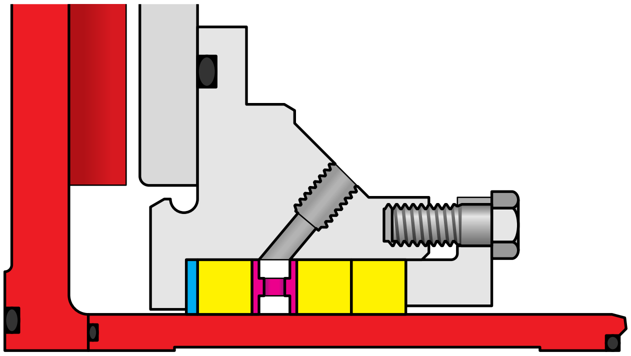
The EMW® pump has been designed to accommodate a wide variety of sealing options to specifically suit your application.



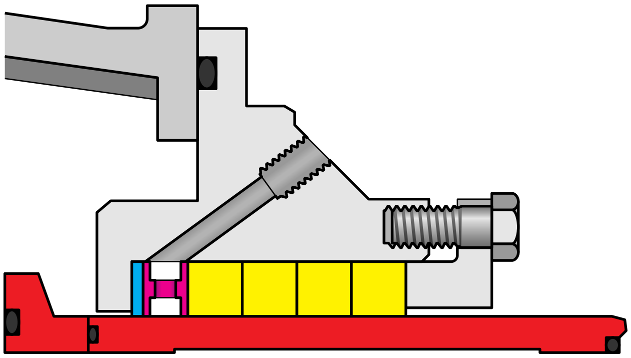
SolidLock® with Purge Port
(Start Up and / or Shut Down Washout Capability)



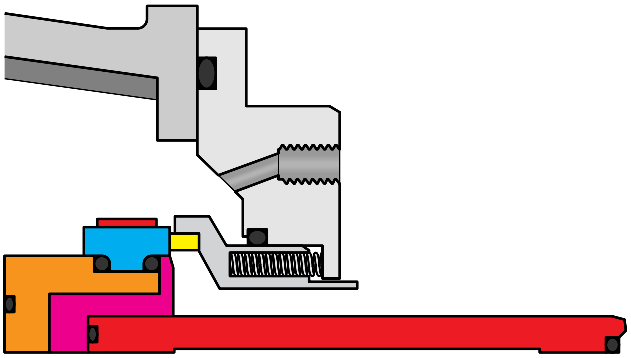
SolidLock® Lite
(Diaphragm Seal with Expeller)



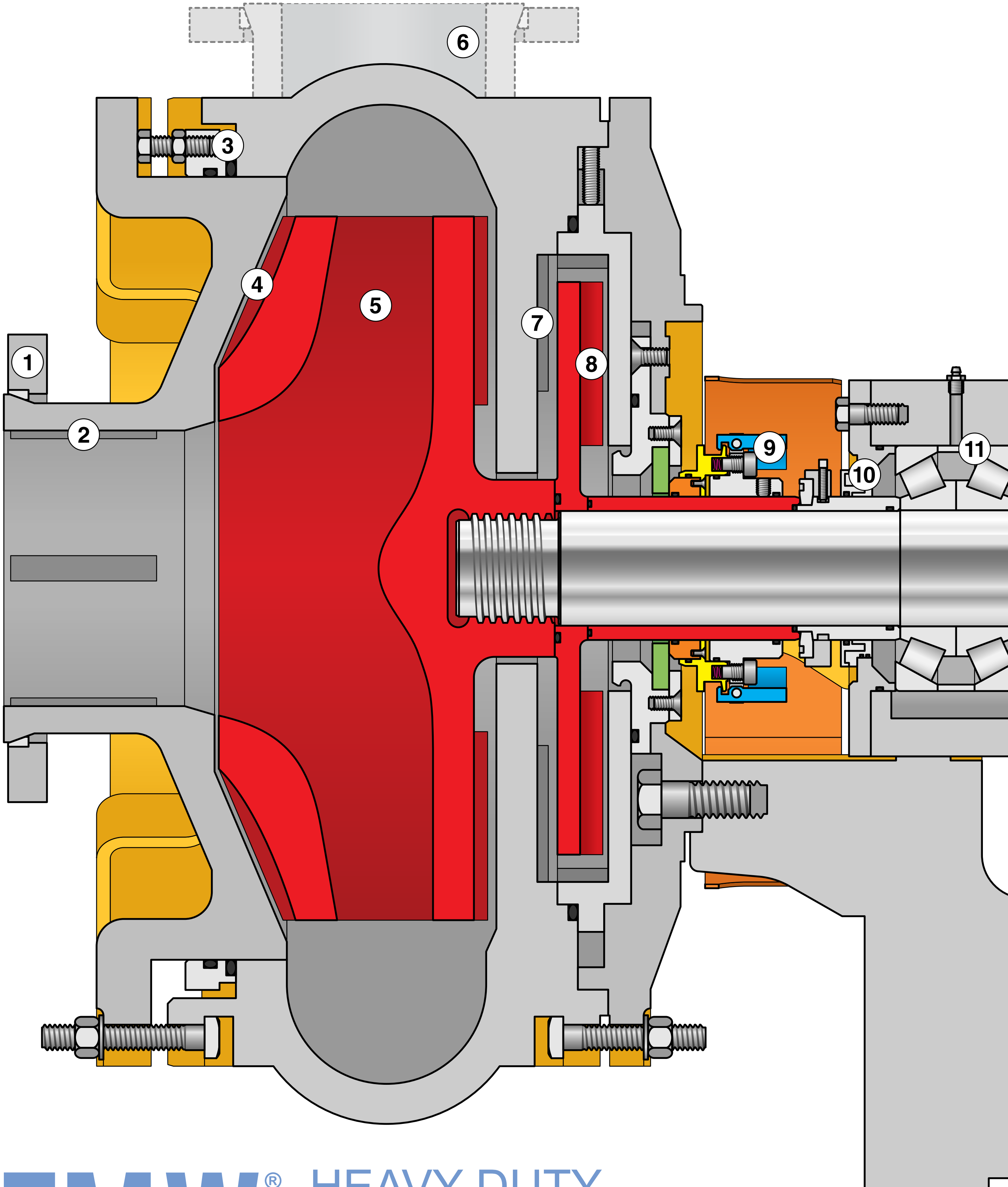
Expeller with Compression Packing
(Weep Configuration Shown)



Compression Packing
(Flush Configuration Shown)

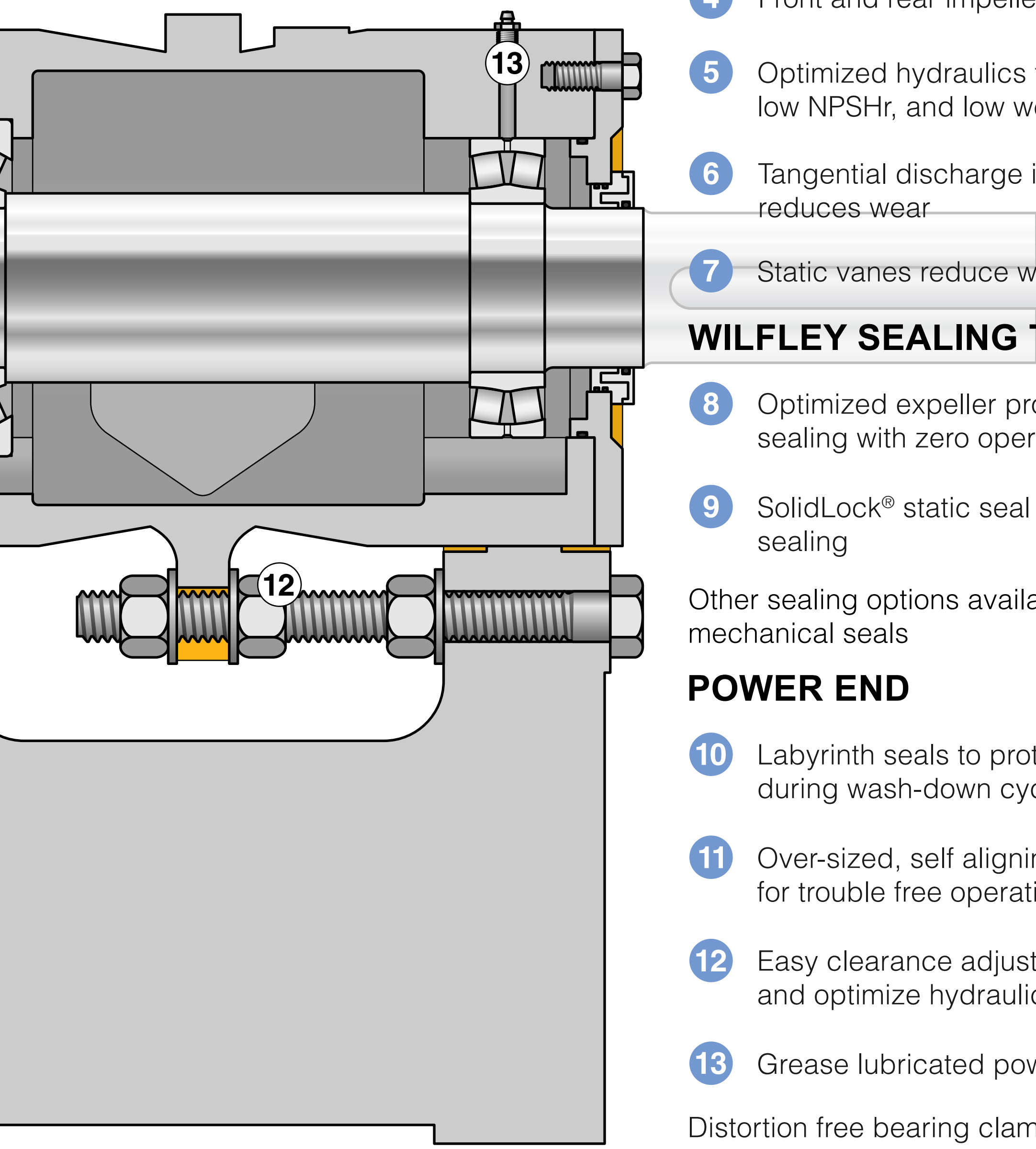


Single / Double Mechanical Seals



EMW® HEAVY DUTY CLASS 3 & 4 SLURRY PUMP

EMW® SLURRY PUMP FEATURES & BENEFITS



WET END

1. ASME/ANSI and ISO/DIN flanges available*
2. Flow straightening vanes minimize turbulence, extend wear life, and improve performance
3. Adjustable suction cover to optimize efficiency and minimize wear (larger sizes only)*
4. Front and rear impeller vanes reduce wear
5. Optimized hydraulics for high efficiency, low NPSHr, and low wear
6. Tangential discharge improves efficiency and reduces wear
7. Static vanes reduce wear

WILFLEY SEALING TECHNOLOGY

8. Optimized expeller provides superior dynamic sealing with zero operational leakage
9. SolidLock® static seal engineered for reliable sealing

Other sealing options available including packing and mechanical seals

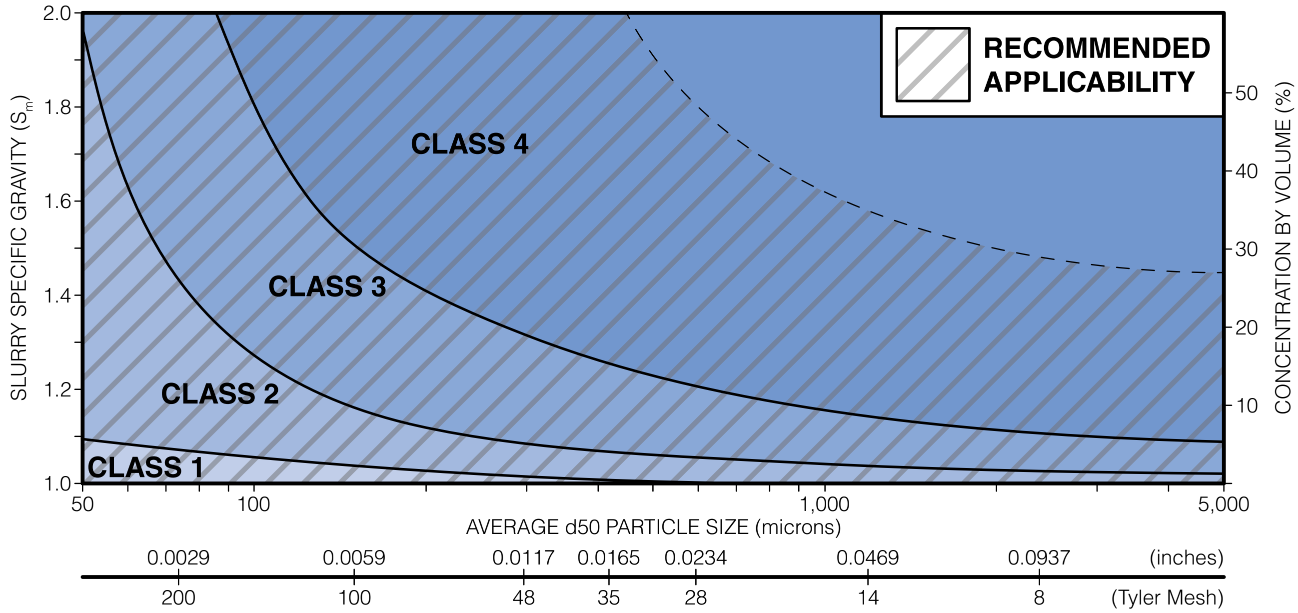
POWER END

10. Labyrinth seals to protect internal components during wash-down cycles
11. Over-sized, self aligning tapered roller bearings for trouble free operation
12. Easy clearance adjustment to maintain efficiency and optimize hydraulic and/or expeller performance
13. Grease lubricated power end

Distortion free bearing clamp system ensures maximum bearing life (see page 10)

*Available on metallic wet end only

DESIGNED FOR CLASS 3 & 4 SLURRY SERVICES



For use as a first guide only, assumes 2.65 s_{sol} silica-based solids. Adjust rating to account for solids of different abrasivity using ASTM G75-95.

Courtesy of Hydraulic Institute, Parsippany, NJ www.pumps.org

ROBUST CONSTRUCTION

The wet end construction of the EMW® pump is built to last and features components with double the thickness of comparable medium duty slurry pumps. This type of design, combined with Wilfley's proprietary MAXALLOY® 5A hard iron and elastomer liners, creates the ideal slurry pump for abrasive applications.

21ST CENTURY HYDRAULICS

Wilfley used the latest computational fluid dynamics software to determine the optimal balance between hydraulic performance and wear life. This design was then validated with extensive empirical testing in the field.

BREAKTHROUGH MATERIALS

Wilfley works discreetly with key suppliers, such as Western Foundries, to provide a variety of engineered metallurgies and proprietary processes for the longest possible pump and parts life and reliability.

WILFLEY KNOWS METALLURGY

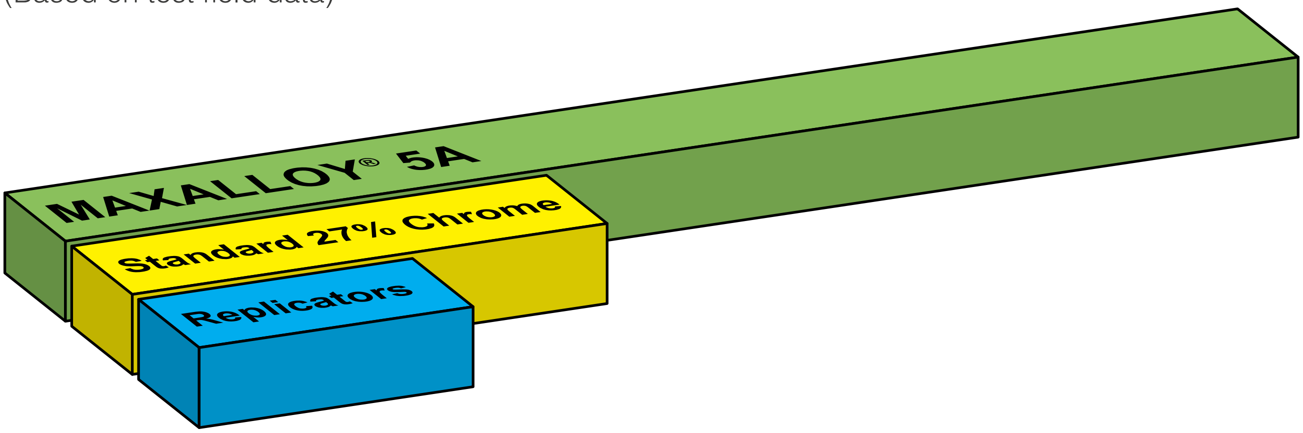
This also allows Wilfley to provide very competitive lead times for both complete pumps and spare parts.

MAXALLOY® 5A

Wilfley's proprietary MAXALLOY® 5A was developed specifically for the toughest slurry applications, combining unsurpassed hardness for wear resistance with superior toughness for durability.

Through special proprietary processing, chromium carbides are evenly distributed in a fully martensitic matrix with an average hardness of **740 HBN**. The microstructure is designed to avoid any retained austenite, delta ferrite and secondary carbides resulting in extraordinary wear performance as compared to commonly available high chrome irons.

AVERAGE SERVICE LIFE
(Based on test field data)



LINED WET END

THE EMW® PUMP IS ALSO AVAILABLE WITH ELASTOMER LINED WET END CONFIGURATIONS

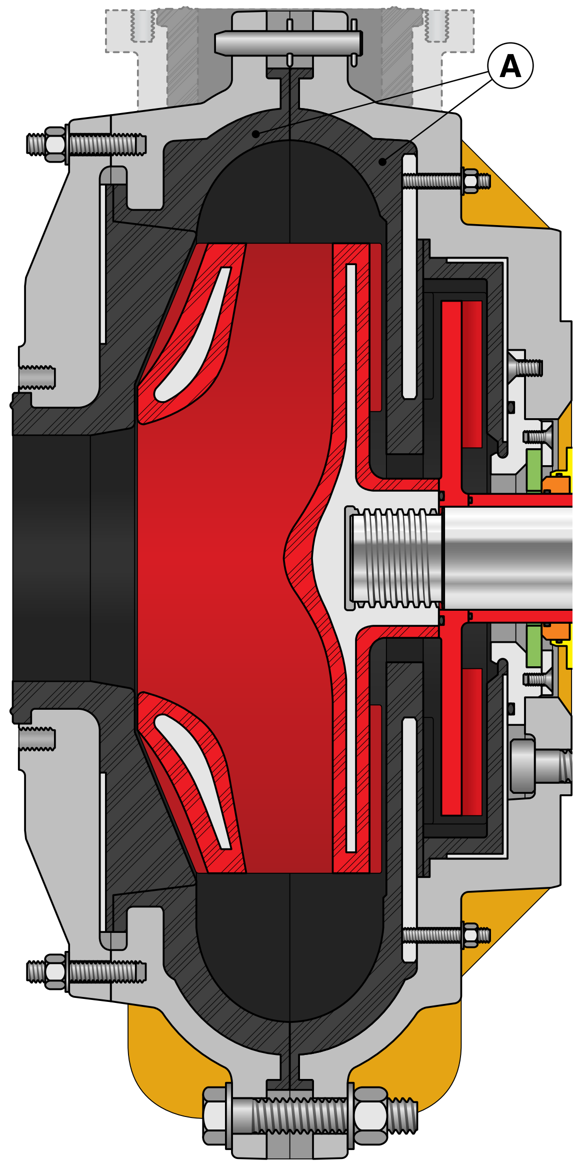
- High wear resistance
- Chemically resistant
- Replaceable wear liners **(A)**
- Maintenance friendly split casing
- Uses the same robust power end as the metallic wet end
- Available with the same sealing options as the metallic wet end

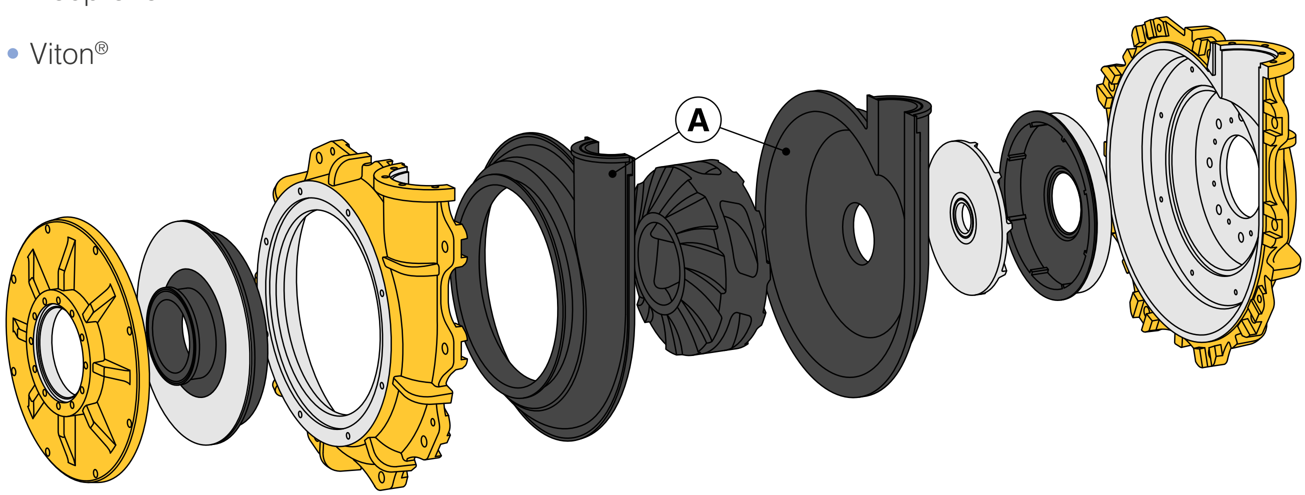
APPLICABILITY

- Particle type: Spherical (non-sharp)
- Max Particle Size: 0.24 in (6 mm)
- Max Temperature: 180°F (80°C)
- Max Peripheral Speed: 5,500 ft/min (28 m/s)

AVAILABLE MATERIALS

- Natural Rubber
- Synthetic Rubber (Butyl)
- Hypalon®
- Neoprene
- Viton®





EXTREME DUTY POWER END

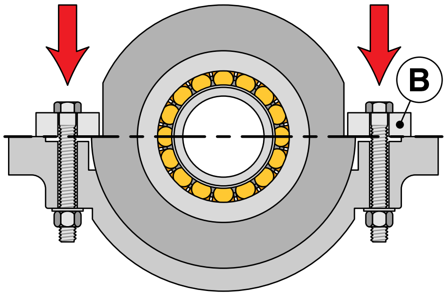
The power end of the EMW® pump has been engineered to handle the most difficult and demanding slurry applications.

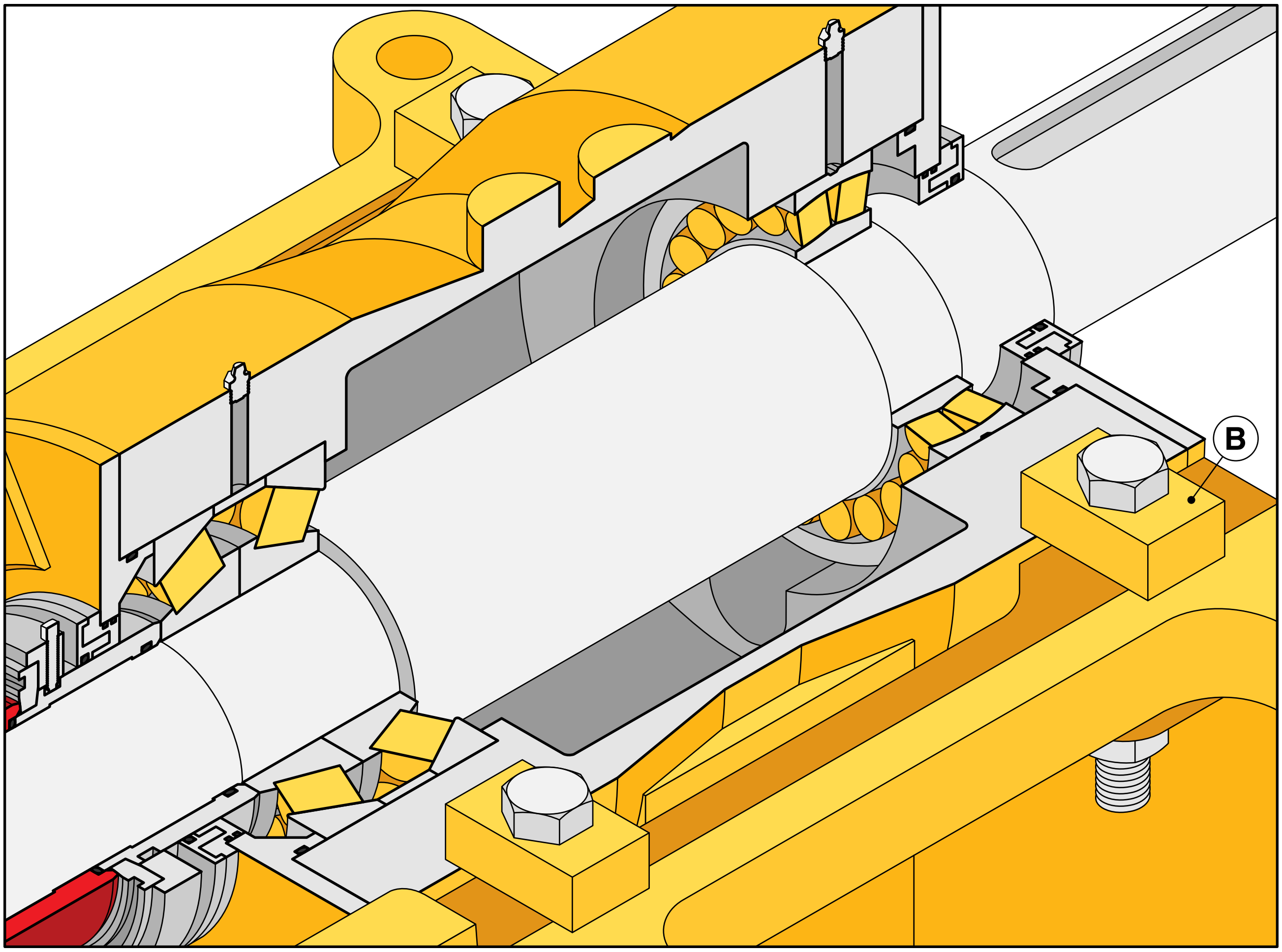
ULTRA-LOW L^3/D^4 SHAFT STIFFNESS RATIOS

EMW 50 2x2	EMW 75 3x3	EMW 100 4x3	EMW 150 6x4	EMW 200 8x6	EMW 250 10x8	EMW 300 12x10	EMW 350 14x12
8.6	3.6	2.6	1.3	1.0	1.1	0.7	0.9

DISTORTION FREE BEARING CLAMP SYSTEM

The bearing cartridge is held in place with specially designed clamps **(B)**, which eliminate hoop stress on the bearings and provide distortion free operation and extended L_{10} life.



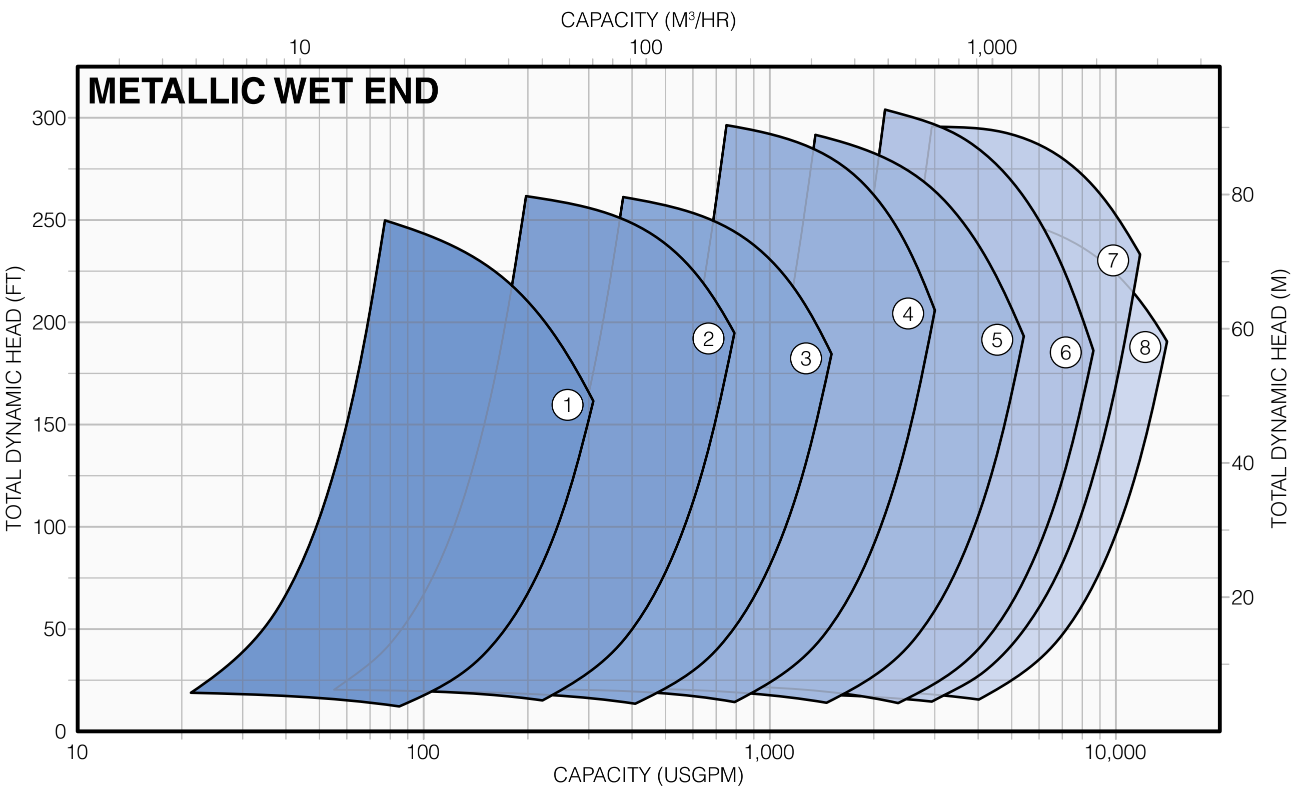


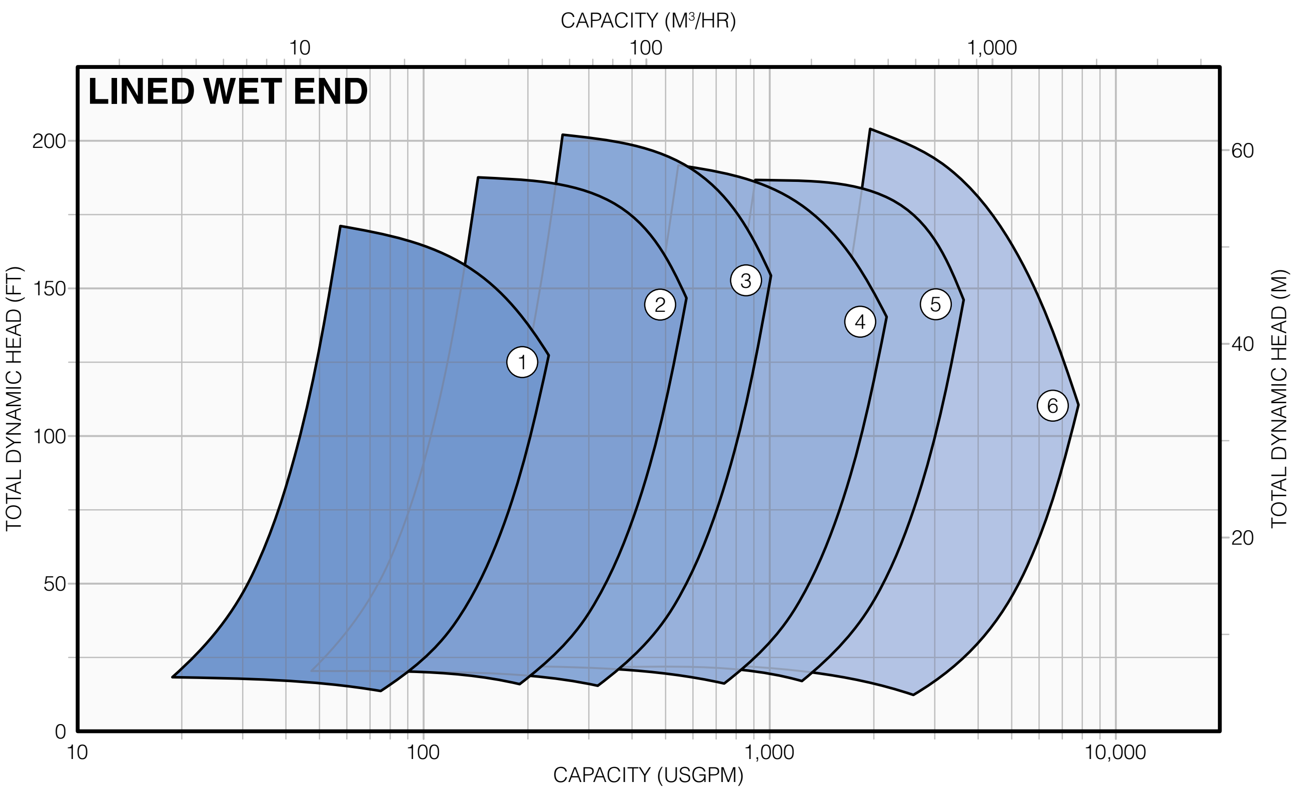
CONSTRUCTION DETAILS

		METALLIC WET END							
		EMW 50 2x2	EMW 75 3x3	EMW 100 4x3	EMW 150 6x4	EMW 200 8x6	EMW 250 10x8	EMW 300 12x10	EMW 350 14x12
GENERAL									
Bare Pump Weight	lbs	360	485	590	1,165	2,345	3,445	7,585	9,025
	kg	163	220	268	528	1,064	1,563	3,440	4,094
Max Passable Solids Size	in	0.71	0.79	1.57	1.97	2.36	2.76	3.74	4.33
	mm	18	20	40	50	60	70	95	110
SHAFT									
Diameter at Impeller	in	1.11	1.22	1.57	2.13	2.72	3.11	3.50	3.90
	mm	28	31	40	54	69	79	89	99
Diameter at Coupling	in	1.30	1.77	2.17	2.56	3.15	3.54	3.94	4.53
	mm	33	45	55	65	80	90	100	115

		LINED WET END					
		EMW 50 2x2	EMW 75 3x3	EMW 100 4x3	EMW 150 6x4	EMW 200 8x6	EMW 250 10x8
GENERAL							
Bare Pump Weight	lbs	310	430	615	1,095	1,930	3,485
	kg	141	195	279	497	875	1,581
Max Passable Solids Size	in	0.71	0.79	1.18	1.57	2.36	2.76
	mm	18	20	30	40	60	70
SHAFT							
Diameter at Impeller	in	1.11	1.22	1.57	2.13	2.72	3.11
	mm	28	31	40	54	69	79
Diameter at Coupling	in	1.30	1.77	2.17	2.56	3.15	3.54
	mm	33	45	55	65	80	90

EMW® SLURRY PUMP CAPACITIES





1. EMW 50 2x2

2. EMW 75 3x3

3. EMW 100 4x3

4. EMW 150 6x4

5. EMW 200 8x6

6. EMW 250 10x8

7. EMW 300 12x10

8. EMW 350 14x12

DIMENSIONS

PUMP DIMENSIONS

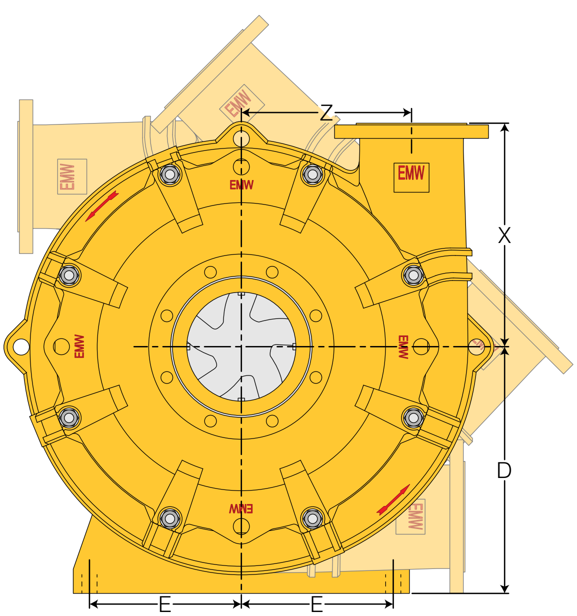
Inches (Millimeters)

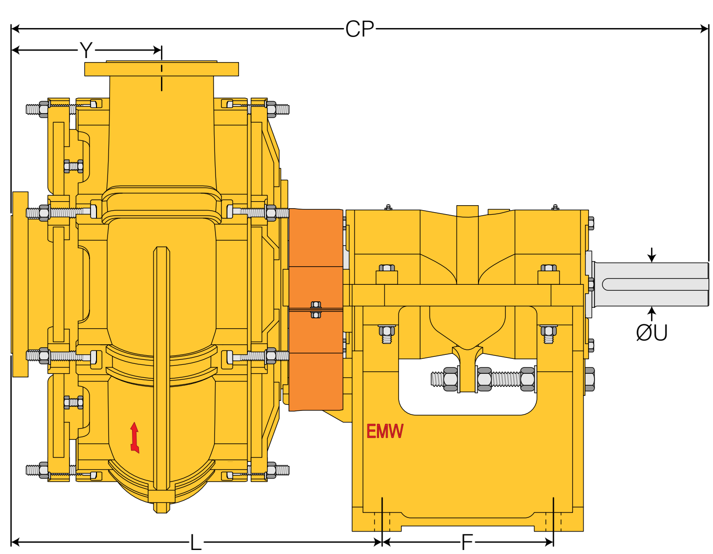
Pump Size	Suction Flange	Discharge Flange	CP	D	E	F	L	U	X	Y	Z	KEYWAY
METALLIC WET END												
EMW 50 2x2	2 (50)	2 (50)	27 (684)	10 (254)	6.4 (161)	7.8 (197)	13.2 (335)	1.3 (33)	8.5 (215)	4.5 (114)	4.9 (123)	0.4 x 0.4 (10 x 8)
EMW 75 3x3	3 (75)	3 (75)	30.3 (769)	10 (254)	6.4 (161)	7.8 (197)	16 (404)	1.8 (45)	8.3 (209)	6 (152)	6.3 (160)	0.6 x 0.4 (14 x 9)
EMW 100 4x3	4 (100)	3 (75)	33 (837)	10 (254)	6.9 (173)	8.5 (215)	18 (457)	2.2 (55)	10.1 (255)	6.9 (173)	6.8 (172)	0.6 x 0.4 (16 x 10)
EMW 150 6x4	6 (150)	4 (100)	39.6 (1004)	13.2 (335)	8.3 (210)	9 (227)	21.8 (553)	2.6 (65)	13.3 (336)	9.1 (230)	9.6 (242)	0.7 x 0.4 (18 x 11)
EMW 200 8x6	8 (200)	6 (150)	50.9 (1291)	18 (457)	11.1 (281)	12.5 (316)	27.1 (687)	3.2 (80)	16.3 (414)	11 (278)	12.5 (315)	0.9 x 0.6 (22 x 14)
EMW 250 10x8	10 (250)	8 (200)	67.6 (1715)	24.1 (610)	17.9 (454)	21.6 (548)	31.3 (793)	3.6 (90)	19.1 (484)	12.3 (310)	14.9 (378)	1 x 0.6 (25 x 14)
EMW 300 12x10	12 (300)	10 (250)	72.3 (1835)	24.1 (610)	17.9 (454)	21.6 (548)	34.8 (882)	4.0 (100)	25.6 (650)	15.3 (388)	19.7 (500)	1.2 x 0.7 (28 x 16)
EMW 350 14x12	14 (350)	8 (300)	75.2 (1908)	24.1 (610)	17.9 (454)	21.6 (548)	38.0 (965)	4.6 (115)	28.2 (715)	16.5 (418)	22 (557)	1.3 x 0.8 (32 x 18)
LINED WET END												
EMW 50 2x2	2 (50)	2 (50)	26.7 (678)	10 (254)	6.4 (161)	7.8 (197)	12.7 (321)	1.3 (33)	6.9 (175)	3.6 (90)	4.9 (123)	0.4 x 0.4 (10 x 8)
EMW 75 3x3	3 (75)	3 (75)	29.2 (740)	10 (254)	6.4 (161)	7.8 (197)	14.4 (365)	1.8 (45)	8.5 (215)	4.8 (121)	6.3 (160)	0.6 x 0.4 (14 x 9)
EMW 100 4x3	4 (100)	3 (75)	32.5 (825)	10 (254)	6.9 (173)	8.5 (215)	17.2 (435)	2.2 (55)	11.2 (283)	5.8 (145)	6.8 (172)	0.7 x 0.4 (16 x 10)
EMW 150 6x4	6 (150)	4 (100)	38.5 (976)	13.2 (335)	8.3 (210)	9 (227)	20.7 (525)	2.6 (65)	14.1 (358)	7.1 (178)	9.6 (242)	0.8 x 0.5 (18 x 11)
EMW 200 8x6	8 (200)	6 (150)	48.6 (1232)	18 (457)	11.1 (281)	12.5 (316)	24.4 (618)	3.2 (80)	17.4 (440)	8.8 (221)	12.5 (315)	0.9 x 0.6 (22 x 14)
EMW 250 10x8	10 (250)	8 (200)	65.5 (1663)	24.1 (610)	17.9 (454)	21.6 (548)	29.2 (740)	3.6 (90)	20.1 (510)	10.4 (263)	14.9 (378)	1 x 0.6 (25 x 14)

These dimensions are not for construction. Certified dimension prints are available for your specific installation

ASME/ANSI and ISO/DIN flanges available.

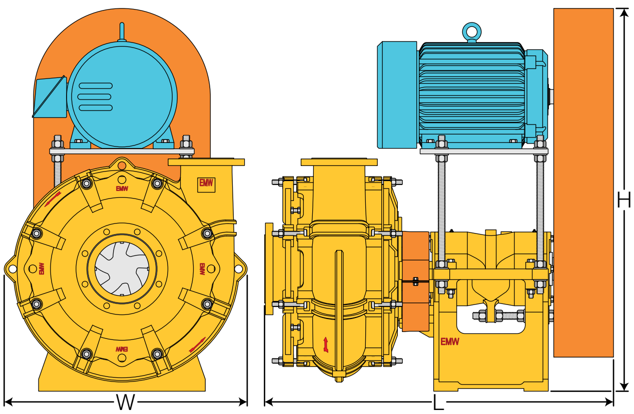
The discharge can rotate in 45° increments to specifically meet your needs.





DRIVE CONFIGURATIONS

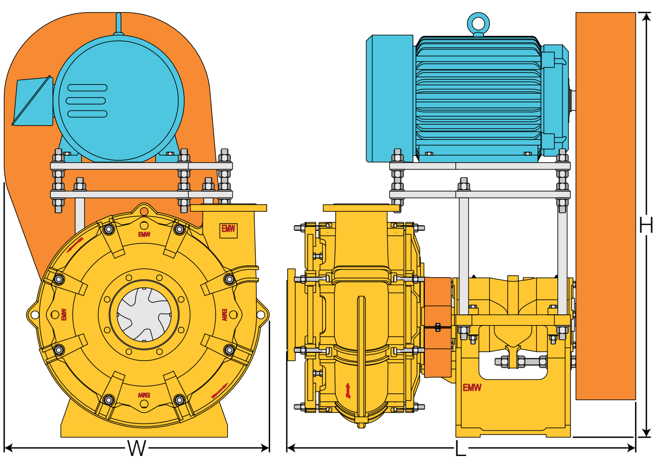
INLINE OVERHEAD (Small Motors)



Approximate Dimensions
Inches (Millimeters) - NEMA (IEC)

Pump Size	Motor Range	L	W	H
EMW 50 2x2	143T-213T (90S-112M)	30 (762)	21 (533)	41 (1041)
EMW 75 3x3	143T-213T (90S-112M)	33 (838)	21 (533)	41 (1041)
EMW 100 4x3	143T-215T (90S-132M)	36 (914)	21 (533)	41 (1041)
EMW 150 6x4	143T-256T (90S-132M)	46 (1168)	29 (737)	64 (1626)
EMW 200 8x6	256T-326T (160S-200L)	55 (1397)	36 (914)	68 (1727)
EMW 250 10x8	286T-405T (180S-280M)	73 (1854)	43 (1092)	75 (1905)
EMW 300 12x10	326T-445T (200M-280M)	80 (2032)	55 (1397)	85 (2159)
EMW 350 14x12	364T-447T (250S-315L)	83 (2108)	63 (1600)	100 (2540)

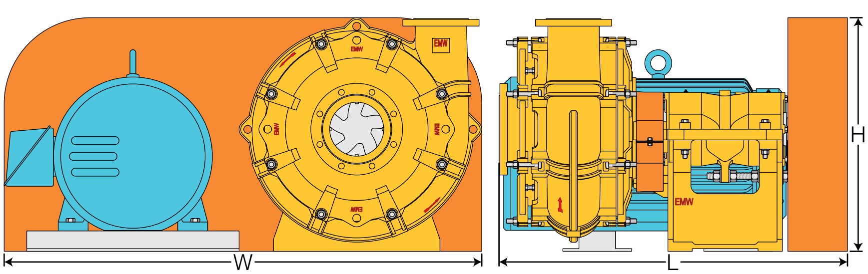
OFFSET OVERHEAD (Medium Motors)



Approximate Dimensions
Inches (Millimeters) - NEMA (IEC)

Pump Size	Motor Range	L	W	H
EMW 50 2x2	215T-405T (132S-250M)	34 (864)	32 (813)	52 (1321)
EMW 75 3x3	215T-405T (132S-250M)	35 (889)	32 (813)	52 (1321)
EMW 100 4x3	254T-405T (160M-250M)	38 (965)	32 (813)	52 (1321)
EMW 150 6x4	284T-405T (160M-250M)	44 (1118)	35 (889)	64 (1626)
EMW 200 8x6	364T-405T (225S-250M)	53 (1346)	39 (991)	69 (1753)
EMW 250 10x8	All overhead configurations are inline			
EMW 300 12x10				
EMW 350 14x12				

SIDE BY SIDE (Large Motors)



Approximate Dimensions
Inches (Millimeters) - NEMA (IEC)

Pump Size	Motor Range	L	W	H
EMW 50 2x2	All belt driven configurations are overhead			
EMW 75 3x3				
EMW 100 4x3	444T-449T (280S-315L)	41 (1041)	69 (1753)	29 (737)
EMW 150 6x4	444T-449T (280S-315L)	46 (1168)	75 (1905)	29 (737)
EMW 200 8x6	444T-586T (280S-355L)	60 (1524)	84 (2134)	35 (889)
EMW 250 10x8	444T-589T (315S-400L)	73 (1854)	90 (2286)	44 (1118)
EMW 300 12x10	444T-589T (315S-400L)	80 (2032)	105 (2667)	55 (1397)
EMW 350 14x12	444T-589T (315S-400L)	83 (2108)	114 (2896)	70 (1778)

Direct drive configurations are also available, contact Wilfley for more information

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A9 Chemical Pump

Kpro® Slurry Pump

WILFLEY®

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pumps@wilfley.com • www.wilfley.com

EMW-TB-EN 1.3
Printed in USA • December 2015

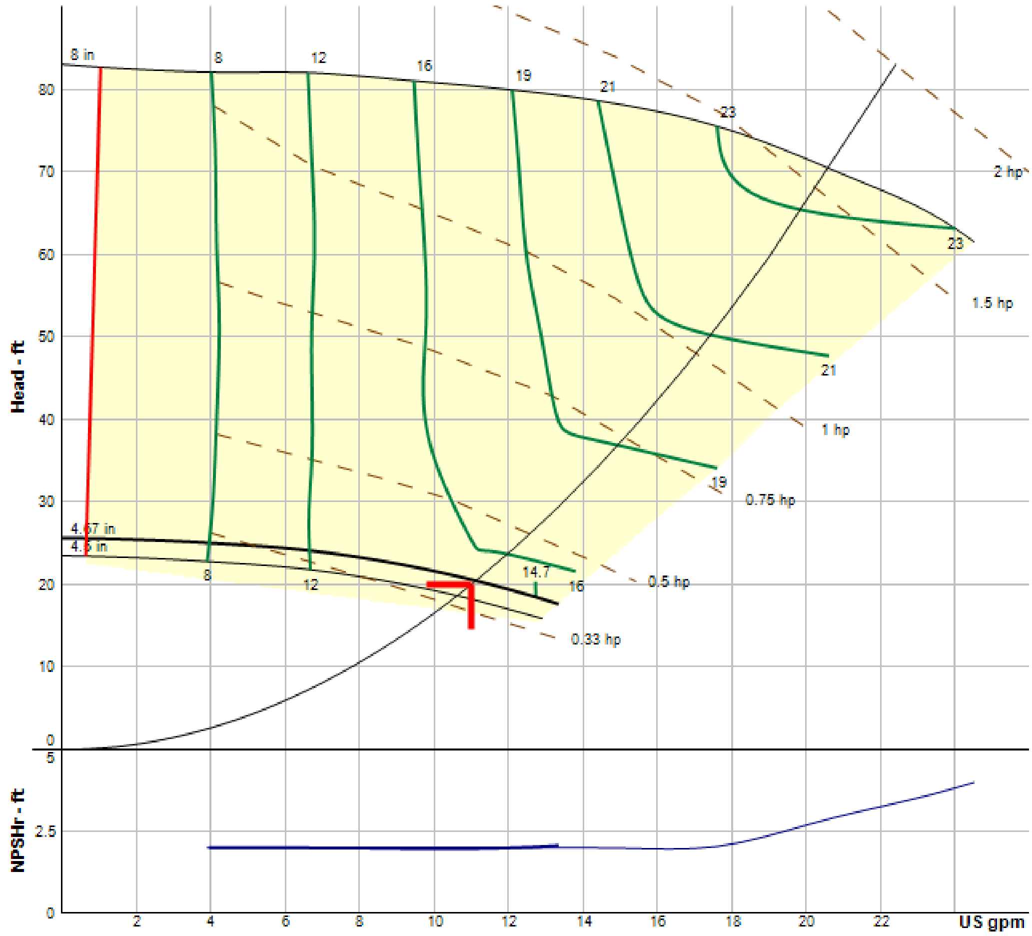
811LF-ANSI Series Performance Data

Model 1.5x1-8 AA

Project: Golder - Sludge and Water Pumps
Contact:
Company: Golder and Assoc.
City:
Region: Colorado
Country: UNITED STATES

Line Item Information
Date: May 31 2019
Quote # TBD
Tag: Filtrate
Quantity: 1

Submitted By: Mark Hibl
Company: Denver Industrial Pumps, Inc.
City: Golden
Region: Colorado UNITED STATES
Phone: 3032339255
eMail: markh@denverpumps.com



Pump Details	
Model	1.5x1-8 AA
Suction	1.5 in
Discharge	1 in
Speed	1800 RPM
Impeller Diameter	4.67 in
Ns	325
Nss	3625
Curve	GLF-1804

Fluid	
Liquid	*Filtrate
Viscosity	4.00
Specific Gravity	1
Temperature	70 °F
Vapor Pressure	

Rated Point	
Flow	11 gpm
Head	20.1 feet
Efficiency	14%
Power	0.385 HP
Speed	1750 RPM
NPSHr	2.02 feet

Design Curve	
Shutoff Head	25.6 feet
Min. Flow	0.636 gpm
BEP	14% at 12.7 gpm
NOL Power	0.405 HP at 13.3 gpm

Max Curve	
Max Power	1.66 HP at 24 gpm

Motor	
Power	0.5 HP
Speed	1800 RPM
Frame	56
Type	NEMA
Enclosure	TEFC
Sizing Criteria	Max power on design curve

Pump Selection Warnings

Pump Quote

Project: Golder - Sludge and Water Pumps

Quoted To:

Golder and Assoc.
Colorado
UNITED STATES

Quote Number:	**Your Ref Number:**
TBD	
Quote Date:	**Quote Expiration Date**
5/31/2019	6/30/2019
Rev Number:	**Currency:**
	USD ($)

Quoted By	**Contact**	**Email**
Denver Industrial Pumps, Inc. Golden Colorado UNITED STATES	Mark Hibl 3032339255	markh@denverpumps.com

Tag	Item/Description	Qty	UOM	Lead-Time (Working Days)	Weight	List Price
Filtrate	S/1.5x1-8L/DR1D/40467/TE/CSB_S 1AHCS11V01-A/X_BGRI-18378-139-14005PK/C/SC5_M9012022 <u>Pump Detail</u> S - Frame Size: Small 1.5x1-8L - Model: 1.5x1-8L (AA) D - Case/Stuffing Box Material: Ductile Iron R1 - Flange Option: 150 lb. Raised Face Flanges D - Special Taps: Drain & Discharge Nozzle Tap 4 - Impeller Material: CD4MCu (Duplex) 0467 - Impeller Trim(Inches): 4.67 T - Stuffing Box Type: Taper Bore E - Case Gasket Option: EPDM (Standard) C - Shaft Material: 4140 Steel (Standard) S - Sleeve Material: 316 Stainless Steel B - Lab Seal Material : Bronze 1AHCS11V01-A - Seal: X - Flush Plan: TBD C - Baseplate: BASE PLATE\`SM\`139\`140\`5.25\`CARBON STEEL C - Coupling Guard Material : Powder Coated Carbon Steel (Standard) SC5 - Coupling Type/Size : TB WOODS/SC5 M9012022 - Motor : MTR\`00118-1131-143T\`1HP\`1800RPM\`TEFC\`143T\`WEG NOTE: Ductile Iron and SS impellers, cases and stuff boxes may be upgraded to CD4MCuN at the discretion of Griswold Pump Company	1	EA			$6,630.00

Total: $6,630.00

Warranty Policy

Griswold Pump Company warrants that 811 pumps, accessories and parts manufactured by it to be free from defects in material and workmanship under normal use and service for a period of five (5) years from date of shipment.

Griswold Pump Company warrants that E, F, G and H Series pumps, accessories and parts manufactured by it to be free from defects in material and workmanship under normal use and service for a period of one(1) year from date of shipment.

Additional Notes:

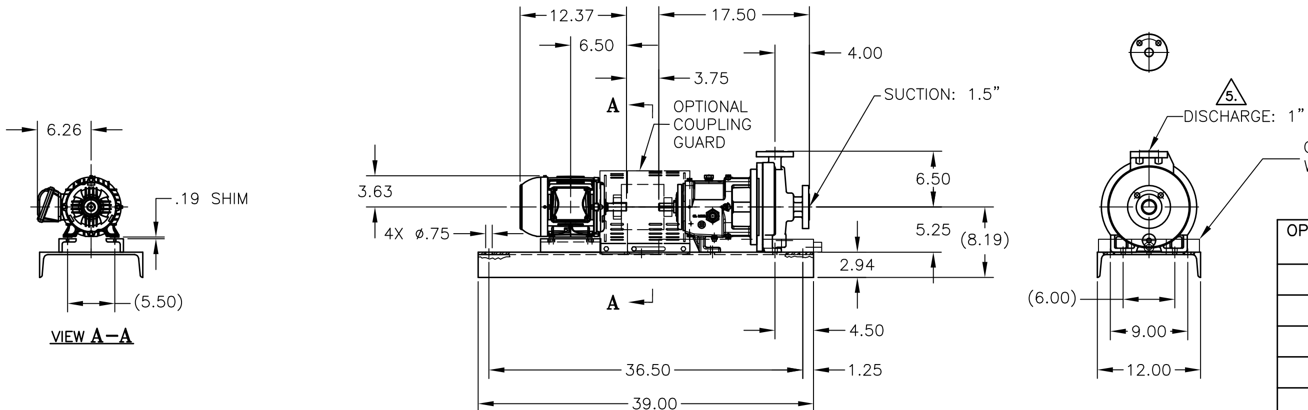
We attempt to ship our orders as prompt as possible. However, orders are only accepted on the express understanding that PSG will not be liable for any loss or damage resulting from any delay in shipment or delivery due to any cause whatsoever.

Price Sheet: Griswold ALL - January 2019

REV.	DESCRIPTION	BY	CHK.	APP.	DATE
A	RELEASED INTO PRODUCTION SEE ECN #G00994	–	–	–	–

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5M–1994.
2. * INDICATES DIMENSIONS AND/OR FEATURES MODIFIED ON CURRENT REVISION LEVEL.
3. DIMENSIONS REFLECT STANDARD MFG TOLERANCES.
4. WEIGHTS ARE APPROXIMATE AND MAY VARY BASED ON MANUFACTURER'S MATERIALS AND PUMP CONFIGURATION.
5. THIS PUMP MAY HAVE TAPPED HOLES IN THE DISCHARGE FLANGE PER ASME B73.1.



ITEM	DESC.	WEIGHT/LBS (4)
PUMP	1.5x1–8LF (AA)	119
MOTOR	143T	55
BASEPLATE	139	68
GUARD	COUPLING	8

FLANGE OPTION DIMENSIONS

OPTION ✓	NOMINAL PIPE SIZE	FLANGE DIAMETER	BOLT CIRCLE DIAMETER	NO. OF BOLTS	DIAMETER OF BOLTS	BOLT HOLE	FLANGE
	1" ASME 150# (SHOWN) (THD)						DISCHARGE
	1.00	4.25	3.12	4	0.50	.500–13 UNC–2B	
	1.5" ASME 150# (SHOWN)						SUCTION
	1.50	5.00	3.88	4	0.50	0.63	
	1" ASME 300# (THD)						DISCHARGE
	1.00	4.88	3.50	4	0.63	.625–11 UNC–2B	
	1.5" ASME 300#						SUCTION
	1.50	6.12	4.50	4	0.75	0.88	
	25 mm DIN PN16 (THD)						DISCHARGE
	25 mm	115 mm	85 mm	4	12 mm	M12 x 1.75–6H	
	40 mm DIN PN16						SUCTION
	40 mm	150 mm	110 mm	4	16 mm	19 mm	

CERTIFIED FOR CONSTRUCTION

ONLY WHEN SIGNED

Signature ____________ ______
Date

Customer ____________

Customer P.O. # ____________

OPTION ✓	AVAILABLE OPTIONS
	PUMP MATERIAL
	N6 DUCTILE IRON
	N6 DUCTILE IRON CASE / 91 SS IMPELLER
	91 STAINLESS STEEL
	20 HASTELLOY
	X4 CD4MCU SS
	OTHER
	BASEPLATE
	ASTM A36 STEEL
	STAINLESS STEEL
	COMPOSITE CONSTRUCTION
	DRIP PAN
	ASTM A36 STEEL
	STAINLESS STEEL
	COUPLING GUARD
	CARBON STEEL
	STAINLESS STEEL
	ALUMINUM
	FLANGE FACE
n/a	FLAT FACE
	RAISED FACE

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

DECIMALS .XX ± –
.XXX ± –
ANGLES ± –
SCALE – SHEET 1 OF 1

GRISWOLD PUMP COMPANY
22069 VAN BUREN STREET
GRAND TERRACE, CA 92313-5607
PHONE: (800) 843-9222 / (229) 226-5255
WWW.GRISWOLDPUMP.COM

TITLE: 1.5x1–8LF (AA) 139 BASE, 143T MTR, SM PF

DRAWN BY	Srikanth	DATE	11/03/16
CHECKED BY	R.Schwartz	DATE	12/09/16
APPROVED BY	R.Beach	DATE	12/09/16

ASSY. NO. _
DRAWING NO. LG0817 REV. A

REVISED 03–01–2012

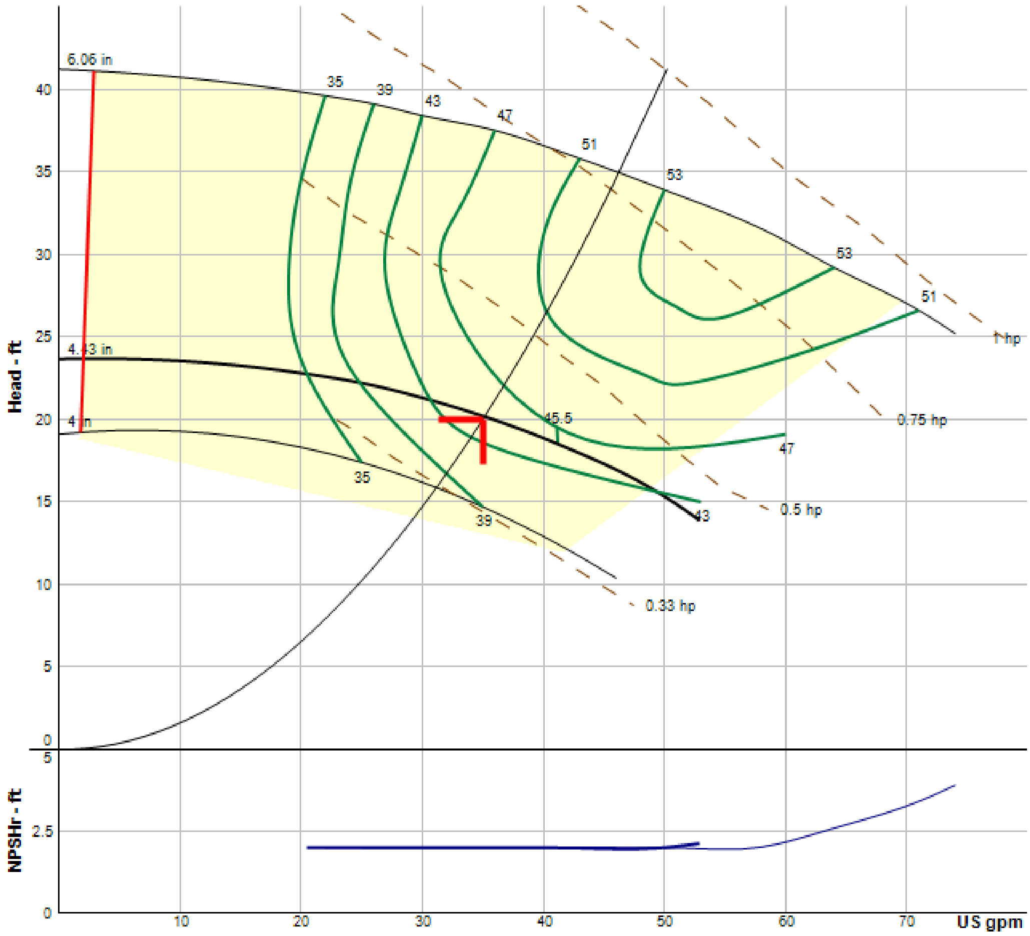
811-ANSI Series Performance Data

Model 1.5x1-6 AA

Project: Golder - Sludge and Water Pumps
Contact:
Company: Golder and Assoc.
City:
Region: Colorado
Country: UNITED STATES

Line Item Information
Date: May 31 2019
Quote # TBD
Tag: Process Water Return
Quantity: 1

Submitted By: Mark Hibl
Company: Denver Industrial Pumps, Inc.
City: Golden
Region: Colorado UNITED STATES
Phone: 3032339255
eMail: markh@denverpumps.com



Pump Details	
Model	1.5x1-6 AA
Suction	1.5 in
Discharge	1 in
Speed	1800 RPM
Impeller Diameter	4.43 in
Ns	950
Nss	8150
Curve	G-1801

Fluid	
Liquid	Process Water
Viscosity	1.00
Specific Gravity	1
Temperature	70 °F
Vapor Pressure	

Rated Point	
Flow	35 gpm
Head	20.1 feet
Efficiency	44%
Power	0.399 HP
Speed	1750 RPM
NPSHr	2 feet

Design Curve	
Shutoff Head	23.7 feet
Min. Flow	2.06 gpm
BEP	44% at 41.2 gpm
NOL Power	0.453 HP at 49.4 gpm

Max Curve	
Max Power	0.941 HP at 74 gpm

Motor	
Power	0.5 HP
Speed	1800 RPM
Frame	56
Type	NEMA
Enclosure	TEFC
Sizing Criteria	Max power on design curve

Pump Selection Warnings

Performance data and curves are based on test data, interpolations and accuracy of application input data.
As a result, actual performance may vary.

CAD generated and maintained drawing. All printed and electronic copies outside of Griswold's engineering database are **"Uncontrolled"** and shall be used for reference only.

REV.	DESCRIPTION	BY	CHK.	APP.	DATE
A	RELEASED INTO PRODUCTION SEE ECN #G00994	–	–	–	–

NOTES: UNLESS OTHERWISE SPECIFIED

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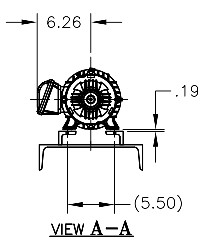
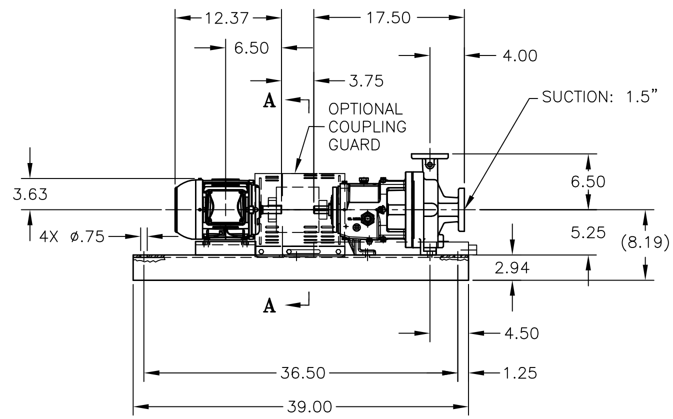
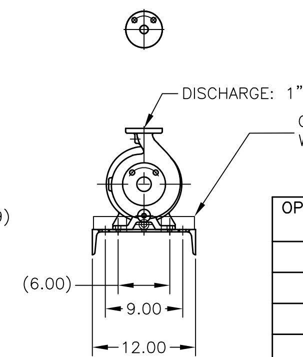






ITEM	DESC.	WEIGHT/LBS (4)
PUMP	1.5x1–6 (AA)	90
MOTOR	143T	55
BASEPLATE	139	68
GUARD	COUPLING	8

OPTION ✓	AVAILABLE OPTIONS
	PUMP MATERIAL
	N6 DUCTILE IRON
	N6 DUCTILE IRON CASE / 91 SS IMPELLER
	91 STAINLESS STEEL
	20 HASTELLOY
	X4 CD4MCU SS
	OTHER
	BASEPLATE
	ASTM A36 STEEL
	STAINLESS STEEL
	COMPOSITE CONSTRUCTION
	DRIP PAN
	ASTM A36 STEEL
	STAINLESS STEEL
	COUPLING GUARD
	CARBON STEEL
	STAINLESS STEEL
	ALUMINUM
	FLANGE FACE
	FLAT FACE
	RAISED FACE

FLANGE OPTION DIMENSIONS

OPTION ✓	NOMINAL PIPE SIZE	FLANGE DIAMETER	BOLT CIRCLE DIAMETER	NO. OF BOLTS	DIAMETER OF BOLTS	BOLT HOLE	FLANGE
	1" ASME 150# (SHOWN)						DISCHARGE
	1.00	4.25	3.12	4	0.50	0.63	
	1.5" ASME 150# (SHOWN)						SUCTION
	1.50	5.00	3.88	4	0.50	0.63	
	1" ASME 300#						DISCHARGE
	1.00	4.88	3.50	4	0.63	0.75	
	1.5" ASME 300#						SUCTION
	1.50	6.12	4.50	4	0.75	0.88	
	25 mm DIN PN16						DISCHARGE
	25 mm	115 mm	85 mm	4	12 mm	14 mm	
	40 mm DIN PN16						SUCTION
	40 mm	150 mm	110 mm	4	16 mm	19 mm	

CERTIFIED FOR CONSTRUCTION

ONLY WHEN SIGNED

Signature ______________ Date ______

Customer ______________

Customer P.O. # ______________

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

DECIMALS .XX ± –

.XXX ± –

ANGLES ± –

SCALE – SHEET 1 OF 1

GRISWOLD PUMP COMPANY
22069 VAN BUREN STREET
GRAND TERRACE, CA 92313-5607
PHONE: (800) 843-9222 / (229) 226-5255
WWW.GRISWOLDPUMP.COM

TITLE 1.5x1–6 (AA) 139 BASE, 143T MTR, SM PF

DRAWN BY	Srikanth	DATE	11/01/16
CHECKED BY	R.Schwartz	DATE	12/09/16
APPROVED BY	R.Beach	DATE	12/09/16

ASSY. NO. _

DRAWING NO. LG0800 REV. A

REVISED 03–01–2012

Pump Performance Datasheet

Customer	:	Quote number	: 742587
Customer reference	:	Size	: EMW-M 50 2x2-8.5 8.27E
Item number	: Golder - Sludge	Stages	: 1
Service	: Sludge Pump	Based on curve number	: 2x2-8.5-E VS (EMW-M) Rev 1-57
Quantity	: 1	Date last saved	: 31 May 2019 12:10 PM

Operating Conditions

Flow, rated	: 40.00 USgpm
Differential head / pressure, rated (requested)	: 30.00 ft
Differential head / pressure, rated (actual)	: 30.08 ft
Intake head / pressure, max	: 0.00 ft
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1140 rpm
Speed, maximum	: 3000 rpm
Speed, minimum	: 850 rpm
Impeller diameter, rated	: 8.66 in
Efficiency	: 28.93 %
NPSH required / margin required	: 1.10 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 21 / 62 Metric units
Minimum continuous stable flow	: 33.65 USgpm
Head maximum, rated speed	: 32.16 ft
Head rise to shutoff	: 6.94 %
Flow, best eff. point	: 111.8 USgpm
Flow ratio, rated / BEP	: 35.78 %
Speed ratio (rated / max)	: 38.00 %
Head ratio (rated speed / max speed)	: 13.84 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Customer Defined
Additional liquid description	: HDS Solids / Sludge
Solids diameter, max	: 0.00 in
Solids concentration, by weight	: 50.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.500 / 1.500 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

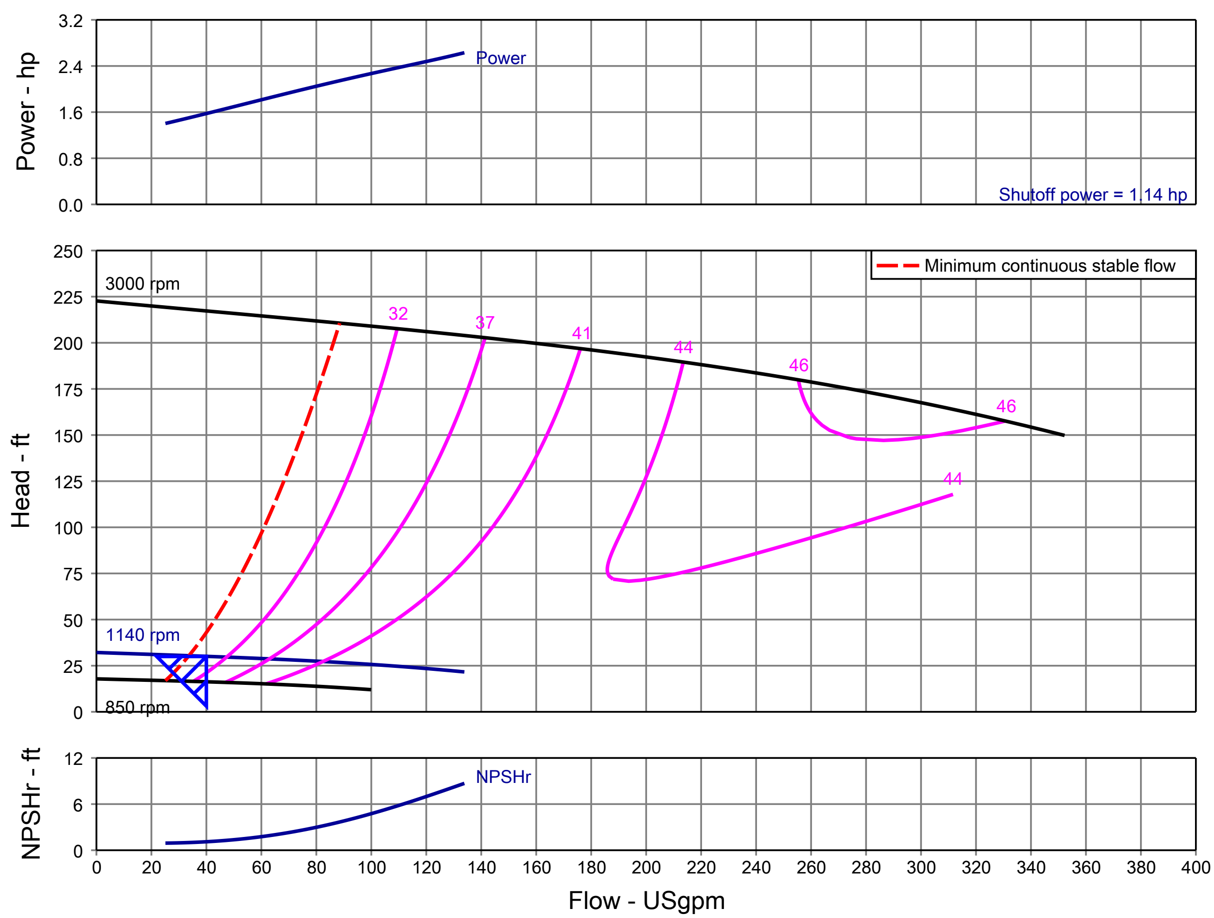
Material selected	: MAXALLOY® 5A

Pressure Data

Maximum working pressure	: 20.89 psi.g
Maximum allowable working pressure	: 230.0 psi.g
Max / min allowable suction head / pressure	: 10.72 / N/A ft
Hydrostatic test pressure	: 299.0 psi.g

Power Data

Power, rated	: 1.58 hp
Power, maximum, rated diameter	: 2.63 hp



Denver Industrial Pumps · 15165 W. 44th Avenue · Golden, CO 80403
phone: (303) 233-9255 · fax: (303) 233-9031 · www.denverpumps.com

Pump Performance - Additional Data

Customer	:	Quote number	: 742587
Customer reference	:	Size	: EMW-M 50 2x2-8.5 8.27E
Item number	: Golder - Sludge	Stages	: 1
Service	: Sludge Pump	Speed, rated	: 1140 rpm
Quantity	: 1	Intellicode	:
		Date last saved	: 31 May 2019 12:10 PM

Performance Data		Stage, Speed and Solids Limits	
Head, maximum speed, rated flow	: 217.3 ft	Stages, maximum	: 1
Head, minimum speed, rated flow	: 16.28 ft	Stages, minimum	: 1
Head maximum, rated speed	: 32.16 ft	Pump speed limit, maximum	: 3000 rpm
Efficiency adjustment factor, total	: 1.00	Pump speed limit, minimum	: 850 rpm
Power adjustment, total	: 0.00 hp	Curve speed limit, maximum	: 3000 rpm
Head adjustment factor, total	: 0.90	Curve speed limit, minimum	: 850 rpm
Flow adjustment factor, total	: 1.00	Variable speed limit, minimum	: -
Flow adjustment factor, efficiency only (shift BEP)	: 1.00	Solids diameter limit	: 0.71 in
Flow adjustment factor, end-of-curve only, total	: 1.00		
Minimum continuous stable flow adjustment factor	: 1.00		
Flow max adjustment factor	: 1.00		
NPSHr adjustment factor, total	: 1.00		
NPSHr slope correction factor	: 1.00		
User applied performance adjustment comments	:		
NPSH margin dictated by pump supplier	: 0.00 ft		
NPSH margin dictated by user	: 0.00 ft		
NPSH margin used (added to 'required' values)	: 0.00 ft		

Mechanical Limits	
Torque, rated power, rated speed	: 0.14 hp/100 rpm
Torque, maximum power, rated speed	: 0.23 hp/100 rpm
Torque, driver power, full load speed	: 0.09 hp/100 rpm
Torque, driver power, rated speed	: 0.26 hp/100 rpm
Torque, pump shaft limit	: 7.45 hp/100 rpm
Radial load, worst case	: -
Radial load limit	: -
Impeller peripheral speed, rated	: -
Impeller peripheral speed limit	: -

Various Performance Data	Flow (USgpm)	Head (ft)	Efficiency (%)	NPSHr (ft)	Power (hp)
Shutoff, rated diameter	0.00	32.16	-	-	1.14
Shutoff, maximum diameter	0.00	222.7	-	-	19.25
Minimum continuous stable flow	33.65	30.42	25.83	1.00	1.50
Rated flow, minimum diameter	40.00	16.28	34.26	-	0.72
Rated flow, maximum diameter	40.00	217.3	15.07	-	21.85
BEP flow, rated diameter	111.8	24.44	43.27	6.03	2.39
120% rated flow, rated diameter	48.00	29.62	32.25	1.30	1.67
End of curve, rated diameter	133.9	21.63	41.70	8.70	2.63
End of curve, minimum diameter	99.95	12.01	41.71	4.83	1.09
End of curve, maximum diameter	352.2	149.8	44.97	58.53	44.44
Maximum value, rated diameter	-	32.16	43.27	-	2.63
Maximum value, maximum diameter	-	-	46.63	-	44.44

System differential pressure	@ Density, rated	@ Density, max
Differential pressure, rated flow, rated diameter (psi)	19.53	19.53
Differential pressure, shutoff, rated diameter (psi)	20.89	20.89
Differential pressure, shutoff, maximum diameter (psi)	144.6	144.6

Discharge pressure	@ Suction pressure, rated	@ Suction pressure, max	@ Suction pressure, rated	@ Suction pressure, max
Discharge pressure, rated flow, rated diameter (psi.g)	19.53	19.53	19.53	19.53
Discharge pressure, shutoff, rated diameter (psi.g)	20.89	20.89	20.89	20.89
Discharge pressure, shutoff, maximum diameter (psi.g)	144.6	144.6	144.6	144.6

Ratios

Pump Performance - Additional Data

Maximum flow / rated flow, rated diameter	: 334.66 %	Head rated diameter / head minimum diameter, rated flow	: 184.70 %
Construction			
Seal Type	: SolidLock™ Static Seal		
Wilfley Slurry Corrections			
Percent Solids By Weight	: 20 to 50% Solids		

WILFLEY®

Wilfley Quotation System 19.1.4

Pump Performance Datasheet

Customer	:	Quote number	: 742587
Customer reference	:	Size	: EMW-M 75 3x3-10.5 8.19E
Item number	: Golder - Underflow	Stages	: 1
Service	: Underflow Pump	Based on curve number	: 3x3-10.5-E VS (EMW-M) Rev 1-57
Quantity	: 1	Date last saved	: 31 May 2019 2:45 PM

Operating Conditions

Flow, rated	: 215.0 USgpm
Differential head / pressure, rated (requested)	: 55.00 ft
Differential head / pressure, rated (actual)	: 55.27 ft
Intake head / pressure, max	: 0.00 ft
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1240 rpm
Speed, maximum	: 2800 rpm
Speed, minimum	: 715 rpm
Impeller diameter, rated	: 10.24 in
Efficiency	: 58.20 %
NPSH required / margin required	: 3.96 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 23 / 100 Metric units
Minimum continuous stable flow	: 88.64 USgpm
Head maximum, rated speed	: 60.24 ft
Head rise to shutoff	: 8.84 %
Flow, best eff. point	: 308.8 USgpm
Flow ratio, rated / BEP	: 69.63 %
Speed ratio (rated / max)	: 44.29 %
Head ratio (rated speed / max speed)	: 18.21 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Customer Defined
Additional liquid description	: HDS Solids / Sludge
Solids diameter, max	: 0.00 in
Solids concentration, by weight	: 25.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.200 / 1.200 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

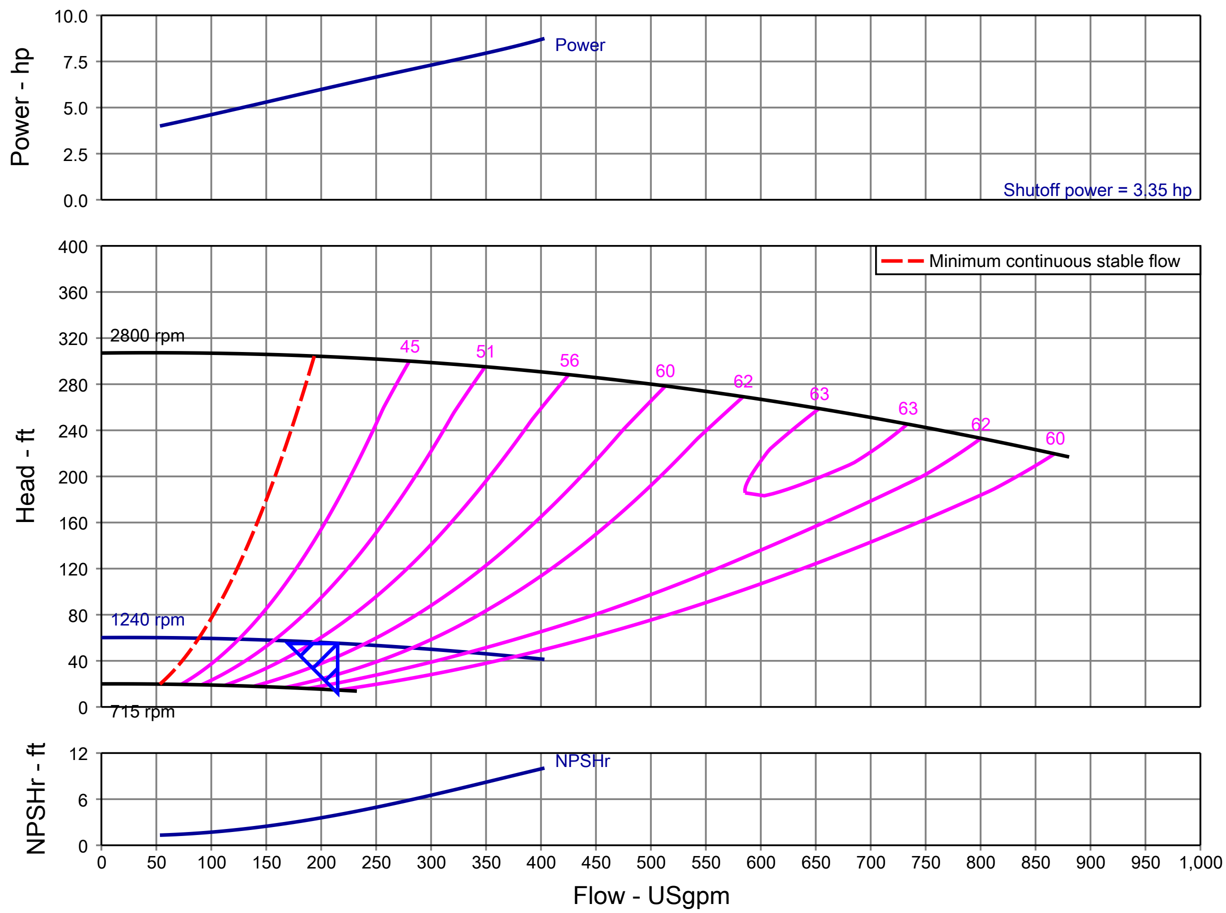
Material selected	: MAXALLOY® 5A

Pressure Data

Maximum working pressure	: 31.29 psi.g
Maximum allowable working pressure	: 230.0 psi.g
Max / min allowable suction head / pressure	: 1.31 / N/A ft
Hydrostatic test pressure	: 299.0 psi.g

Power Data

Power, rated	: 6.19 hp
Power, maximum, rated diameter	: 8.74 hp



Pump Performance - Additional Data

Customer	:	Quote number	: 742587
Customer reference	:	Size	: EMW-M 75 3x3-10.5 8.19E
Item number	: Golder - Underflow	Stages	: 1
Service	: Underflow Pump	Speed, rated	: 1240 rpm
Quantity	: 1	Intellicode	:
		Date last saved	: 31 May 2019 2:45 PM

Performance Data		Stage, Speed and Solids Limits	
Head, maximum speed, rated flow	: 303.5 ft	Stages, maximum	: 1
Head, minimum speed, rated flow	: 14.67 ft	Stages, minimum	: 1
Head maximum, rated speed	: 60.24 ft	Pump speed limit, maximum	: 2800 rpm
Efficiency adjustment factor, total	: 1.00	Pump speed limit, minimum	: 715 rpm
Power adjustment, total	: 0.00 hp	Curve speed limit, maximum	: 2800 rpm
Head adjustment factor, total	: 1.00	Curve speed limit, minimum	: 715 rpm
Flow adjustment factor, total	: 1.00	Variable speed limit, minimum	: -
Flow adjustment factor, efficiency only (shift BEP)	: 1.00	Solids diameter limit	: 0.79 in
Flow adjustment factor, end-of-curve only, total	: 1.00		
Minimum continuous stable flow adjustment factor	: 1.00		
Flow max adjustment factor	: 1.00		
NPSHr adjustment factor, total	: 1.00		
NPSHr slope correction factor	: 1.00		
User applied performance adjustment comments	:		
NPSH margin dictated by pump supplier	: 0.00 ft		
NPSH margin dictated by user	: 0.00 ft		
NPSH margin used (added to 'required' values)	: 0.00 ft		

Mechanical Limits	
Torque, rated power, rated speed	: 0.50 hp/100 rpm
Torque, maximum power, rated speed	: 0.71 hp/100 rpm
Torque, driver power, full load speed	: 0.28 hp/100 rpm
Torque, driver power, rated speed	: 0.81 hp/100 rpm
Torque, pump shaft limit	: 9.80 hp/100 rpm
Radial load, worst case	: -
Radial load limit	: -
Impeller peripheral speed, rated	: -
Impeller peripheral speed limit	: -

Various Performance Data	Flow (USgpm)	Head (ft)	Efficiency (%)	NPSHr (ft)	Power (hp)
Shutoff, rated diameter	0.00	60.16	-	-	3.35
Shutoff, maximum diameter	0.00	307.0	-	-	39.05
Minimum continuous stable flow	88.64	59.65	35.91	1.58	4.46
Rated flow, minimum diameter	215.0	14.67	60.05	-	1.59
Rated flow, maximum diameter	215.0	303.5	37.80	-	52.32
BEP flow, rated diameter	308.8	49.38	62.31	6.80	7.41
120% rated flow, rated diameter	258.0	52.84	61.12	5.18	6.76
End of curve, rated diameter	403.2	41.28	57.68	10.05	8.74
End of curve, minimum diameter	232.5	13.73	57.44	3.35	1.68
End of curve, maximum diameter	880.6	216.9	59.48	48.86	97.30
Maximum value, rated diameter	-	60.24	62.31	-	8.74
Maximum value, maximum diameter	-	-	63.16	-	97.30

System differential pressure	@ Density, rated	@ Density, max
Differential pressure, rated flow, rated diameter (psi)	28.71	28.71
Differential pressure, shutoff, rated diameter (psi)	31.25	31.25
Differential pressure, shutoff, maximum diameter (psi)	159.5	159.5

Discharge pressure	@ Suction pressure, rated	@ Suction pressure, max	@ Suction pressure, rated	@ Suction pressure, max
Discharge pressure, rated flow, rated diameter (psi.g)	28.71	28.71	28.71	28.71
Discharge pressure, shutoff, rated diameter (psi.g)	31.25	31.25	31.25	31.25
Discharge pressure, shutoff, maximum diameter (psi.g)	159.5	159.5	159.5	159.5

Ratios

Pump Performance - Additional Data

Maximum flow / rated flow, rated diameter	: 187.52 %	Head rated diameter / head minimum diameter, rated flow	: 376.88 %

Construction

Seal Type	: SolidLock™ Static Seal	

Wilfley Slurry Corrections

Percent Solids By Weight	: Up to 10% Solids	

Proposal

Date of Proposal: 6/7/2019

Proposal #: VR19-1975

Revision:

Proposal For:
Elizabeth Travis
Golder
Elizabeth_Travis@golder.com
303-980-0540

Project: New Mexico HDS Polymer System

Equipment: VeloBlend Liquid Polymer Activation System

VeloDyne Contact Information:

Sales Manager: Vincent Rada
VeloDyne
Louisville, CO 80027
Phone: (303) 530-3298 (238)
vrada@velodynesystems.com

PROPOSED SCOPE OF SUPPLY

Bid Type: Budget.

VeloDyne is pleased to offer the following proposal for the liquid polymer blending equipment, including options and accessories as indicated below.

QTY. **DESCRIPTION**

1 **VeloBlend Model VM-1P-120-D-O-A-1 Liquid Polymer Blending System**

Polymer Flow Range: 0.05 to 1.0 GPH
Dilution Water Flow: 0.2 to 2.0 GPM

Each unit shall include the following unless otherwise indicated:

1 Polymer Mixing Chamber:

A. Series: VeloBlend VM
B. Type: Staged Hydro-Mechanical
C. Mixer Motor: ½ HP, 90 VDC, 1750 RPM, wash-down duty
D. Mixer Shaft Seal: Mechanical with seal flushing assembly
E. VeloCheck™ Neat Polymer Check Valve with Quick Release Pin
F. Construction:
   1. Body: Stainless steel
   2. Impeller: Stainless steel
   3. Mechanical Seal: Ceramic, Carbon, Stainless steel, Viton
   4. Cover: Clear polycarbonate with stainless steel reinforced flange & discharge
G. Pressure Rating: 100 psi
H. Pressure Relief Valve: Brass

1 Neat Polymer Metering Pump Assembly:

A. PVC FNPT union style polymer inlet
B. Type: Progressive Cavity type
C. Motor: ½ HP, 1750 RPM, 90 VDC, Wash-down duty motor with gear reducer
D. Loss of polymer flow sensor
E. Metering pump calibration assembly with isolation valves: 100 ml (1.5 GPH)
F. Plumbing: SCH. 80 PVC

1 Dilution Water Inlet Assembly shall be provided, including the following:

A. Stainless steel FNPT water inlet connection
B. Dilution water ON/OFF solenoid valve
C. Control Valve: Manual rate control valve
D. Primary dilution water flow meter type: Rotameter
E. Low differential pressure alarm switch
F. 0-160 psi inlet water pressure gauge (stainless steel, liquid filled)
G. Plumbing – SCH. 80 PVC

1 Solution Discharge Assembly:

A. Stainless steel FNPT solution discharge connection
B. 0-160 psi solution discharge pressure gauge (stainless steel, liquid filled)
C. Plumbing – SCH. 80 PVC

1 Control Panel:

(Discrete Control Panel)

A. Enclosure: NEMA 4X (FRP)
B. Power:
    1. Required: 120 VAC, 60 Hz., 1 Ph
    2. Disconnect: 10' power cord with 120 VAC plug
C. Motor controllers:
    1. Mixing Chamber
    2. Neat polymer metering pump
D. Miscellaneous:
    1. Control circuit protection
    2. Control relays
    3. Power supplies
    4. Grounding blocks
    5. Numbers terminal blocks
    6. Wire labels, shrink-tube type
E. Certification: uL 508A

(Series D)

F. Operator Interface – Discrete Selector Switch
    1. System ON / OFF(reset) / REMOTE
    2. Ten-Turn Potentiometer – Metering Pump Control
    3. One-Turn Potentiometer – Mixer Speed Control
G. Status / Alarm Indicators:
    1. System Running Indication
    2. Main Power ON Indication
    3. LED Display Metering Pump Rate
    4. Low Water Differential Pressure Alarm
    5. Low Polymer Flow Alarm
H. Inputs (signals by others):
    1. Remote Start / Stop (discrete dry contact)
    2. Pacing Signal Based on Process Flow (4-20mA)
I. Outputs:
    1. System Running (discrete dry contact)
    2. System Remote Mode (discrete dry contact)
    3. Common Alarm (discrete dry contact)

1 System Skid:

A. Frame: 304 stainless steel, open frame design for access to all components
B. Fasteners: 304 SS
C. Designed for bolt-down

1 Accessories (NONE PROVIDED PLEASE REQUEST):

A. (0) Drum Suction Pipe
B. (0) Drum Dollie
C. (0) Drum Cart / Dispenser
D. (0) Drum Level sensor
E. (0) Drum Desiccant / Drier
F. (0) Drum Mixer
G. (0) Drum / Tote Suction Valve & Quick Disconnect Assembly
H. (0) Tote Mixer
I. (0) Tote Truck / Tilt
J. (0) Tote Level sensor
K. (0) Tote Rack
L. (0) Set Spare Parts - Progressive Cavity Pump: One (1) Rotor, One (1) Stator, One (1) set packing

1 Engineering & Documentation:

A. Submittals for approval (electronic version in PDF & hard copies, if applicable)
   1. Detailed scope of supply
   2. Mechanical drawings (solids models in shaded isometric and wire orthogonal views)
   3. Mechanical component data sheets annotated for specific models, features, etc.
   4. Pump performance curves
   5. Electrical schematics with interconnecting layout
   6. Process & Instrumentation Drawings
   7. Process description
   8. Electrical component data sheets annotated for specific models, features, etc.

B. O&M Manuals for approval (electronic version in PDF & hard copies)

1 Start-Up / Field Services:

A. Factory Start-Up & Field Services:
   1. Number of Trips:1
   2. Number of Days (total on site):1

Note: a minimum of four (4) weeks' notice required for domestic orders prior to factory services being scheduled

Clarifications:

1. This proposal shall become part of the final purchase order documents.
2. Any equipment or appurtenances not specifically listed in the scope of supply shall be provided by others.
3. VeloDyne has proposed its standard equipment as detailed above, modified only to the extent to meet the intent of the project requirements.
4. Where there are contradictions between project specifications and drawings or omissions, VeloDyne is providing our best interpretation of the intent of the design as detailed in our scope of supply.
5. Unless otherwise indicated above, standard submittals and O&M manuals are included herein.
6. This proposal is based on equipment delivery within one year of date of customer's purchase order.
7. Unless otherwise indicated above, the following are not included in this proposal: Installation. Chemicals. Interconnecting wiring, conduit, piping and valves. Anchor bolts. Field Painting. Taxes. Tariffs. Duties. Bonds.

Commercial Terms Summary (see complete terms & conditions attached):

1. Price Valid For 90 Days
2. Payment Terms: Net 30
3. Freight: FOB factory, full freight allowed
4. *Submittals: 4-6 weeks after acceptance of order
5. *Shipment: 4-6 weeks after acceptance of order or customer's written approval and release for production

** Note: lead times are estimates based on the current engineering and production work load at the time of bid. Actual lead times may vary based on the workloads at the time of order and release for production – consult factory at time for order and release for production to confirm lead times.*

Total Price Including Field Services & Freight: $18,525

VELODYNE STANDARD TERMS & CONDITIONS OF SALE

All orders placed with Velocity Dynamics, LLC. d/b/a VeloDyne (the "Company" or "Seller"), if accepted, shall be accepted subject to VeloDyne Standard Terms and Conditions of Sale ("Terms and Conditions") as set forth below and incorporated by reference into the Purchase Contract:

1. **CONTRACT; OFFER AND ACCEPTANCE**. These Terms and Conditions, together with the product descriptions, prices and other terms appearing on the face hereof or in a separate document submitted to you, (collectively, "our Quotation"), as such may result in a final Purchase Contract between us (all such documents collectively referred to as the "Contract"), shall constitute the only terms and conditions of our offer. If our Quotation is submitted in response to an offer made by you, whether your offer is in the form of a request for proposal or otherwise, our Quotation is expressly conditioned on your acceptance of these Terms and Conditions, which are incorporated into any offer, acceptance, response, acknowledgment, invoice, amendment and/or any other document issued by you or the Company in connection with your Order (the "Contract" or "Contract Documents"), and any reference thereto shall include these Terms and Conditions. No waiver, alteration, or modification of these Terms and Conditions shall be valid unless expressly agreed to in writing by the Company. In any event, we object to all additional or conflicting terms and conditions that may appear in your order or other form of acceptance you may submit to us in response to our Quotation. The Company shall supply to Purchaser the equipment and parts (the "Products") in accordance with the design, manufacturing and performance specifications set forth in the Company's Quote and incorporated in the Purchase Contract (including these Terms and Conditions). No representation, promise or warranty of any kind has been made by us except as set forth in the Contract, which conclusively supersedes all prior writings, representations and negotiations with respect thereto. The Company has no obligation to furnish other equipment, materials or services that may be shown in any plans and/or specifications except for those goods actually ordered by you for a project to which the goods ordered herein pertain.

2. **PRICES**. Unless otherwise noted in the Contract, prices are net Ex-Works our facility and firm for 30 days. **Prices do not include**: freight; permitting, licensing and/or export fees; labor charges; storage fees; or taxes. If you require the Company's assistance for installation or set-up, we will invoice you at standard rates (please contact us for current pricing). Regarding taxes as set forth below, you will either (i) pay to the appropriate authority all applicable taxes and other government charges upon the production, sale, shipment or use of the goods and provide us with proof of payment; or (ii) provide us with a tax exemption certificate from the appropriate taxing authorities. You agree to provide us with written proof of payment of taxes (or exemption therefrom) within ninety (90) calendar days of your receipt of the goods. Time is of the essence.

3. **CREDIT AND PAYMENT**. Unless otherwise stated in the Contract, payment terms are net 30 days from the date of our invoice(s). Any payment outstanding beyond sixty (60) calendar days from the date of any Company invoice shall be subject to a late payment charge on the overdue balance in the amount of 1.5% per month calculated on the outstanding payment amount (or such lesser amount as is the maximum rate of interest allowed by law). Purchaser shall be responsible for all reasonable costs (including attorney's fees) incurred by the Company while collecting any delinquent balance. For international shipments, payment terms are cash only (unless otherwise approved in writing by us). The Company may decline to deliver except for cash, or stop goods in transit, should we develop any reasonable doubt as to Purchaser's financial responsibility. Pro-rata payments shall become due with partial shipments. If Purchaser is responsible for any delay in shipment: (a) the Company may treat the date of completion of goods as the date of shipment for purposes of invoice and payment, (b) completed goods shall be held at Purchaser's cost and risk; and (c) Purchaser shall be responsible for reasonable storage and insurance expenses, with storage fees accruing at a rate of two percent (2%) of the Purchase Price per month or $500 per month, whichever is greater, beginning on the first day of the first calendar month following the date the equipment was scheduled to ship. If retainages are accepted by the Company, the retainage shall be based on an agreed upon percentage of the total invoice amount. Unless otherwise agreed in writing, (a) retainage will not be held for more than 180 calendar days from the date of shipment and (b) no retainage will be imposed for approval of shop drawings, O&M manuals or any other documentation.

4. **DELIVERY AND ACCEPTANCE OF PRODUCTS; TRANSFER OF TITLE.**

(A) **Products to be Used in the United States.** Seller will deliver Products manufactured and to be used by Purchaser in the United States Ex-Works at our facility ("Shipping Point") Incoterms 2010, or in such other manner as may be mutually agreed to by us and set forth in separate Shipping Terms under the Contract. On all shipments marked "Ex-Works (or EXW) Shipping Point," the Company shall make the Products available to Purchaser at the Company's facility, which shall constitute delivery, and Purchaser shall bear all costs and risks of moving the Products from our facility to Purchaser's destination. Any claim for loss or damages in transit must be entered with the freight carrier and prosecuted by you.

(B) **Products to be Used Outside of the United States.** Seller will deliver all Products to be used by Purchaser outside of the United States "FAS (Free Alongside Ship) Named Port of Shipment" ("Shipping Point") Incoterms 2010, which means the Company will deliver the Products to the designated port, origin point or designated freight forwarder, with Purchaser bearing all costs and risk of loss or damage from the origin point to Purchaser's destination point outside of the United States. Purchaser shall be responsible for payment of all sales and use taxes, or to recover such taxes through appropriate procedures and documentation under applicable law.

(C) **Shipping**. Goods will be boxed or crated as Seller may deem proper for protection against normal handling, and extra charge will be made for preservation, waterproofing or similar added protection of goods. Routing and manner of shipment will be at Seller's discretion, and may be insured at Purchaser's expense, value to be stated at order price.

(D) **Delivery, Shipment & Installation Dates**. Delivery, shipment and installation dates are estimates only, not guarantees, and unless otherwise specified, are calculated from the date of Seller's receipt of complete technical data and approved drawings as such may be necessary to fulfill the Contract. In estimating such dates, no allowance has been made, nor shall we be liable directly or indirectly, for delays of third-party vendors, carriers or delays from labor difficulties, shortages, strikes or stoppages of any sort, fires, accidents, failure or delay in obtaining materials or manufacturing facilities, acts of government affecting us directly or indirectly, bad weather, or any cause beyond our control or causes designated as Acts of God or forced by any court of law, and the estimated delivery date shall be extended accordingly without penalty to the Company. We will not be liable for any damages or penalties whatsoever, whether direct, indirect, special or consequential, liquidated or otherwise, resulting from our failure to perform or delay in performing. Overtime and other expenses incurred to hasten delivery at Purchaser's request shall be added to the quoted prices and charged to and paid for by Purchaser. Shipment of goods ready for delivery can be deferred beyond the date for delivery on with Seller's written consent.

(E) **Delivery Terms**. Seller's obligation to deliver the goods shall be fulfilled when we have delivered the same in good condition to a carrier at the designated Shipping Point. Unless otherwise specified in the Contract, Purchaser shall be charged with and pay for the costs of all transportation, freight, insurance, loading, packaging and handling charges, taxes, duties, fees, storage, and all other charges applicable to the goods. Purchaser shall not be responsible for any taxes based on Seller's income.

(F) **Title / Security**. Title to the goods shall be retained by Seller as a vendor's lien until such goods are paid for in full by the Purchaser, even though risk of loss shall be borne by Purchaser as set forth in paragraphs 4(A) and (B) respectively. Purchaser herby grants to Seller, and Seller hereby reserves, a purchase money security interest in and to the goods sold to Purchaser, together with all proceeds thereof, to secure Purchaser's payment and performance. Purchaser agrees upon Seller's request to do all acts and execute all documents reasonably necessary to assist Purchaser's perfection and maintenance of any such security title and right of possession including, but not limited to, executing and filing documents with the appropriate governmental agency.

(G) **Cancellation and Returned Equipment**. Orders may be canceled or amended only with our written consent, and must be returned within 30 days of Seller's written authorization at Purchaser's cost. If Purchaser returns the goods in the manner required under the previous sentence, and if the returned goods are (i) in substantially the same condition that existed on the date the Seller delivered the Products to you, undamaged; and (ii) not more than 12 months after the original Invoice date; the returned goods will, subject to the applicable handling charge, be accepted by the Seller for return. Used or discontinued goods or parts or equipment specially manufactured will not be accepted for credit unless specifically agreed to by the Seller in our sole discretion. Purchaser's sole remedy for returns will be a credit for the purchase price less any handling charges. Returned goods are subject to a minimum of 20% restocking and handling charge. Returns found to be free of material and workmanship defects will be held for 30 days and if Purchaser does not provide the Seller with repair or return instructions, then we will scrap or resell the goods. Purchaser will be charged for placing returned goods in saleable condition, any sales expenses then incurred by us, plus a restocking charge and any out-going and in-coming transportation costs which the Company pays.

(H) **Acceptance by Purchaser**. Purchaser shall conduct any incoming inspection tests on delivered Products within 10 days of delivery, and if delivery is made in multiple shipments, then Purchaser shall conduct incoming inspections of Products within 10 days of receipt of each delivery. In the event of a shortage, damage or discrepancy in any shipment, Purchaser shall promptly give notice to Seller in writing (at such address designated by Seller for such purpose) but in no event later than 30 days of the subject delivery, detailing the exact nature of the shortage, damage or discrepancy and provide such supporting documentation as Seller shall deem necessary and appropriate (i.e., photos, insurance reports, etc.). If such evidence indicates, in Seller's reasonable judgment, that such shortage, damage or discrepancy existed at the time of delivery of the goods to the carrier, Seller will promptly deliver additional or substitute goods to Purchaser; provided, however, that Seller may, in its sole and absolute discretion, require Purchaser to return all damaged goods to the Company prior to delivery of substitute goods. If Purchaser shall fail to timely give Seller such written notice, the goods shall be deemed to conform to the requirements of the Contract, and Purchaser shall be deemed to have accepted the goods and shall pay for the goods in accordance therewith.

(I) **Purchaser's Specifications**. Purchaser shall be solely responsible for ensuring that all specifications, drawings, information, advice, recommendations or requests provided to the Company by Purchaser or any of its agents are accurate and suitable for Purchaser's purposes. The Company's examination or consideration of any such specifications, drawings, information, advice, recommendations or requests shall not result in any liability on the part of the Company.

5. **<u>TERMINATION</u>.** The Company shall have the right to cancel for default hereunder all or any part of Purchaser's Order. This right of cancellation is in addition to and not in lieu of any other remedies that the Company may have in law or equity.

6. **<u>TAXES & IMPORT- EXPORT CHARGES</u>.**

(A) **Purchaser's Responsibility for Taxes, Reports and Withholding.** Seller shall be responsible for reporting and paying all state and federal income taxes associated with sales of equipment and products to Purchaser under this Contract. However, Purchaser shall be responsible for all liabilities or claims for taxes that any taxing authority having jurisdiction over this Contract may assess or levy relating to the Products or this Contract. Purchaser shall comply with all applicable tax requirements, file all registrations (including all Transaction and Sales Tax registrations) and reports, and take all actions necessary to make its tax payments (or secure exemptions from or reductions in payments of same). Within 90 days from the date of any payment by Purchaser under Seller's Invoice, Purchaser shall provide Seller with tax receipts (or other proof of payment or written evidence of tax exemption) for all taxes to be paid by Purchaser under this Contract.

(B) **Import and Export Charges.** Purchaser shall be solely responsible for all import and export charges, licenses, permits ad any other lawfully payable charge related to the import or export of Products under this Contract.

(C) **Export Controls & Related Regulations.** Purchaser represents and warrants that it is not designated on, or associated with, any party designated on any of the U.S. government restricted parties lists, including without limitation, the U.S. Commerce Department Bureau of Industry and Security ("BIS") Denied Persons List; Entity List or Unverified List; the U.S. Treasury Department Office of Foreign Assets Control ("OFAC") Specially Designated Nationals and Blocked Persons List; or the U.S. State Department Directorate of Defense Trade Controls ("DDTC") Debarred Parties List. Purchaser shall comply with all applicable U.S. economic sanctions and export control laws and regulations, including without limitation, the regulations administered by the OFAC, the Export Administration Regulations administered by BIS, and the International Traffic in Arms Regulations administered by DDTC. Seller may terminate this Contract and discontinue any ongoing supply to or business with Purchaser immediately, without notice and without liability, upon Seller becoming aware that Purchaser is named on any restricted party list.

7. **<u>WARRANTY; LIMITED REMEDIES</u>.**

(A) **Seller Warranties.** Seller shall provide the standard warranties provided in the form Warranty Agreement (a copy of which is attached and incorporated by reference into our Contract).

(B) **Assignment.** Seller assigns to Purchaser all warranties given by manufacturers and vendors of Seller as such relate to the Products (equipment or components). These warranties are not exclusive.

(C) **Limitation on Damages**. Other than as set forth in Paragraph 9 (Purchaser Indemnification) and any breaches of Paragraph 11 below (Confidentiality), each party's cumulative liability for damages to the other party for any cause whatsoever, and regardless of the form of action, whether in contract or in tort, including but not limited to, negligence, shall be limited to the total Contract price of the goods sold hereunder, plus or minus, as applicable, the amounts of all unpaid accounts payable and receivable between the parties. In no event shall Seller's liability exceed the limits of the Company's insurance coverage.

8. **<u>SOLE REMEDY</u>.** The sole and exclusive remedy for breach of any non-warranty obligation of the Company and the sole remedy for the Company's liability of any kind (including negligence) with respect to the goods and services provided to Purchaser shall be to use all commercially reasonable efforts to promptly cure such breach. Purchaser must prosecute any claim for a cause of action arising hereunder with one year from the date on which the facts that gave rise to the cause of action first occurred subject to the terms set forth in Section 14 (Governing Law and Resolution of Disputes).

9. **<u>INDEMNIFICATION</u>.** Purchaser shall hold harmless, indemnify and defend the Company (at the Company's request) for any and all damages, liabilities, costs and expenses (including the costs of any dispute resolution, including but not limited to, attorneys' fees and any other costs and expenses), fines, or losses in connection with any threatened or actual claims, actions, demands, investigations, suits, including but not limited to, claims or suits by third parties, arising out

of any of the following: (a) Purchaser's negligent or willful acts, or those of its employees and/or agents, (b) such goods being repaired or altered by persons other than Seller (unless expressly authorized in writing by the Seller), (c) any claim of patent infringement arising out of the manufacture by Seller of goods created in accordance with a design or specifications furnished to Seller by Purchaser, (d) in the event that Purchaser modifies, or combines with any non-Seller goods, any of the goods purchased from Seller, and such modification or combination results in the actual or alleged infringement of any intellectual property rights of any third party, (e) from goods produced by Seller according to Purchaser's specifications, (f) any violations of export control laws by Purchaser, (g) any violations of state or federal tax laws by Purchaser, or (h) Purchaser's breach of any provisions of these Terms and Conditions.

10. **<u>SELLER'S INTELLECTUAL PROPERTY INDEMNIFICATION</u>.** Seller will defend, indemnify and hold harmless Purchaser from and against any and all loss, damage, cost or expense arising as a result of any claim that the goods sold hereunder infringe any third party U.S. patent, copyright, trademark, trade secret or intellectual property right. Otherwise, Seller will not be liable for any claim of infringement. If you notify us promptly of any such claim of infringement and, if we so request, authorize us to defend or settle any suit or controversy involving such claim, we will indemnify you against the reasonable expenses of any such suit and will satisfy any judgment or settlement in which we acquiesce, but only to an amount not exceeding the price paid for the allegedly infringing goods. If an injunction is issued against the further use of allegedly infringing goods, the Company shall have the option of procuring for you the right to use the goods, or replacing them with non-infringing goods, or modifying them so that they become non-infringing or of removing them and refunding the purchase price. The foregoing states the Company's entire and exclusive liability with respect to a claim of infringement, and we will not be liable for any damages whatsoever suffered by reason of any infringement claimed, except as provided herein.

11.**<u>CONFIDENTIALITY</u>.**"Confidential Information" means any of the Company's business information, specifications and all related writings, drawings, designs, software applications and similar works or any other information disclosed by the Company that are disclosed as "Confidential" or proprietary. All Confidential Information shall be the exclusive property of the Company and we retain all right, title and interest in and to the same. Purchaser agrees to use Confidential Information for the exclusive purpose of performance under the Contract and not to disclose or provide any Confidential Information to any third party and to take all necessary measures to prevent any such disclosure by its employees, agents, contractors or consultants. Upon request of the Company or completion of the Contract, Purchaser shall return all Confidential Information to the Company and provide certification of such return.

12. **<u>TOOLING; SPECIAL JIGS, FIXTURES & PATTERNS</u>**. Charges made for tools, jigs, fixtures, patterns and equipment made or acquired by the Company in connection with your Order and utilized in manufacturing will be considered the exclusive property of the Company, without credit to Purchaser.

13. **<u>INSPECTION, RECORDS, AUDITS & PROPRIETARY DATA.</u>** Inspection of goods in our facility by Purchaser and/or its representative will be permitted, provided that (a) Purchaser gives reasonable written notice of its desire to inspect the goods, and (b) the inspection does not unduly interfere with the Company's production work flow. Neither Purchaser nor any of Purchaser's representatives shall have any right to examine or audit the Company's cost accounts, books or records of any kind, or be entitled to, or have control over, any engineering or production prints, drawings or technical data which the Company, in our sole discretion, may consider in whole or in part to be proprietary to our business.

14. **<u>GOVERNING LAW & DISPUTE RESOLUTION</u>.**

(A) **Governing Law.** The Contract and these Terms and Conditions are governed by and interpreted under the laws of the State of Colorado, without regard to its choice of law rules unless the matters in dispute come within the scope of Article 2 of the Uniform Commercial Code (UCC-Sales) prepared under the joint sponsorship of The American Law Institute and the National Conference of Commissioners on Uniform State Laws, in which event the dispute shall be governed by and interpreted under the referenced Code in effect on the date of this Contract.

(B) **Dispute Resolution.** Except for any action where the sole relief sought is an injunction, any controversy or claim arising out of or relating to the Contract and these Terms and Conditions, or the making, performance or interpretation hereof, and the dispute cannot be settled by direct negotiations, either Party may initiate mediation. If the parties fail to settle the dispute within 30 days of notice of mediation, either party may initiate binding arbitration under this paragraph. The place of arbitration shall be in the Boulder-Denver Metro-Area of Colorado, and shall be conducted by one arbitrator in accordance with the Commercial Arbitration Rules of the American Arbitration Association. Judgment upon any binding arbitration award may be entered in any court having jurisdiction thereof.

15. **<u>GENERAL PROVISIONS.</u>**

(A) **Prior Agreements.** This Contract comprises the complete and exclusive agreement between the parties regarding the subject matter of this Contract, and supersedes all oral and written communications, negotiations, representations or agreements made or entered into before the Effective Date.

(B) **Amendments.** No amendment to this Contract is effective unless made in writing and signed by authorized representatives of Purchaser and Seller. Specifications, drawings, price lists and documents of a technical nature prepared by Seller and submitted to Purchaser to describe the equipment and parts being purchased hereunder automatically become part of this Contract.

(C) **Survival.** All provisions set forth herein regarding warranty, confidential information, indemnification, liability and limits thereon, and any other provisions that survive on their terms including all provisions relating to tax, import / export, inspection, dispute resolution and governing laws, and all causes of action which arose prior to completion or termination of this Contract shall survive indefinitely until, by their respective terms, they are no longer operative.

(D) **Conflicts.** If a conflict exists between these Terms and Conditions and any other writings connected with this Contract, these Terms and Conditions shall prevail with respect to such conflict. In the event that any provisions of these Terms and Conditions is held to be illegal, invalid or unenforceable under the present or future law, rule or regulation, such provision shall be deemed stricken from these Terms and Conditions, but such illegality, invalidity or unenforceability shall not invalidate any of the other provisions of these Terms and Conditions.

September 27, 2018

Ms. Paige Pruisner
Golder
44 Union Blvd. – Suite 300
Lakewood, CO 80228
Phone: 303-980-0540

RE: INQ #2100 NM LIME SLAKING SYSTEM

Dear Ms. Pruisner,

Thank you for contacting us about this project and providing your process data to allow us to size this system and provide budget pricing for your feasibility study.

Proposed equipment descriptions and scope limits are as follows:

LIME SLAKING SYSTEM OVERVIEW:
1. Lime system shall be comprised of 1 field erected bolted, skirted, silo that would be located outdoors, and be complete with dust filter, fill pipe, interior lighting, heat, and ventilation, internal access to the feeder level platform, and a local control panel.

2. System shall utilize a vibrating bin activator mounted on the silo cone discharging to a metering screw to the slaker pre-mixer inlet. Lime slurry flows out of the slaker through a vibrating grit screen and through an equipment support floor to the 2,500 gallon slurry holding tank located at the grade level of the skirted silo.

3. Internal silo components shall be provided loose for field installation on and inside the skirted silo. Interconnecting piping and wiring shall be provided by others on site.

4. Scope limits would be the inlet connection on the 4" lime fill pipe. On the slurry discharge side, Vulcan scope ends at the 2 pump outlet flanges on the exterior of the skirted silo.

A. EQUIPMENT PRICING: (USD$)

BUDGET PRICING:
Lime Slaking System: Field Erected by Others

-DV-50 Horizontal Detention Slaking System – w/10,000 CF MT SILO		**$985,000**

Estimated Freight Costs:

1. Estimated Lump Sum Freight costs, FCA Origin	**EST**	**$45,000**

B. Commercial Rates of Payment: (Daily Rates $USD)	STD
1. Field erection advisor	$1800
2. Electrical engineer for verification of proper wiring	$2000
3. Commissioning of equipment ADDL DAYS	$2000
4. Operator training	$2000

C. Terms of Payment

-**20% with order**
-20% on transmittal of approval drawings
-20% on release for purchase for major material purchases
-20% on start of shop fabrication for silo and slaker
-20% on notification of readiness to ship major components

D. Proposed warranty is 12 months from startup or 18 months from shipment (as requested), whichever occurs first.

E. Budget pricing valid for 10 days from submission date.

NOTES:
1. Shipping costs to site location have not been included and have been listed as an additional item.
2. Equipment startup services for a total of 10 days on site have not been included.
3. Spare parts lists with costs shall be provided as part of the equipment submittal for approval prior to fabrication.

Thank you for your interest in our products and systems, and we look forward to working with you on this project.

Do not hesitate to contact me if you have questions or need additional information.

Sincerely,
Michael D. Mohle
Louisville Dryer Company
Ph: 712-461-1332
www.vulcanironworksonline.com
Your solution provider for kilns, dryers, ball mills and other processing equipment!

VULCAN IRON WORKS EQUIPMENT DIVISION

DATE: 9-27-19

TO: GOLDER ASSOCIATES – Quote #2100
RE: LIME SLAKING SYSTEM, Rev. 0

DESIGN CRITERIA: Code NBC 2005
A. Seismic – 2A; Importance Factor:
B. Wind – 100 MPH; Exposure:
C. Silo Pressure/Vacuum Design:
   1. Pressure: 4 oz.
   2. Vacuum: .4 oz.

LEAD TIME:
SUBMITTAL DRAWINGS AND DOCUMENTATION: 8-10 weeks ARO
FOR SHIPMENT AFTER RELEASE TO PROCEED WITH FABRICATION: 24-28 weeks ARAD

NOTE: Equipment described below is for supply of 1 field assembled lime slaking system.

EQUIPMENT DESCRIPTION:
A1. Storage Silo: 1
   1. 10,000 CF field bolted and gasketed storage silo; 55 PCF material volume calculations, 80 PCF for structural calculations
   2. 20' diameter, 60 Deg cone, skirted
   3. 32’ storage cylinder height, 70’ approx. eave height
   4. 7' flanged opening for bin activator
   5. 24" manway with pressure/vacuum relief valve
   6. 4” flange for lime inlet fill pipe with elbow and target box
   7. HI and LO bin level silo penetrations with paddle guards for horizontal mounted units, 1-1/4” couplings
      a. Roof mounted flange for Radar level indicator transducer
   8. Dust Filter Flange on silo roof
   9. Storage silo shall be constructed of A-36 carbon steel.
   10. Silo provided as factory coated carbon steel silo, bolted and gasketed construction, materials on site, for field assembly and interior equipment installation by others.
   11. Interior and exterior silo and skirt panels provided with factory applied epoxy powder coating.
A2. Silo Support Structure:
   1. Skirted with interior platform at the feeder level, internal spiral stair access, HDG coated carbon steel.
      a. Double door opening at grade level.
   2. Height of discharge above floor approximately 12 feet (subject to change), to allow access to lime screw to slaker inlet chute and bin activator.
B. Silo Access:
   1. HDG steel ladder cage from grade to silo roof with rest platforms.

2. 2 rail roof and platform handrail provided as galvanized steel pipe, 1.5” diameter Schedule 40, with bolted pipe connections.
3. Roof toeplate provided as painted carbon steel.
4. Access components field mounted during field erection of silo

C. Bin Activator: 1
1. 7’ diameter with carbon steel mounting ring
2. 10” diameter flanged outlet
3. 3 HP, 460/3/60 vibrator motor
4. Field mounted and wired

D. Silo Knife Gate: 1
1. 10" diameter, manual chainwheel operated, open and closed limit switches
2. Cast Iron body with SS blade
3. Packing: PTFE
4. Field mounted
5. Flexible connection provided between knife gates and feeder inlets

E1. Silo Point Level Indicators: 2 (High and Low level)
1. Rotating paddle type with SS paddles
2. NEMA 4X exterior housing, SPDT switch
3. 120/1/60 powered
4. Field mounted and wired by installation contractor

E2. Silo Continuous Level Indicator: 1
1. Roof mounted radar level indicator (Siemens/Milltronics)
2. Transducer field installed, with 30 meter range
   a. 24VDC - 2 wire loop powered
3. E-Z Aimer kit provided
4. Indicator/controller shipped loose for field mounting and wiring

F. Silo Fill System:
1. 4”, Sch. 40 carbon steel pipe coated to match silo finish color
2. Pipe sections connected with compression couplings with connecting straps
3. Fill elbow provided as 90 degree cast iron Vortice Ell or wide-sweep
4. Truck coupling, limit switch, and end cap provided on pipe end
5. Fill pipe assembly field installed

G. Dust Filter: 1
1. Roof mounted on silo flange
2. Welded CS housing painted to match silo
3. 1200 CFM pulse-jet bag filter, with 250 Sq. Ft. minimum cloth area
4. 3 HP – 460/3/60 fan motor – 3450 RPM
5. Ships loose for field attachment and wiring

H. Fill Station Panel: 1
1. NEMA 4X enclosure
2. Panel complete with indicating lights, alarm horn, and H-O-A switch, interlocked to silo dust collector and fan
3. Panel ships loose for field mounting and wiring by others

I. Lime Feed Screw: 1
1. Volumetric screw conveyor, SS contact parts, 6” diameter tube with 4” screw
2. 1.5 HP AC motor 460/3/60, inverter duty
3. Sized for transfer rate of up to 5,000 PPH (3/4” minus @ 55 pcf)
4. Fabricated SS feed chute provided on feeder outlet to slaker
5. Feeder shipped loose for field assembly and installation on site

J. Detention Lime Slaker: 1
   1. Vulcan DV-50 detention type lime slaker, carbon steel construction
      a. Slaker max output 50 GPM of 20-25% solids hydrated lime slurry
   2. Sized for feed rate of 500-5,000 PPH
   3. Slaker provided with 5 HP 460/3/60 motor, belt driven
   4. Slaker provided with draft inducer with fan, factory mounted
   5. Makeup water piping (galvanized) with the following plumbing components and valves factory mounted:
      a. 1 Makeup water ON-OFF solenoid valve
      b. 1 Pneumatic water control segmented ball valve
      c. 1 Magnetic flow meter/transmitter with local display
      d. 1 Aspirator spray ON-OFF valve
      e. 1 Manual ball valve for water inlet shutoff
      f. 1 Direct reading temperature gauge with 2 switch control
         1. 1 Temperature transmitter with 4-20mA out to PLC
      g. 1 Solenoid for emergency/high-temp water feed
   6. Slaker shall be factory welded and coated (exterior only), with valves and piping factory mounted and wired. Field installed in silo skirt area on 2nd equipment level platform of skirted silo
   7. Slaker shall be provided with premixer for warming of incoming water prior to injection into the slaker reactor. Slaker body shall be insulated and provided with an exterior 16 gauge shell, to protect the insulation material.

K. Grit Removal Equipment: 1
   1. 30″ diameter vibrating screen unit, SS cloth, 16 mesh
   2. Screen unit provided with carbon steel housing, base, and cover
   3. Unit provided with 0.5 HP, 460/3/60 motor
   4. Flexible chutes provided on the screen inlet and outlet
   5. Field mounted and wired in silo skirted area on second level

L. Grit Screw: 1
   1. 6″ diameter carbon steel helicoid full-pitch, carbon steel
   2. Length 10′ nominal, with inlet and outlet flanges
   3. Motor: ½ HP, 460/3/60
   4. Field installed

M. Slurry Storage Tank: 1
   1. 2,500 gallon capacity, ¼″ thick A-36 carbon steel, 8′ diameter, 6′ tall with flat bottom and flat top
      a. Tank design factory welded, exterior coated with epoxy
   2. All tank penetrations, mounting brackets, flanges, and couplings factory completed based on system design requirements
      a. Tank overflow and drain piping shall be provided as Sch. 40 threaded carbon steel, with manual gate valve at tank bottom for draining, factory installed
   3. Tank provided with hinged 20″ roof mounted access/inspection manway
   4. Tank provided with 2 outlet flanges

N. Slurry Tank Level Indication: 1
   1. Ultrasonic type, top tank mount, 8m transducer
   2. 4-20 mA output to PLC
   3. 2 Wire loop powered
   4. Factory mounted and wired on tank top

O. Slurry Tank Mixer: 1
   1. 1.5 HP, TEFC, 460/3/60 motor
   2. 316 SS shaft and single impeller, 350 RPM
   3. Factory mounted and wired, with shaft/impeller removed for shipment, requiring reinstallation on site by installation contractor

P. Slurry Tank Dilution Water Plumbing Piping and Components: SEE P&ID FOR DETAILS
   1. Water inlet piping:
      a. Galvanized threaded water piping, Sch. 40
      b. 1 Bronze pressure reducing valve with strainer
      c. 1 Pressure indicating valve
      d. 1 Pressure switch
      e. 1 Local reading flow meter/transmitter
      f. 1 Solenoid water feed valve
      g. 1 globe water valve for water inlet control
   2. Slurry Piping: SEE P&ID FOR REQUIREMENTS
      a. Schedule 40 steel
      b. Manual ball valves for water flush
      c. Manual rubber lined pinch valves for on/off control

Q. Slurry Pumps: 2
   1. Horizontal Centrifugal, Cast-iron, rubber lined construction, constant speed
      a. Overhead belt-drive with guard
   2. Warman 1.5/1 BAH, or equal
   3. Capacity: 60 GPM @ 80' TDH
      a. 10HP, 1750 RPM, TEFC motors
   4. Seals: Packed gland seals, water flushed
   5. Factory skid mounted, for field mounting in grade level of skirted silo

R. Wiring:
   1. Conduit and wiring field installed and mounted on silo for integral components (provided an installed by others)
      a. Lime Slaker shall be factory wired to local junction box
   2. Internal and External Lighting: By others

S. System Local Controls: (Feed/Slaking area)
   1. NEMA 4X-SS enclosure
   2. Terminal strips provided for connection to MCC and DCS
      a. VFD by others in MCC
   3. External mounted 3 phase to single phase transformer not included
   4. PLC not included
   5. Plain language operating description provided to allow PLC programming (programming by others)
   6. Control panel shipped loose for mounting on slaker work level platform
   7. Interconnecting wiring between panel and devices/JBs by others

T. Paint and Coatings:
   1. SP-10 prep for silo shell exterior and equipment area interior
   2. Silo:
      a. Interior of silo storage area: Epoxy power coating, 4 mils
      b. Skirt area and Silo Exterior: 2 coat powder coat system epoxy/polyester
         1. 6 mils minimum DFT
   3. Paint colors to be determined by customer/engineer
   4. Touch up paint provided

5. Purchased products shall be provided with manufacturer's standard paint
6. Field erected silo provided with factory applied coating

U. Environmental Components:
Silo interior provided with the following components loose for field mounting and wiring by others:
1. 4 x 10 kW 575/3/60 heaters
2. 8 x 75 W 120/1/60 HPS vapor tight light fixtures
3. 1 x 24" square ventilation fan, 300 CFM, 120/1/60
4. Double man door shall be provided for installation at grade level of silo, included as part of the silo assembly
5. Interior skirt insulation has not been included

V. Preparation for Shipment:
1. Controls shall be factory tested prior to shipment, panels ship loose

W. Startup Service:
1. 1 man, 2 trips, 5 days per trip on site for startup and commissioning recommended
2. Field erection/assembly advisor: 1 man 10 days, 2 trips **ADDITIONAL COST**

X. Spares:
1. None Included
2. Spare parts list provided in submittal and O&M electronic manual

Y. Special Freight Information: FCA Shipping point (various), No Freight Allowed
FCA Locations:
1. Parsons, KS
2. Louisville, KY

Z. O&M Documentation:
1. 3 CD electronic copies shall be provided in PDF format, English language

ITEMS AND SERVICES NOT INCLUDED IN THIS PROPOSAL:
1. Freight costs, unloading at site, erection, or installation
2. Hook up/supply of utilities (water, power, air)
3. Foundation design or supply, or anchor bolts
4. Chemicals
5. Slaker water heater or water pressure supply system
6. Skirt insulation
7. Silo aeration system air supply system

Equipment Proposal - All equipment is sold subject to the terms and conditions stated on Attachment #1 (below) which by this reference is incorporated as part of this proposal.

Attachment #1

LOUISVILLE DRYER COMPANY

DBA: VULCAN IRONWORKS

PROJECTS and PARTS ORDERS

GENERAL LIMITATION OF LIABILITY

Except to the extent that Vulcan Ironworks is entitled to be indemnified under a policy of insurance effected pursuant to the requirements of the contract, the liability of Vulcan for any defect in the goods supplied or work performed is limited to the repair or replacement, at Vulcan's option, of any nonconforming goods or work resulting from defects in material or workmanship under normal use and service which are reported within 12 months after the date of the contract covering such goods or work.

THE REMEDY OF REPAIR OR REPLACEMENT OF THE NONCONFORMING GOODS OR WORK SHALL BE THE SOLE AND EXCLUSIVE REMEDY AVAILABLE TO THE BUYER OR ANY OTHER PERSON. IN THE EVENT THAT REPAIR OR REPLACEMENT IS NOT ACHIEVED OR OTHERWISE IS AN INEFFECTIVE REMEDY, THE BUYER'S SOLE AND EXCLUSIVE ADDITIONAL REMEDY IS THE RIGHT TO RECOVER AN AMOUNT NOT TO EXCEED THE AMOUNT PAID TO FOR THE NONCONFORMING GOODS OR WORK. EXCEPT FOR SUCH REPAIR, REPLACEMENT, OR REFUND, VULCAN SHALL NOT BE LIABLE FOR ANY LOSS, INJURY, EXPENSE, OR DAMAGE, WHETHER DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR OTHERWISE, RESULTING FROM THE GOODS OR WORK OR IKD'S ACTION UNDER THIS AGREEMENT, WHETHER A CLAIM FOR SUCH DAMAGES IS BASED UPON WARRANTY, CONTRACT, NEGLIGENCE, OR ANY OTHER LEGAL OR EQUITABLE THEORY.

All completion or start-up dates specified in the contract are estimates only and are not guaranteed. VULCAN SHALL NOT BE LIABLE FOR ANY LOSSES OR DAMAGES (WHETHER DIRECT, INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR OTHERWISE) RESULTING FROM ANY DELAYS IN COMPLETION OF THE FIELD SERVICE PROJECT OR START-UP OF THE EQUIPMENT.

These limitations of liability apply to all liability whatsoever arising under, or out of, or in the course of this contract or the performance thereof and continue to apply notwithstanding rescission, repudiation or termination of the contract for any reason, whether deliberate, unintentional or by operation of law.

DENVER
INDUSTRIAL
PUMPS, INC.

19-39973

May 09, 2019

Entered by: Steve Blake

15165 W. 44th Avenue Golden, CO 80403 **303-233-9255** FAX 303-233-9031

PUMP QUOTATION

To: Paige Pruisner
Fax: 303.985.2080
Phone: 303.980.0540
Email: Paige_Pruisner@golder.com

GOLDER ASSOCIATES INCORPORAT
44 UNION BLVD
SUITE 300
LAKEWOOD, CO 80228

We are pleased to offer the following quote for your consideration.

QTY: 1, DSS-S2-DDA-7.5-16-PEF-C-BNNR-P5050W, GRUNDFOS DUPLEX METERING SKID

INCLUDES:
QTY-2 MODEL DDA 7.5-16 AR-PVC/E/C-F-31U7U7 PUMPS W/ STANDARD CHECK VALVES
CONTROL INPUT CABLE
RELAY OUTPUT CABLE
HOA TYPE PANEL
1/2" PVC PIPE
VALVES
CALIBRATION COLUMN
DUPLEX FLOOR MOUNT SKID

CONDITIONS OF SERVICE
FLUID: COAGULANT
FLOW RATE: 0.1 GPH TO 2 GPH
DISCHARGE:10 PSI
VISCOSITY: 12 CP
NO 304SS MATERIAL
NO OTHER CONDITIONS OF SERVICE GIVEN OR APPLY

CLARIFICATIONS AND EXCEPTIONS
1. DOES NOT INCLUDE PULSATION DAMPENER, EBOX OR ANALOG OUTPUT CABLE
2. CUSTOMER TO VERIFY THAT THE QUOTED DUPLEX PUMP METERING SKID SPECIFICATIONS MEETS THEIR SYSTEM REQUIREMENTS

SHIPMENT: 2-4 WEEKS ARO, FOB FACTORY, PLUS TRANSIT TIME

Price - $7,053.00 each / $7,053.00 total

QuoteTotal:	**$7,053.00**

Sincerely, David Wellington / Steve Blake

Denver Industrial Pumps, Inc. has a complete service shop for pump repair, rebuild, modifications, and custom packaged units. Our field service technicians offer on-site pump removal, installation, repair, alignment services, and maintenance contracts. If we can be of further assistance please contact us. Please be advised, pricing good for 30 days of quotation and standard Terms and Conditions of sales are incorporated by reference posted at www.denverpumps.com All equipment quoted FOB factory unless otherwise stated.

FOB factory means freight from the origin will be added to invoice and purchaser takes title to equipment at shipping point. Availability subject to prior sale.

Taxes will be added to your invoice unless a current tax exempt certificate is supplied.

For all orders totaling $50,000.00 or more progress payments may be required.

Equipment left over 90 days are subject to scrap/disposal.

If not sending a hard copy Purchase Order, we require that you sign and return a copy of this quote when placing your order. Please verify item quantities, shipping address and shipping method.

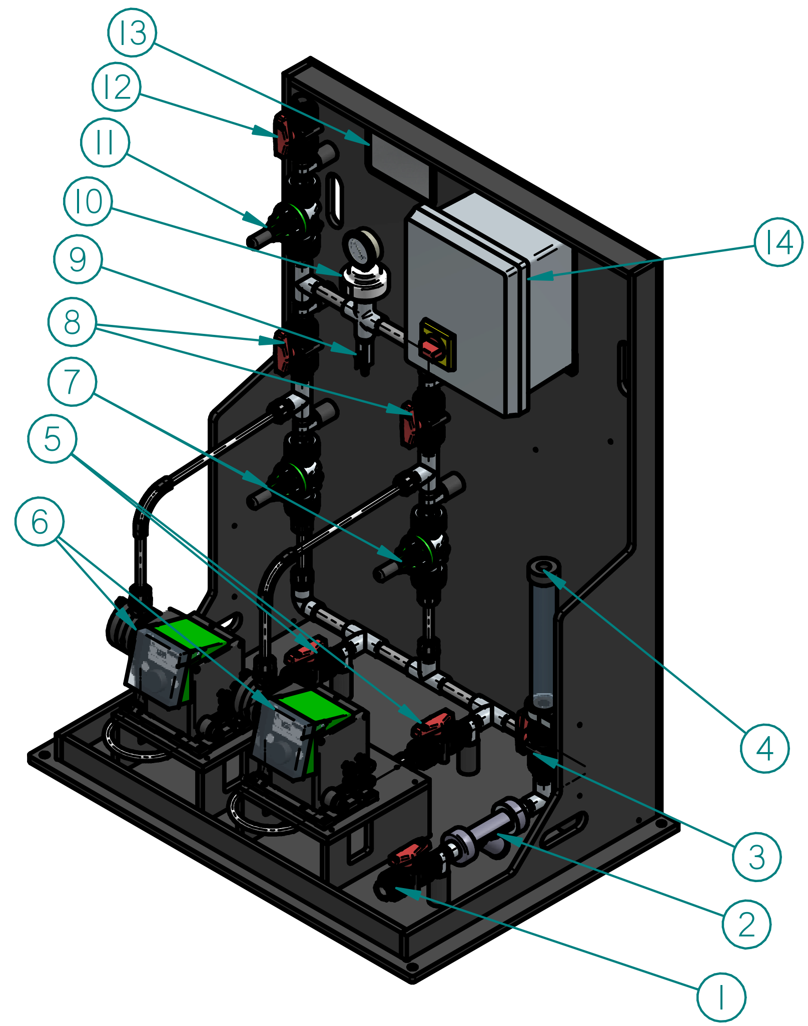
APPROVED:

Signature ______________________________ Date ______________

Purchase Order No. ______________________________ Attached: Yes ___ No ___

Shipping/Special Instructions:

POS.	Description
1	FNW Inlet Isolation Valve
2	Spears Y-Strainer
3	FNW Calibration Column Isolation Valve
4	Primary Fluids Calibration Column
5	FNW Dosing Pump Inlet Isolation Valve
6	Grundfos Dosing Pump
7	Primary Fluids Pressure Relief Valve
8	FNW Dosing Pump Outlet Isolation Valve
9	Spears Sample Valve/Bleed Valve
10	Wika Pressure Gauge with Blacoh Fluid Control Diaphragm Gauge Guard
11	Primary Fluids Back Pressure Valve
12	FNW Discharge Isolation Valve
13	Grundfos Nameplate
14	Junction Box/Control Panel (Optional)



For Reference Only. Not For Construction.

GRUNDFOS

FRESNO, CALIFORNIA 93727 USA

ECM	NAME	DATE
DRAWN	58847	3/14/16
CHECKED		
ENG APPR		
MGR APPR		

DRAWING TYPE: Solid Edge Drawing

RELATED DOCUMENTS:

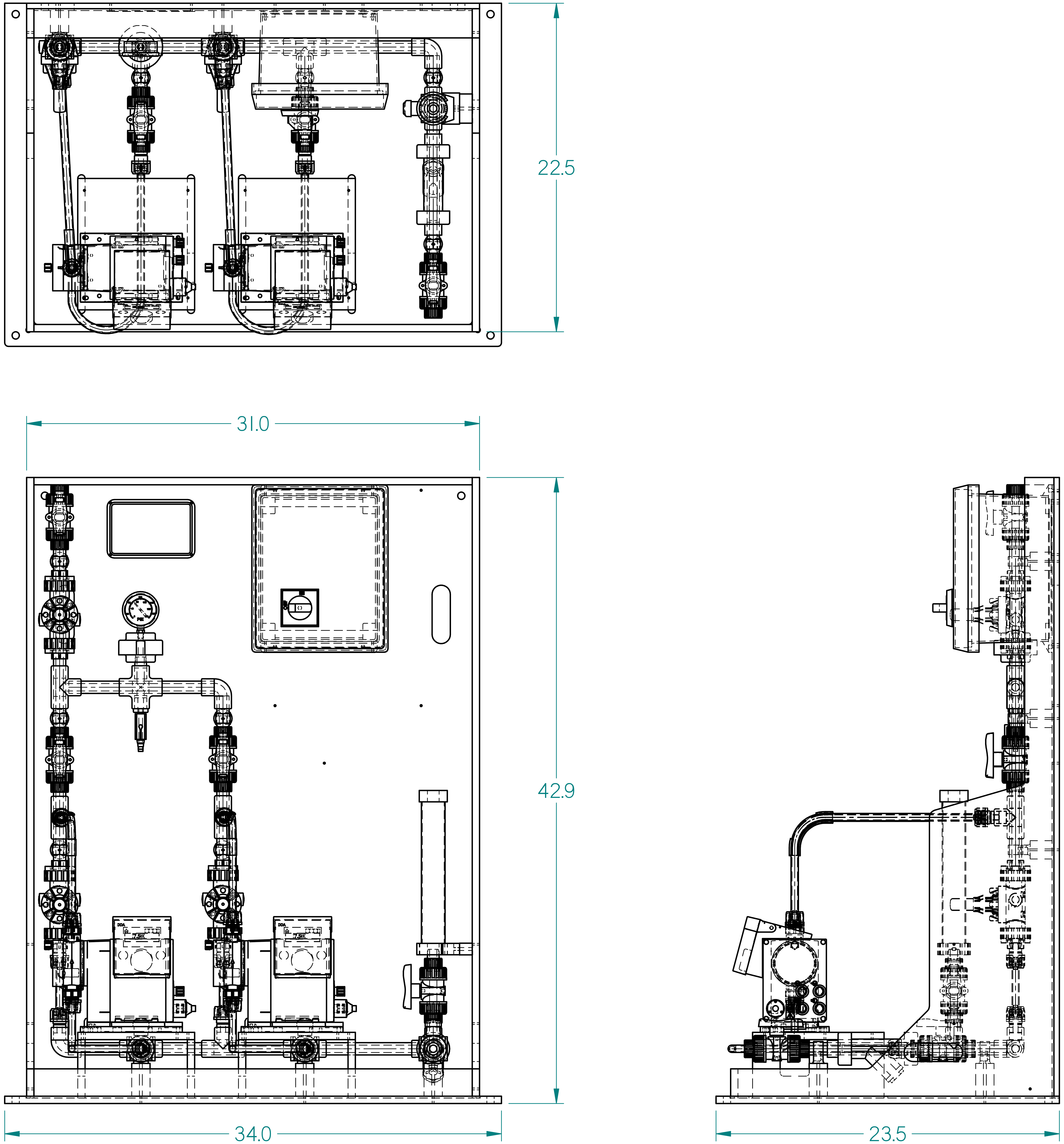
DESCRIPTION: 2 Pump PVC Dosing Skid Parts Callout

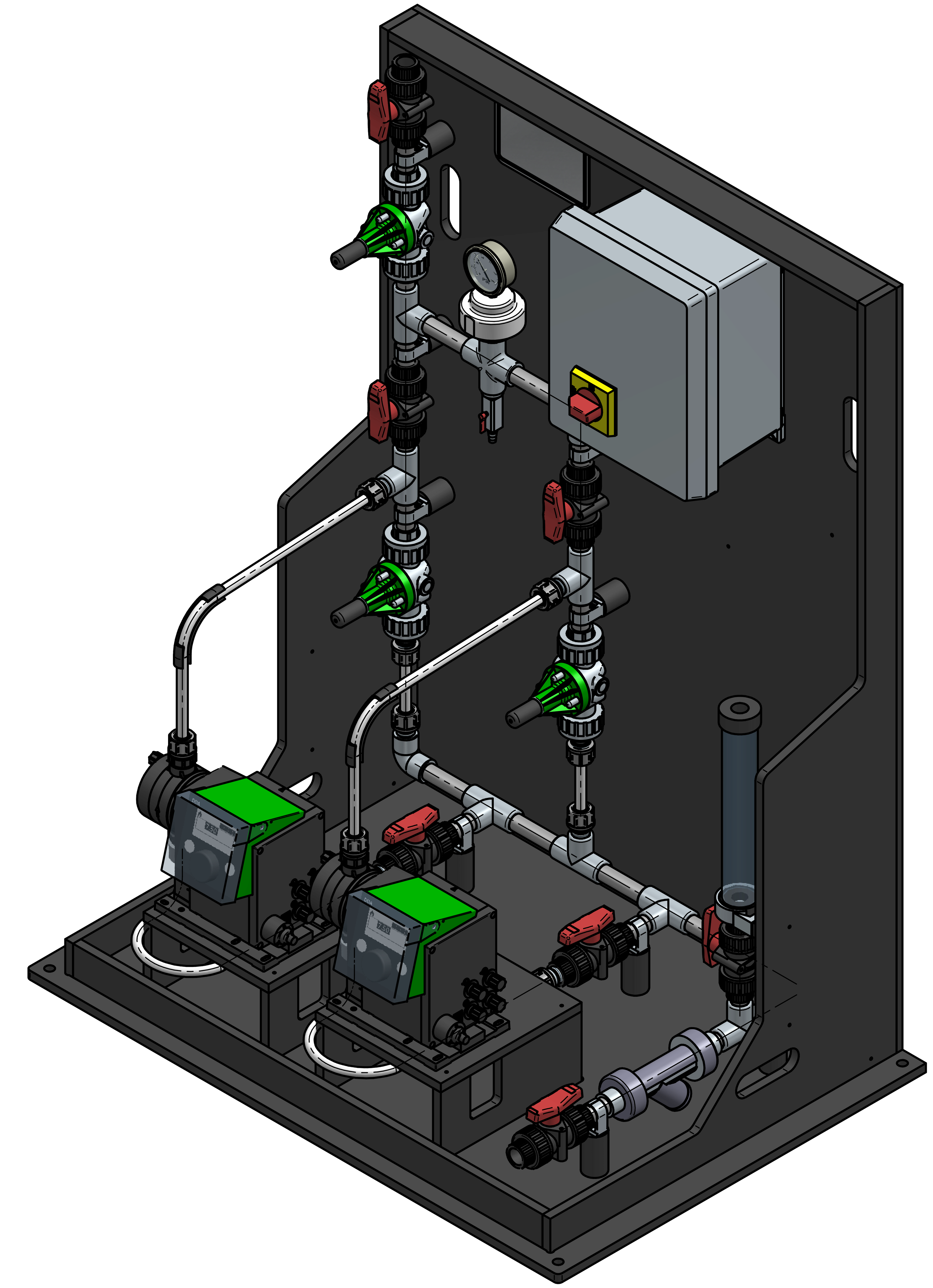
SIZE: A | DWG NO: None | REV:

FILE NAME: Two Pump Production Launch PVC

SCALE: 1:12 | WEIGHT: | SHEET 1 OF 1

FOR REFERENCE ONLY
NOT FOR CONSTRUCTION





GRUNDFOS	ECM	NAME	DATE	DRAWING TYPE: Solid Edge Drawing
FRESNO, CALIFORNIA 93727 USA				RELATED DOCUMENTS:
				DESCRIPTION: Two Pump Smart Digital PVC DSS
	DRAWN	GMUCJM	01/12/16	
As this is the property of GRUNDFOS a/s it must not be passed on to any person not authorized by GRUNDFOS or be copied or otherwise utilized by anybody without GRUNDFOS' expressed written permission.	CHECKED			SIZE D / DWG NO REFERENCE / REV 0
	ENG APPR			FILE NAME: Two Pump Production Launch PVC.dft
	MGR APPR			SCALE: / WEIGHT: / SHEET 1 OF 1

	D r
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N Pr d r d r r r d

Product No.: 97722365
DDA 7.5-16 AR-PVC/E/C-F-31U7U7

The SMART Digital DDA is a compact positive displacement, diaphragm dosing pump with variable-speed drive (stepper motor) and intelligent control electronics with minimum energy consumption. The SMART Digital Dosing series operates at full stroke length to ensure optimum accuracy, priming and suction, even for high-viscosity or degassing liquids. The duration of each discharge stroke varies according to the capacity set, resulting in optimum smooth and continuous discharge flow.

The click-stop mounting plate allows installation in three different positions without using any additional accessories. The control cube can be turned easily into front, left or right position. The click wheel and the multi-coloured backlit graphical, plain-text LC display make commissioning and operation intuitive. The control elements are protected by a transparent cover.

The dosing head is composed of:
- Long lifetime and universal, chemically resistant full-PTFE diaphragm.
- Double ball valves for highest dosing accuracy.
- Deaeration valve for easy start-up.

Operation modes:
- Manual dosing in ml/h, l/h or gph.
- Pulse control in ml/pulse (incl. memory function).
- Analog control 0/4-20 mA (scalable).
- Pulse-based batch function in ml, l or gal.
- Timer-based batch function (Dosing timer, cycle or week).
- Fieldbus control (Genibus prepared for ProfibusDP E-box).

Other features:
- Auto deaeration during pump standby to avoid breakdowns due to air-locking.
- Two SlowMode steps (anti-cavitation), 50 % (maximum flow: 0.9906 US GPH) and 25 % (maximum flow: 0.4966 US GPH), e.g. for high-viscosity or degassing liquids.
- Service information display to show when service and which wear-part order number is required.
- Two-step key lock function to protect the pump against unauthorised access.
- Additional display function to provide further information, e.g. the actual mA input signal.
- Counter for total dosed volume (resettable), operating hours, etc.
- Save and load customised settings as well as reload of factory settings.

Signal inputs/outputs:
- Input for pulse, analog 0/4-20mA, external stop.
- Input for low-level and empty-tank signal.
- Two potential-free output relays for max. 30 V AC/DC (configurable, e.g. alarm, stroke signal, pump dosing, timer etc.)
- Output analog 0/4-20mA.
- Fieldbus communication interface (GeniBus, also for additional Profibus DP E-box to retrofit).

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Type key: DDA 7.5-16 AR-PVC/E/C-F-31U7U7

GRUNDFOS

Denver Industrial Pumps

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Max. Flow: 1.981 US GPH
Max. flow in slow mode 50%: 0.9906 US GPH
Max. flow in slow mode 25%: 0.4966 US GPH
Min flow: 2.5 ml/h
Turn-down ratio: 1:3000
Approvals on nameplate: CE,CSA-US,NSF61,RCM
Valve type: Standard
Maximum viscosity at 100 %: 50 mPas
Maximum viscosity in slow mode 50 %: 1800 mPas
Maximum viscosity in slow mode 25 %: 2500 mPas
Accuracy of repeatability: 1 %

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Dosing head: PVC (Polyvinyl chloride)
Valve ball: Ceramic
Gasket: EPDM

I

Range of ambient temperature: 32 .. 113 F
Maximum operating pressure: 145.04 psi
Installation set: NO
Installation type: No installation set
Pump inlet: 0.17x 1/4, 1/4x3/8, 3/8x1/2"
Pump outlet: 0.17x 1/4, 1/4x3/8, 3/8x1/2"
Max. Suction lift during operation: 19.7 ft
Max. Suction lift during priming: 6.56 ft

L d

Pumped liquid: Water
Liquid temperature range: 14 .. 113 F
Selected liquid temperature: 68 F
Density at selected liquid temperature: 62.29 lb/ft³

E r d

Maximum power input - P1: 24 W
Mains frequency: 60 Hz
Rated voltage: 1 x 100-240 V
Enclosure class (IEC 34-5): IP65 / NEMA 4X
Length of cable: 4.92 ft
Type of cable plug: USA, Canada
Inrush current: 25A at 230V for 2ms

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Control variant: AR
Level control: YES
Analog input: 0/4-20 MA
Pulse control: YES
Ext. Stop input: YES
Analog output: 0/4-20 MA
Output relays: 2
Bus communication: YES

O r

Net weight: 4.41 lb
Gross weight: 6.62 lb
Color: RED
Custom tariff no.: 8413.50.0050

Denver Industrial Pumps

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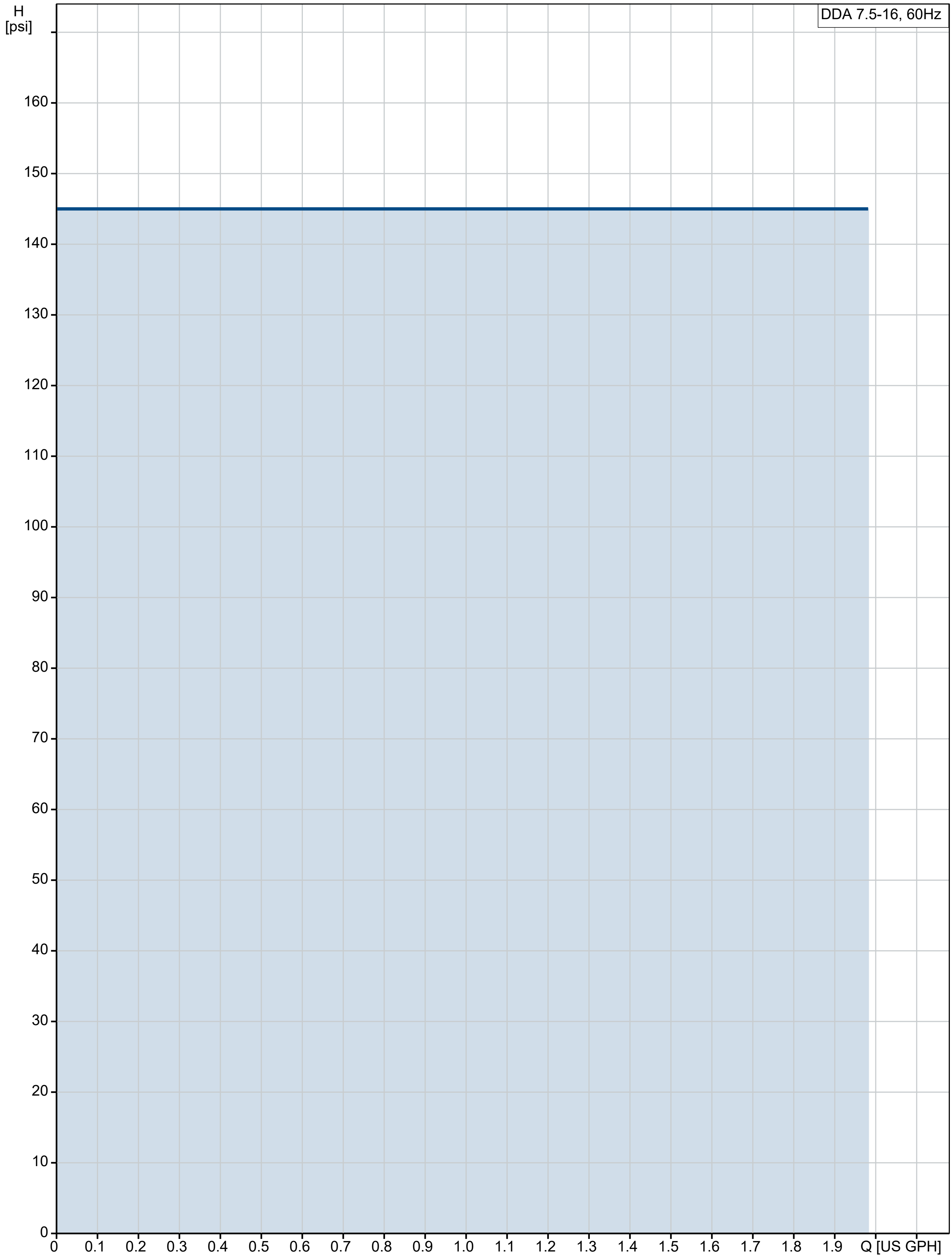

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Denver Industrial Pumps

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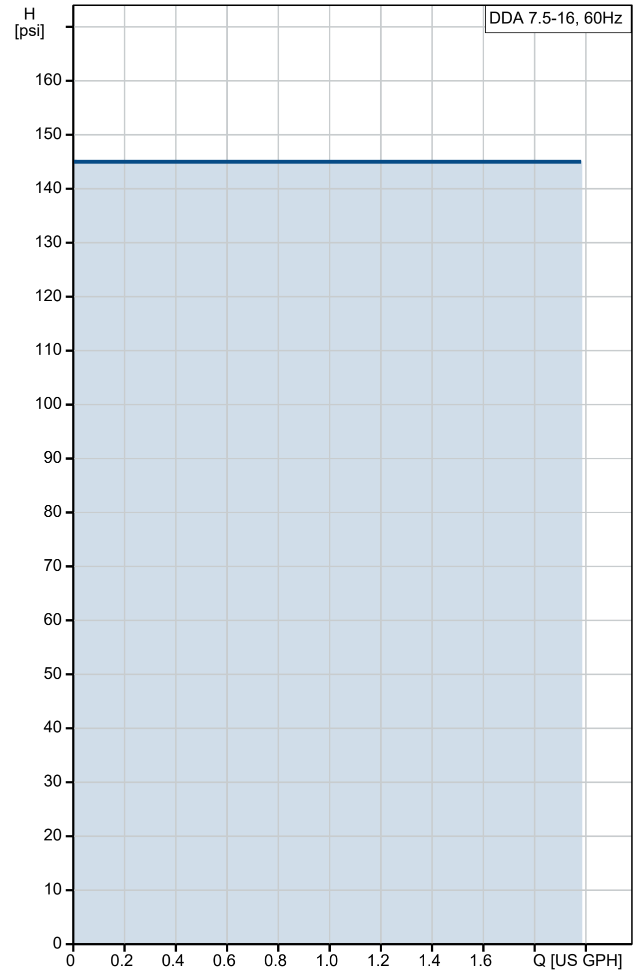
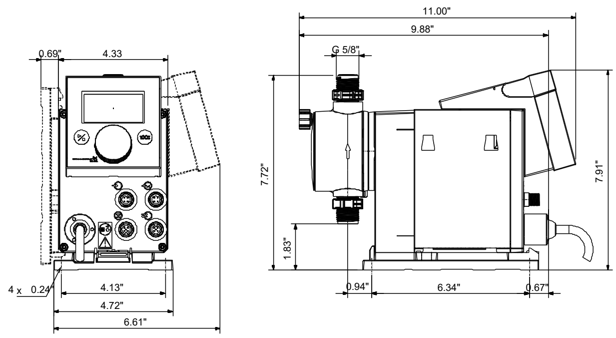
G r r	
Product name:	DDA 7.5-16
Product No:	97722365
EAN number:	5710622725070
T	
Type key:	DDA 7.5-16 AR-PVC/E/C-F-31U7U7
Max. Flow:	1.981 US GPH
Max. flow in slow mode 50%:	0.9906 US GPH
Max. flow in slow mode 25%:	0.4966 US GPH
Min flow:	2.5 ml/h
Turn-down ratio:	1:3000
Approvals on nameplate:	CE,CSA-US,NSF61,RCM
Valve type:	Standard
Maximum viscosity at 100 %:	50 mPas
Maximum viscosity in slow mode 50 %:	1800 mPas
Maximum viscosity in slow mode 25 %:	2500 mPas
Accuracy of repeatability:	1 %
M r	
Dosing head:	PVC (Polyvinyl chloride)
Valve ball:	Ceramic
Gasket:	EPDM
I	
Range of ambient temperature:	32 .. 113 F
Maximum operating pressure:	145.04 psi
Installation set:	NO
Installation type:	No installation set
Pump inlet:	0.17x 1/4, 1/4x3/8, 3/8x1/2"
Pump outlet:	0.17x 1/4, 1/4x3/8, 3/8x1/2"
Max. Suction lift during operation:	19.7 ft
Max. Suction lift during priming:	6.56 ft
L d	
Pumped liquid:	Water
Liquid temperature range:	14 .. 113 F
Selected liquid temperature:	68 F
Density at selected liquid temperature:	62.29 lb/ft³
E r d	
Maximum power input - P1:	24 W
Mains frequency:	60 Hz
Rated voltage:	1 x 100-240 V
Enclosure class (IEC 34-5):	IP65 / NEMA 4X
Length of cable:	4.92 ft
Type of cable plug:	USA, Canada
Inrush current:	25A at 230V for 2ms
r	
Control variant:	AR
Control panel:	FRONT-MOUNTED
Level control:	YES
Analog input:	0/4-20 MA
Pulse control:	YES
Ext. Stop input:	YES
Analog output:	0/4-20 MA
Output relays:	2
Bus communication:	YES
O r	
Net weight:	4.41 lb





Denver Industrial Pumps

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D r	V
Gross weight:	6.62 lb
Color:	RED
Custom tariff no.:	8413.50.0050

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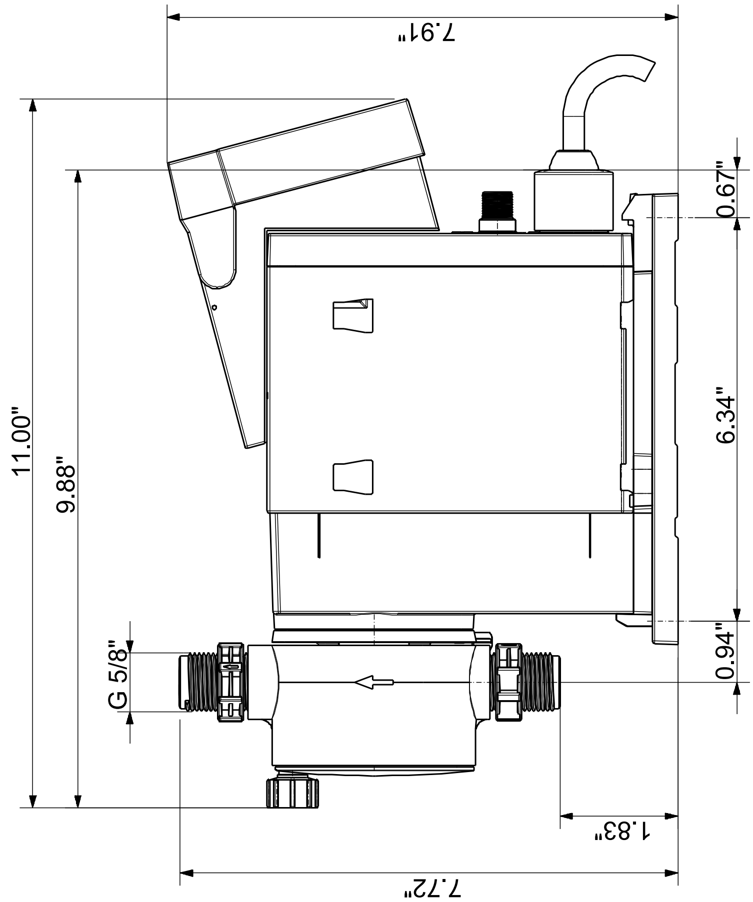
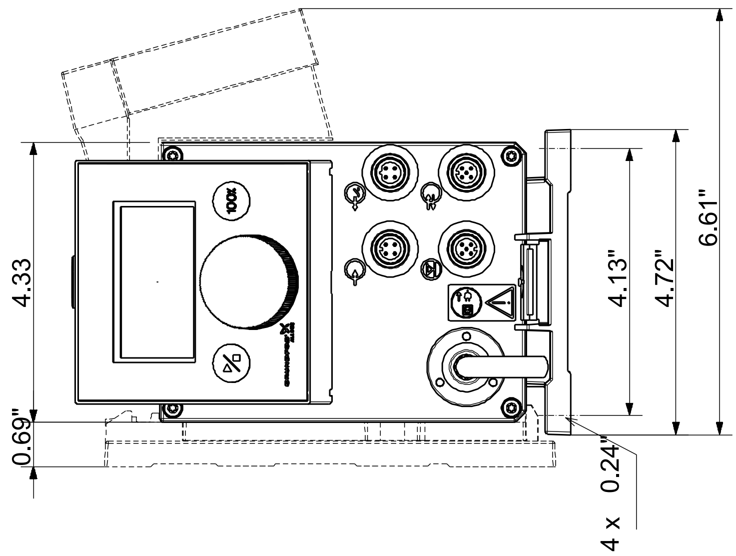


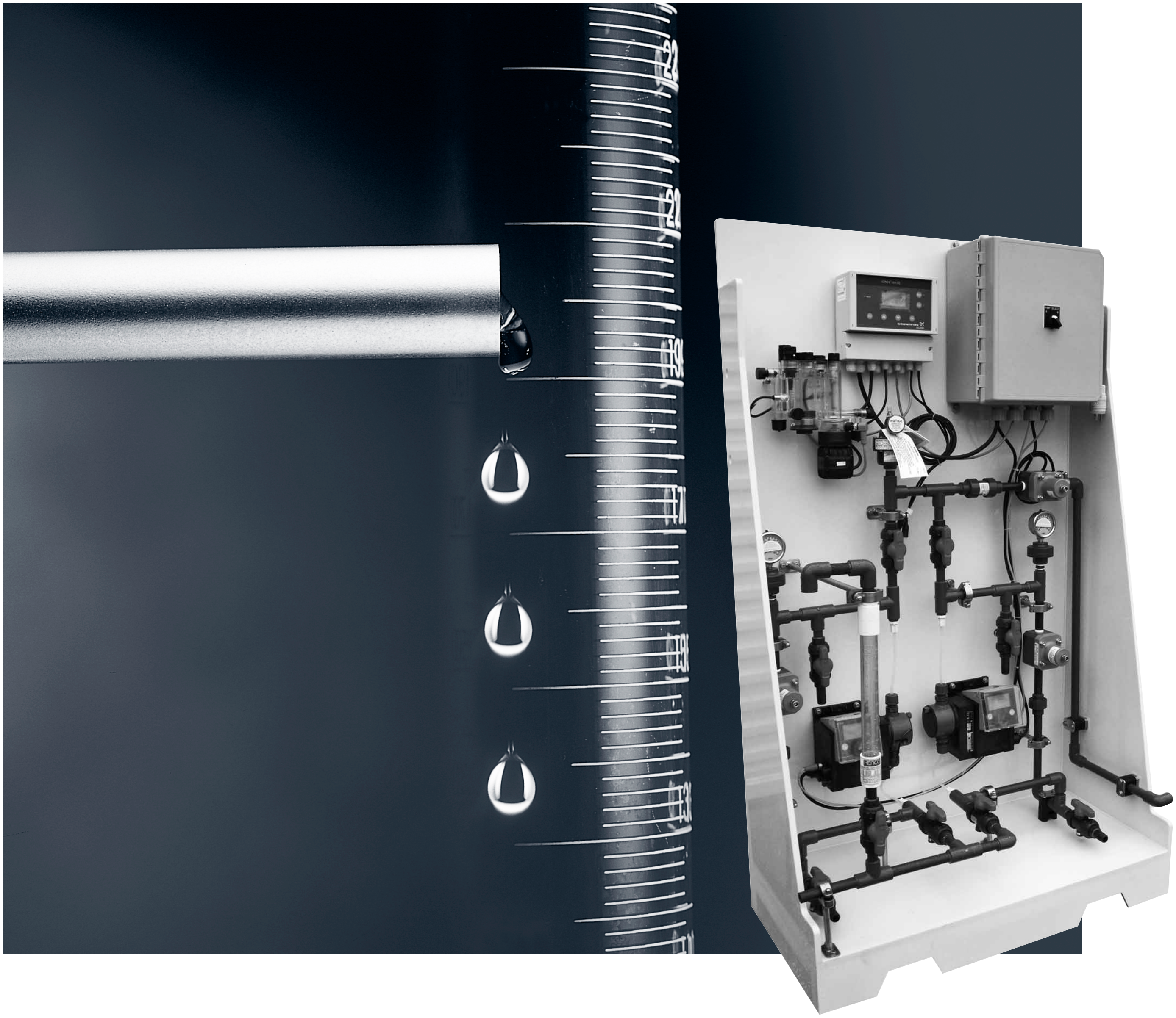


Note! All units are in [in] unless others are stated.
Disclaimer: This simplified dimensional drawing does not show all details.

GRUNDFOS **PRODUCT GUIDE**

DSS

Dosing skid systems



BE > THINK > INNOVATE >

GRUNDFOS

Table of contents

1. Product introduction

Grundfos Dosing Skid Systems (DSS) are designed to feed liquid chemicals from a supply source (usually tank or drum) to an injection point.

Systems typically include:

- pre-piped pumps
- fittings
- other components (depending on the system) i.e. strainers, calibration columns, back pressure valves, pressure gauges, pulsation dampeners, pressure relief valves.

Grundfos Dosing Skid Systems (DSS) can range from pre-engineered, standard one- and two-pump systems on polypropylene or stainless steel bases, to custom systems with multiple pumps and tanks all piped on a common skid with complete controls.

Dosing Skid Systems (DSS) are available for all models of Grundfos metering pumps: hydraulically actuated and mechanically actuated pumps including Digital Dosing pumps with stepper motor technology offering up to 3000:1 flow turndown.

Features and benefits

Grundfos Dosing Skid Systems offer critical benefits:

- Faster and easier onsite installation in comparison with the purchase of individual components that must be separately piped, installed, wired and tested.
- Each system is delivered as a complete package so many installations may be as simple as connecting the piping and electrical.
- System designs can cover a wide range of capabilities and materials to suit most applications and environments.
- Systems can operate with manual control or can be provided with automation options to improve process control, efficiency and reliability.
- System pumps, piping and control panels are factory inspected and tested prior to shipment.

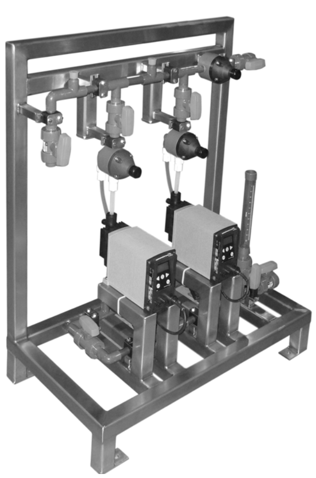


Fig. 1 Stainless steel base - floor mounted system

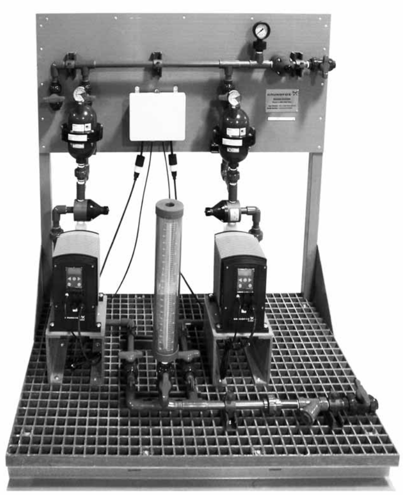


Fig. 2 FRP base - floor mounted system

Fig. 3 Polypropylene base - floor mounted system

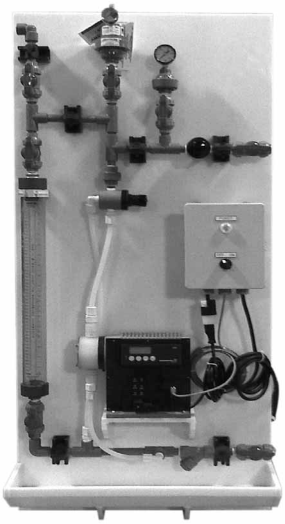


Fig. 4 Polypropylene panel - wall mounted system

2. Identification

Type key

Example	DSS	S	2	-	DMH	-	PP	FM	-	N	-	P	-	A9	-	A9	-	N

Dosing Skid System

System type
S: Standard
C: Custom

Pumps per skid
1: one pump
2: two pumps

Pump model
DME pump
DDI pump
DMI pump
DMX pump
DMH pump
DDA pump
DDC pump
DDE pump

Base material
SS: Stainless steel
PP: Polypropylene
FR: FRP
CS: Carbon steel
PC: PVC

Mounting
FM: Floor / base mounted skid
WM: Wall mounted panel
TM: Tank mounted

Control panel option
C: Control panel
N: No control panel

Piping material
P: PVC
S: SS
C: CPVC
F: PVDF
A: Alloy 20

Suction pipe size
A9: 0.5"
A7: 0.75"
V1: 1"
V2: 1.5"
20: 2"
30: 3"

Discharge pipe size
A9: 0.5"
A7: 0.75"
V1: 1"
V2: 1.5"
20: 2"
30: 3"

Piping connection type
N: NPT (threaded)
S: Weld: socket/solvent/butt
F: Flanged

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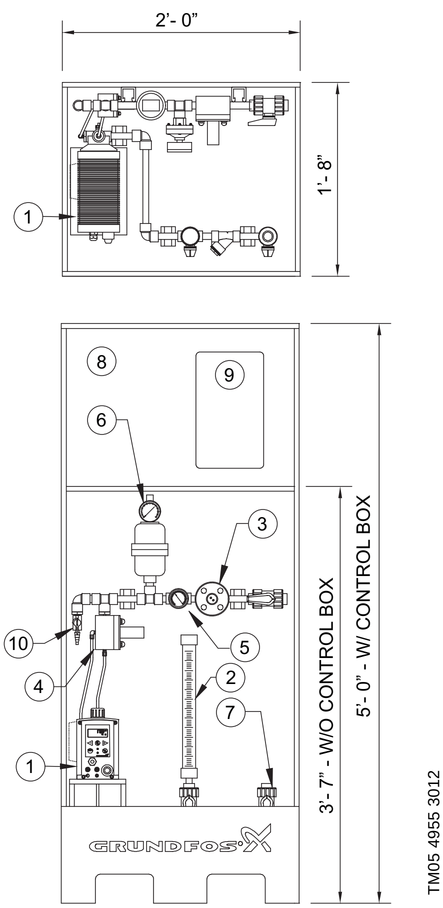
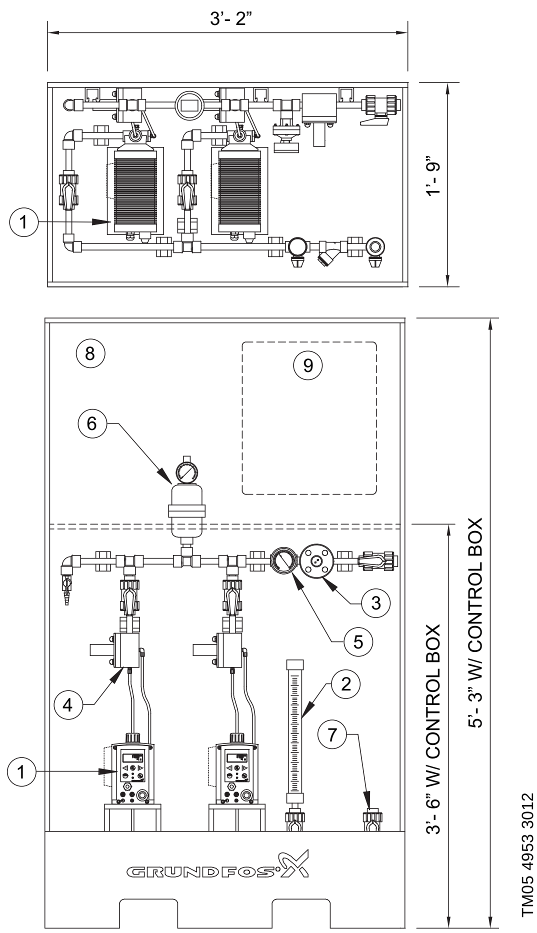
3. Components

Standard skid systems with polypropylene base

**Small one-pump system
with polypropylene base**

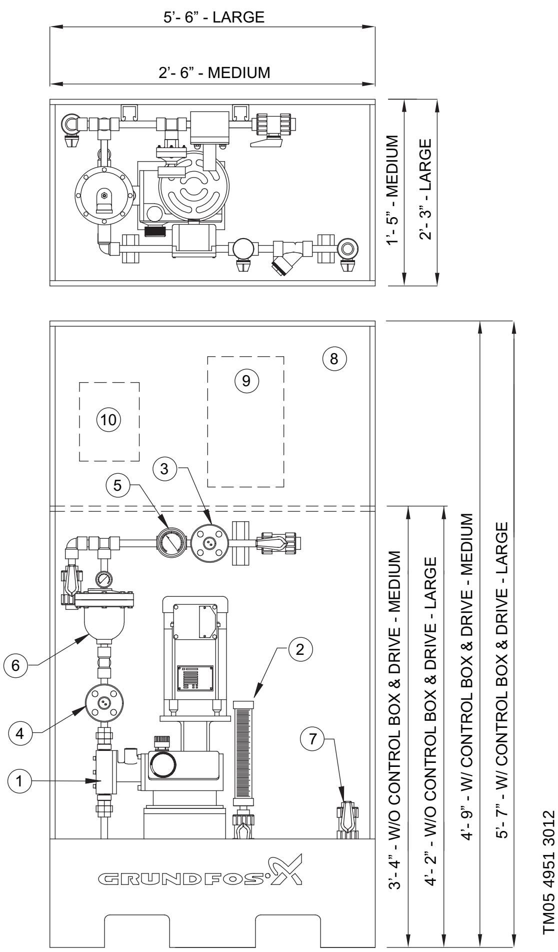


**Small two-pump system
with polypropylene base**

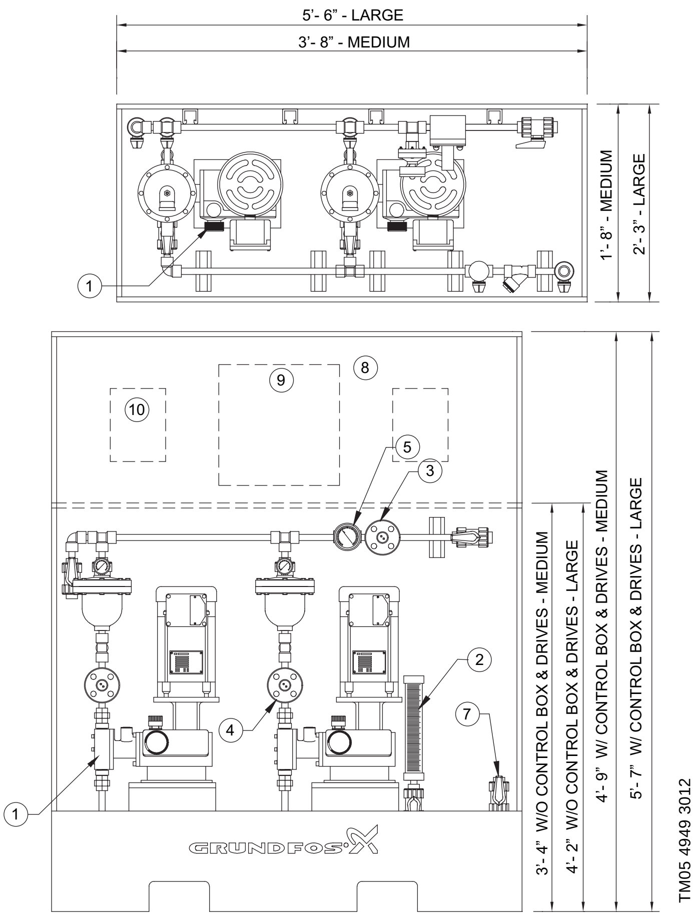


Pos.	Component
1	Metering pumps
2	Calibration cylinder
3	Back pressure valve
4	Pressure relief valve
5	Pressure gauge
6	Pulsation dampener
7	Ball valve
8	Skid
9	FRP enclosure
10	Sample valve

Medium and large one-pump system with polypropylene base



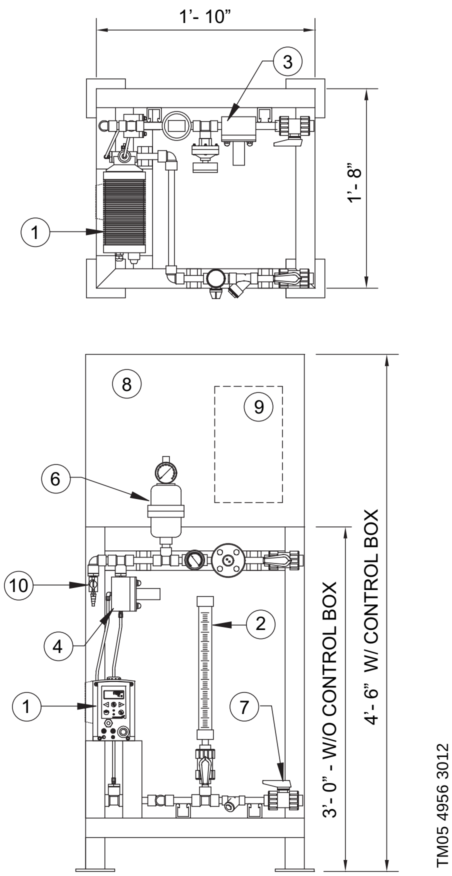
Medium and large two-pump system with polypropylene base



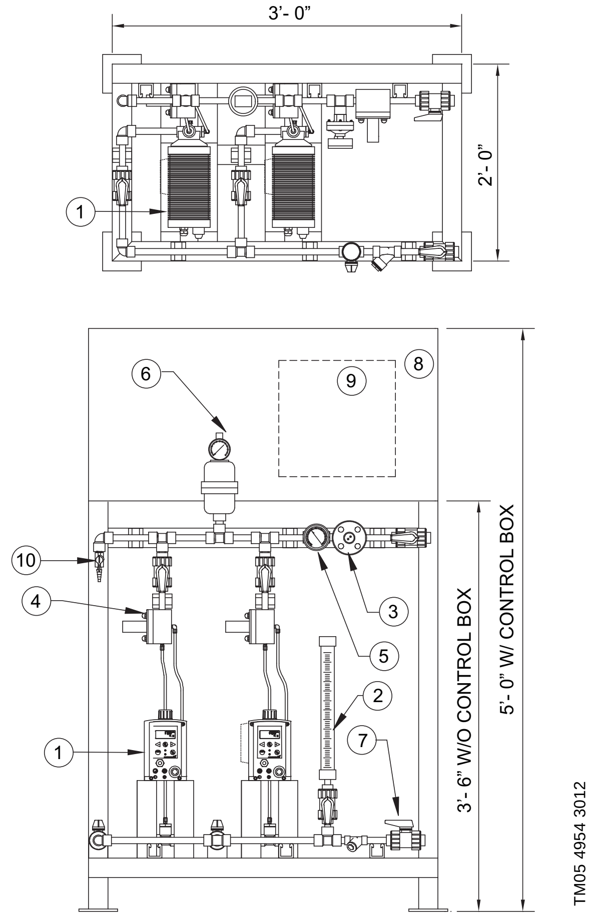
Pos.	Component
1	Metering pumps
2	Calibration cylinder
3	Back pressure valve
4	Pressure relief valve
5	Pressure gauge
6	Pulsation dampener
7	Ball valve
8	Skid
9	FRP enclosure
10	Optional controller
11	Sample valve

Standard skid systems with stainless steel base

Small one-pump system with stainless steel base

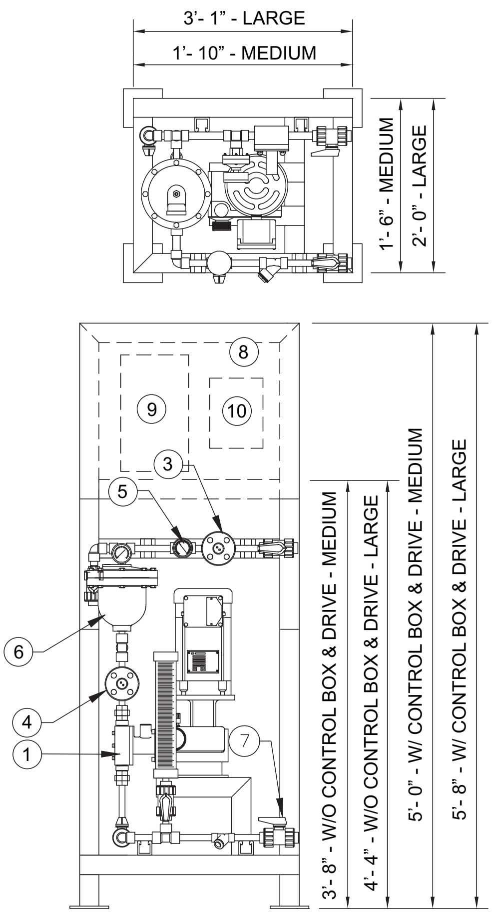


Small two-pump system with stainless steel base



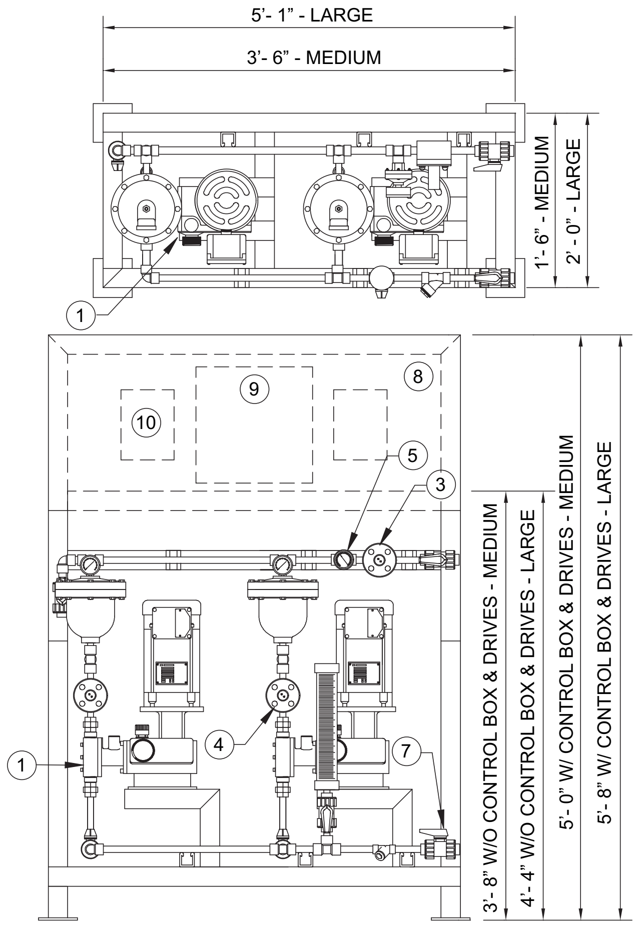
Pos.	Component
1	Metering pumps
2	Calibration cylinder
3	Back pressure valve
4	Pressure relief valve
5	Pressure gauge
6	Pulsation dampener
7	Ball valve
8	Skid
9	FRP enclosure
10	Sample valve

Medium and large one-pump system with stainless steel base



TM05 4952 3012

Medium and large two-pump system with stainless steel base

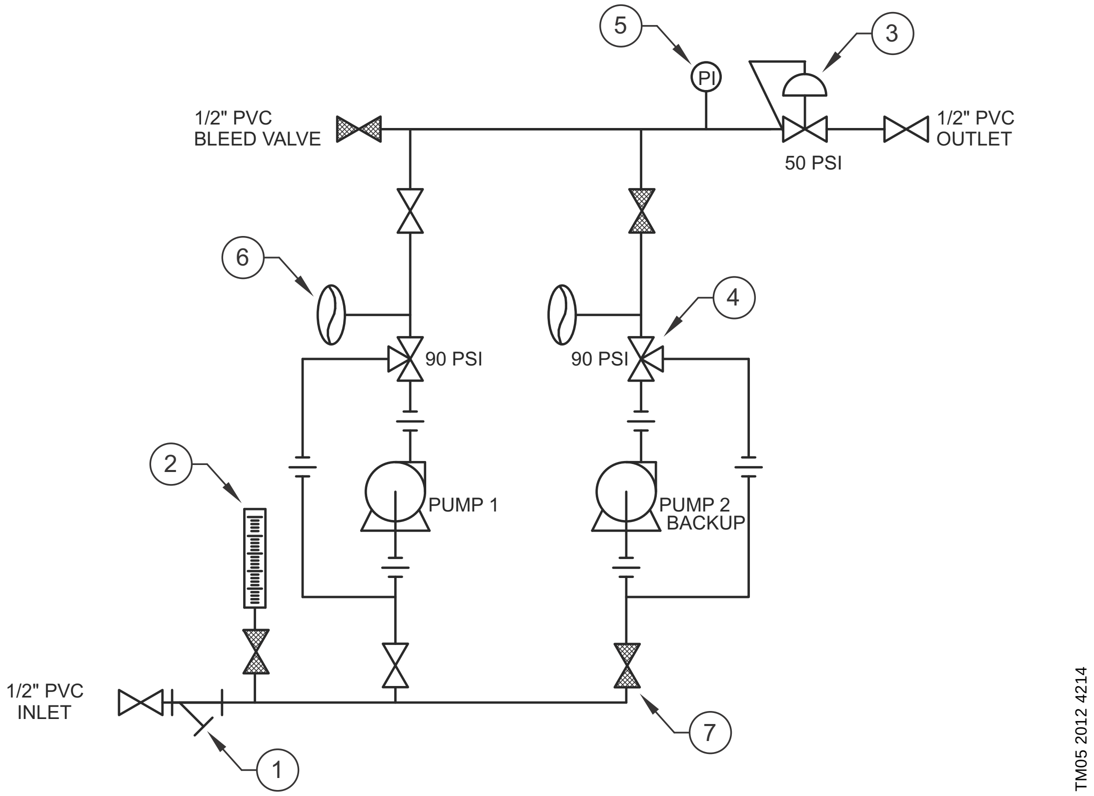


TM05 4950 3012

Pos.	Component
1	Metering pumps
2	Calibration cylinder
3	Back pressure valve
4	Pressure relief valve
5	Pressure gauge
6	Pulsation dampener
7	Ball valve
8	Skid
9	FRP enclosure
10	Optional controller
11	Sample valve

P&ID

Typical layout, two-pump system



Typical system components*

Pos.	Component
1	PVC, strainer
2	Calibration cylinder
3	Back pressure valve
4	Pressure relief valve
5	Pressure gauge
6	Pulsation dampener
7	Ball valve

* Review layout, general arrangement, component and P&ID drawings issued on specific orders as these may differ from "Typical" as shown here.

4. Special application systems

Selcoperm

Electrolytic chlorination systems

Selcoperm electrolytic chlorination systems offer easy and reliable generation of a hypochlorite solution for disinfection applications.

TM04 6823 0910

Fig. 5 Selcoperm electrolytic chlorination system

Conex®

Compact measuring systems

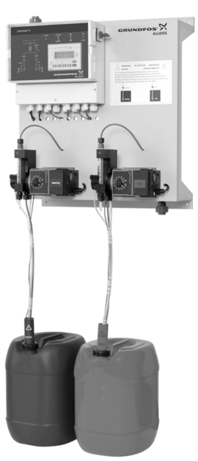
Our DSS systems with Conex® utilize our tried-and-tested electrodes and controllers, combined to suit specific applications, and installed on a mounting board ready for quick installation.

TM05 4046 1506

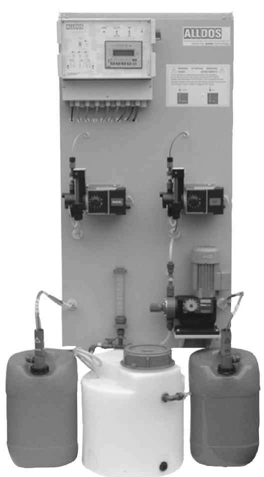
Fig. 6 Conex® compact measuring systems

Chlorine dioxide systems

Continuous chlorine dioxide dosing ensures highly effective disinfection and prevents the build-up of biofilm in water pipes. Grundfos chlorine dioxide disinfection systems can be installed in existing systems without disrupting operations.

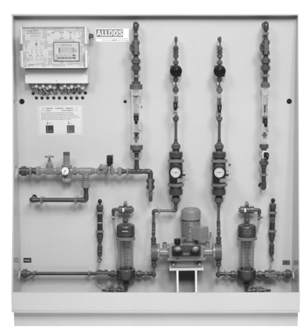


TM05 3821 1612



TM05 3794 1612

TM05 3822 1612



TM05 3793 1612

Fig. 7 Chlorine dioxide systems

5. Technical data

DDA

SMART Digital Series (0.0007 to 8.0 gph)

Technical data		7.5-16	12-10	17-7	30-4
Turndown ratio (setting range)	[1:X]	3000	1000	1000	1000
Max. dosing capacity	[gph (l/h)]	2.0 (7.5)	3.1 (12.0)	4.5 (17.0)	8.0 (30.0)
Min. dosing capacity	[gph (l/h)]	0.0007 (0.0025)	0.0031 (0.0120)	0.0045 (0.0170)	0.0080 (0.0300)
Max. operating pressure	[psi (bar)]	230 (16)	150 (10)	100 (7)	60 (4)
Accuracy of repeatability	[%]	± 1			
Max. suction lift during operation [1]	[ft (m)]	19.68 (6)			
Weight (PVC, PP, PVDF)	[lb (kg)]	5.3 (2.4)	5.3 (2.4)		5.8 (2.6)
Weight (stainless steel)	[lb (kg)]	7.1 (3.2)	7.1 (3.2)		8.9 (4.0)
Diaphragm diameter	[in (mm)]	1.73 (44)	1.97 (50)		2.92 (74)

[1] Data is based on measurements with water

TM05 4007 1912

DDC

SMART Digital Series (0.0015 to 4.0 gph)

Technical data		6-10	9-7	15-4
Turndown ratio (setting range)	[1:X]	1000	1000	1000
Max. dosing capacity	[gph (l/h)]	1.5 (6.0)	2.4 (9.0)	4.0 (15.0)
Min. dosing capacity	[gph (l/h)]	0.0015 (0.0060)	0.0024 (0.0090)	0.0040 (0.0150)
Max. operating pressure	[psi (bar)]	150 (10)	100 (7)	60 (4)
Accuracy of repeatability	[%]	± 1		
Max. suction lift during operation [1]	[ft (m)]	19.68 (6)		
Weight (PVC, PP, PVDF)	[lb (kg)]	5.3 (2.4)		
Weight (stainless steel)	[lb (kg)]	7.1 (3.2)		
Diaphragm diameter	[in (mm)]	1.73 (44)		1.97 (50)

[1] Data is based on measurements with water

TM05 4008 1912

DDE

SMART Digital Series (0.0015 to 4.0 gph)

Technical data		6-10	15-4
Turndown ratio (setting range)	[1:X]	1000	1000
Max. dosing capacity	[gph (l/h)]	1.5 (6.0)	4.0 (15.0)
Min. dosing capacity	[gph (l/h)]	0.0015 (0.0060)	0.0040 (0.0150
Max. pressure	[psi (bar)]	150 (10)	60 (4)
Accuracy of repeatability	[%]	± 5	
Max. suction lift during operation [1]	[ft (m)]	19.68 (6)	
Weight (PVC, PP, PVDF)	[lb (kg)]	5.3 (2.4)	
Weight (stainless steel)	[lb (kg)]	7.1 (3.2)	
Diaphragm diameter	[in (mm)]	1.73 (44)	1.97 (50)

[1] Data is based on measurements with water

TM05 4009 1912

DDI 222 AR

(0.02 to 39.7 gph)

Technical data							
Pump	Model	Vstroke [cm^3]	Max. pressure[1)] [psi (bar)]	Capacity[2)] [gph (l/h)]			Max. stroke rate [strokes/min]
				Normal	Slow Mode - 1	Slow Mode - 2	
DDI 60-10	222 AR	6.63	145 (10)	15.9 (60)	10.6 (40)	6.5 (24.7)	180
DDI 150-4	222 AR	13.9	58 (4)	39.7 (150)	26.4 (100)	16.4 (62)	180

1) Observe the maximum permissible temperatures. When dosing the more viscous liquids, observe the maximum permissible viscosity.

2) The maximum dosing flow of HV type pumps is reduced by up to 10%.

The maximum capacity is measured at maximum pump back pressure.

The pump can be operated in the range of 0.125% to 100% of the maximum dosing capacity.

TM03 4770 2706

Electrical data	
Power supply	100-240 V, 50/60 Hz
Power consumption	50 VA

DME

DME 60/150

(0.02 to 39.7 gph)

Pump type		DME 60-10	DME 150-4
Capacity at max. pressure	[gph (l/h)]	15.85 (60)	39.6 (150)
Min. capacity	[gph (l/h)]	0.0198 (0.075)	0.0497 (0.188)
Max. pressure	[psi (bar)]	145 (10)	58 (4)
Setting range		800:1	
Stroke frequency	[spm]	160	
Power supply	[V, Hz]	1×100-240V, 50-60 Hz	
Accuracy	[%]	±1% repeatability	
Pump head material		PP, PVDF, stainless steel	
Suction lift: primed/dry	[ft (m)]	6 (1.5)	
Viscosity (Slow Mode)	[cps]	3000* at 50 % capacity	

TM05 4010 1912

*with spring-loaded valves

DME 375/940

(0.13 to 248 gph)

Technical data		DME 375-10	DME 940-4
Capacity at max. pressure	[gph (l/h)]	99.1 (375)	248.3 (940)
Min. capacity	[gph (l/h)]	0.124 (0.47)	0.31 (1.18)
Max. pressure	[psi (bar)]	145 (10)	58 (4)
Setting range		800:1	
Stroke frequency	[spm]	160	
Power supply	[V, Hz]	1×100-240V, 50-60 Hz	
Accuracy	[%]	±1 % repeatability	
Pump head material		PP, PVDF, 316 SS	
Suction lift: primed/dry	[ft (m)]	19 (4.9) / 6 (1.5)	
Viscosity (Slow Mode)	[cps]	3000* at 50 % capacity	

TM05 4011 1912

*with spring-loaded valves

DMX

(0.13 to 2 x 166 gph)

TM05 4033 1912

DMX 221 pump	Max capacity		Strokes per minute [spm]	Max. viscosity* [cps]	Max. suction lift*		Motor voltage	Accuracy [%]	Linearity [%]
	[gph (l/h)]	[psi (bar)]			Primed [ft]	Dry [ft]			
4-10	1.3 (5)	145 (10.0)	35	400	13.1	13.1			
7-10	2.1 (8)	145 (10.0)	35	400	13.1	13.1			
7,2-16	2.3 (8.6)	232 (16.0)	75	400	13.1	13.1			
8-10	2.6 (10)	145 (10.0)	75	400	13.1	13.1			
9-10	2.9 (11)	145 (10.0)	35	200	9.8	9.8			
12-10	3.7 (14)	145 (10.0)	35	200	9.8	8.2			
13,7-16	4.0 (16)	232 (16.0)	144	200	11.5	8.2			
14-10	4.5 (17)	145 (10.0)	75	400	13.1	13.1			
16-10	5.0 (19)	145 (10.0)	144	200	11.5	8.2			
17-4	5.3 (20)	58 (4.0)	35	200	3.3	3.3	1 x 115 V, 50/60 Hz	+/- 1.5%	+/- 4%
18-10	5.8 (22)	145 (10.0)	75	200	9.8	9.8			
25-3	7.9 (30)	44 (3.0)	35	200	3.3	3.3			
26-10	8.2 (31)	145 (10.0)	75	200	9.8	8.2			
27-10	8.4 (32)	145 (10.0)	144	200	11.5	8.2			
35-10	11.0 (42)	145 (10.0)	144	100	8.2	6.5			
39-4	12.0 (47)	58 (4.0)	75	100	3.3	3.3			
50-10	16.0 (60)	116 (8.0)	144	100	8.2	4.9			
60-3	19.0 (72)	44 (3.0)	75	100	3.3	3.3			
75-3,5	24.0 (90)	51 (3.5)	144	100	1.6	1.6			
115-3	36.0 (138)	36 (2.5)	144	100	1.6	1.6			

DMX 226 pump	Max capacity (Duplex X 2)		Strokes per minute [spm]	Max. viscosity* [cps]	Max. suction lift*		Motor voltage	Accuracy [%]	Linearity [%]
	[gph (l/h)]	[psi (bar)]			Primed [ft]	Dry [ft]			
52-8	16.4 (62)	116 (8.0)	76	700	8.2	3.2			
67-10	21.1 (80)	145 (10.0)	68	700	8.2	3.2			
82-5	25.9 (98)	72 (5.0)	76	500	8.2	3.2			
95-8	30.0 (114)	116 (8.0)	68	500	8.2	3.2			
100-8	31.7 (120)	116 (8.0)	144	400	8.2	3.2			
130-3	41.2 (156)	44 (3.0)	76	400	6.6	3.2			
132-10	41.7 (158)	116 (8.0)	144	400	8.2	3.2			
152-6	48.0 (182)	87 (6.0)	68	400	6.6	3.2	DMX-B: no motor, NEMA 56C flange DMX-AR: 1 X 115V, 60 Hz	+/- 1.5%	+/- 4%
160-5	50.7 (192)	72 (5.0)	144	200	8.2	3.2			
199-8	63.1 (239)	116 (8.0)	144	200	8.2	3.2			
249-3	78.9 (299)	44 (3.0)	68	100	3.2	1.6			
255-3	80.8 (306)	44 (3.0)	144	100	6.6	3.2			
321-6	102.0 (385)	58 (4.0)	144	100	6.6	3.2			
525-3	166.3 (630)	44 (3.0)	144	50	3.2	1.6			

*Suction lift data is for water-like fluids. Please see the pump's Installation and Operating Instructions for more details and dimensional data.

DMH

(0.07 to 2 x 278 gph)

TM05 4045 1912

DMH 250

DMH 250 Series pump		Max capacity [gph (l/h)]	Max capacity [psi (bar)]	Strokes per minute at 60 Hz [spm]	Max. viscosity* [cps]	Max. suction lift [ft]
251	2,2-25	0.69 (2.6)	363 (25)	17	300	3.3
	2,3-16	0.74 (2.8)	232 (16)	17		
	2,4-10	0.77 (2.9)	145 (10)	17		
	4,5-25	1.43 (5.4)	363 (25)	35		
	4,9-16	1.55 (5.9)	232 (16)	35		
	5,0-10	1.58 (6.0)	145 (10)	35		
	11-25	3.43 (13.0)	363 (25)	75	100	—
	12-16	3.7 (14.0)	232 (16)	75		
	13-10	4.22 (16.0)	145 (10)	75		
	17-25	5.28 (20.0)	363 (25)	115		
	18-16	5.81 (22.0)	232 (16)	115		
	19-10	6.07 (23.0)	145 (10)	115		
252	10-16	3.17 (12.0)	232 (16)	35	300	3.3
	11-10	3.45 (13.1)	145 (10)	35		
	23-16	7.13 (27.0)	232 (16)	75	100	
	24-10	7.66 (29.0)	145 (10)	75		
	36-16	11.35 (43.0)	232 (16)	115		
	37-10	11.62 (44.0)	145 (10)	115		
253	21-10	6.6 (25.0)	145 (10)	35	300	3.3
	43-10	13.7 (51.9)	145 (10)	75	100	
	67-10	20.6 (78.0)	145 (10)	115		
	83-10	26.1 (98.8)	145 (10)	144	10	
254	50-10	15.8 (59.8)	145 (10)	32	300	3.3
	97-16	30.6 (115.8)	232 (16)	65	100	
	102-10	32.2 (121.9)	145 (10)	65		
	136-16	43 (162.8)	232 (16)	90		
	143-10	45.4 (171.9)	145 (10)	90		
	166-16	52.8 (199.9)	232 (16)	110		
	175-10	55.4 (209.7)	145 (10)	110		
	202-16	63.9 (241.9)	232 (16)	134		
	213-10	67.3 (254.8)	145 (10)	134	5	
255	194-10	61.5 (232.8)	145 (10)	65	200	Flooded**
	270-10	85.5 (323.7)	145 (10)	90		
	332-10	105 (397.5)	145 (10)	110		
	403-10	128 (484.5)	145 (10)	134	5	
257	220-10	69.7 (263.8)	145 (10)	33	200	3.3
	440-10	139.4 (527.7)	145 (10)	65		
	575-10	182.2 (689.7)	145 (10)	90		
	770-10	244 (923.6)	145 (10)	110		
	880-10	278 (1052.3)	145 (10)	134	5	Flooded**

DMH 280

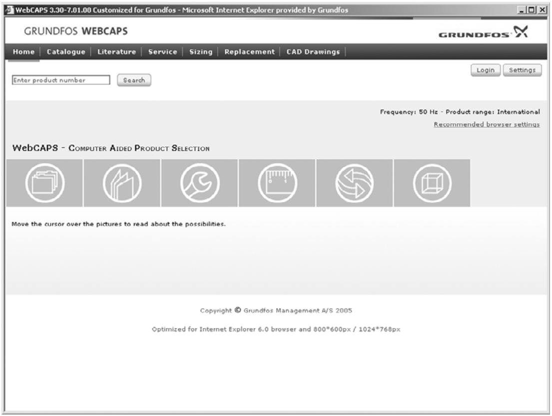
DMH 280 Series pump		Max capacity [gph (l/h)]	Max capacity [psi (bar)]	Strokes per minute at 60 Hz [spm]	Max. viscosity* [cps]	Max. suction lift [ft]
280	1,3-200	0.5 (1.9)	2900 (200)	76	5	Flooded**
	2,2-200	0.7 (2.6)	2900 (200)	115		
	2,5-200	0.9 (3.4)	2900 (200)	144		
281	2-100	0.6 (2.3)	1450 (100)	35	100	3.3
	4,2-100	1.3 (4.9)	1450 (100)	76	50	
	6,4-100	2.0 (7.6)	1450 (100)	115	50	
	8-100	2.5 (9.5)	1450 (100)	144	5	
283	19-100	6.1 (23.1)	1450 (100)	65	50	3.3
	27-100	8.4 (31.8)	1450 (100)	90		
	33-100	10.6 (40.1)	1450 (100)	110		
	40-100	12.7 (48.1)	1450 (100)	134	5	
285	20-100	6.3 (23.8)	1450 (100)	33	100	3.3
	40-100	12.7 (48.1)	1450 (100)	67	50	
	52-100	16.6 (62.8)	1450 (100)	88		
	70-100	22.2 (84.0)	1450 (100)	118		
	80-100	25.3 (95.8)	1450 (100)	134	5	
286	85-50	26.9 (101.8)	725 (50)	67	50	3.3
	111-50	35.1 (132.9)	725 (50)	88		
	170-50	53.9 (204.0)	725 (50)	134	5	Flooded**
287	18-200	5.8 (22.0)	2900 (200)	67	50	3.3
	23-200	7.4 (28.0)	2900 (200)	88		
	31-200	9.8 (37.1)	2900 (200)	118		
	36-200	11.4 (43.2)	2900 (200)	134	5	
288	7.5-200	2.4 (9.1)	2900 (200)	67	50	3.3
	10-200	3.3 (12.5)	2900 (200)	88		
	13-200	4.1 (15.5)	2900 (200)	118		
	15-200	4.9 (18.5)	2900 (200)	134	5	

*Viscosity rating at 60 Hz maximum strokes per minute.
**Flooded suction recommended.
The stated values are approximate and apply to standard pumps.

Motor	DMH B	NEMA 56C: 251, 252, 253, 254, 255, 280, 281, 283, 288
		NEMA 145TC: 257,285,286,287
	DMH AR	1ø115V, 60 HZ
		Models 251, 252, 253, 280, 281 only
Accuracy	Flow	+/- 1%
	Linearity	+/- 2%

6. Further documentation

WebCAPS

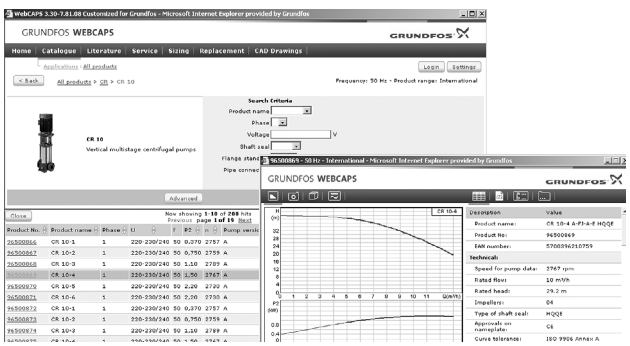


WebCAPS is a **Web**-based **C**omputer **A**ided **P**roduct **S**election program available on www.grundfos.com.

WebCAPS contains detailed information on more than 185,000 Grundfos products in more than 20 languages.

In WebCAPS, all information is divided into 6 sections:

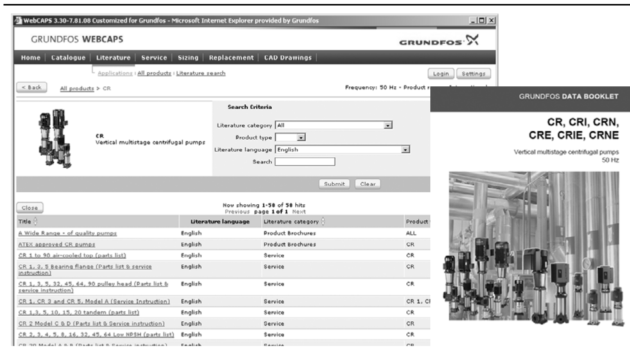
- Catalog
- Literature
- Service
- Sizing
- Replacement
- CAD drawings.



Catalog

This section is based on fields of application and pump types, and contains

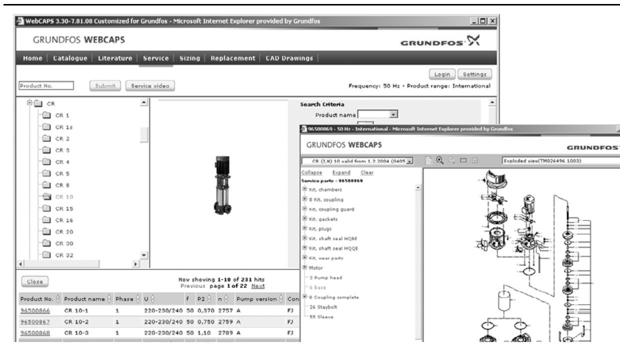
- technical data
- curves (QH, Eta, P1, P2, etc) which can be adapted to the density and viscosity of the pumped liquid and show the number of pumps in operation
- product photos
- dimensional drawings
- wiring diagrams
- quotation texts, etc.



Literature

In this section you can access all the latest documents of a given pump, such as

- product guides
- installation and operating instructions
- service documentation, such as Service kit catalog and Service kit instructions
- quick guides
- product brochures, etc.



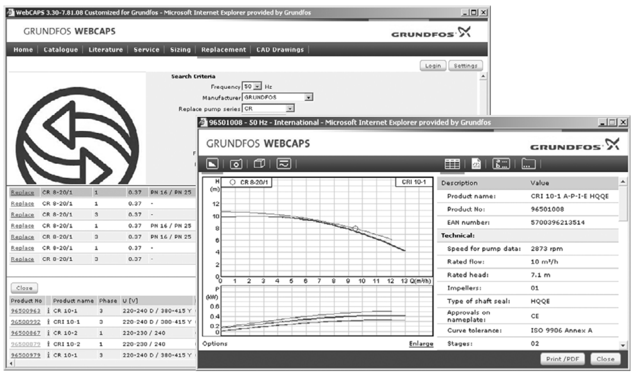
Service

This section contains an easy-to-use interactive service catalog. Here you can find and identify service parts of both existing and discontinued Grundfos pumps.
Furthermore, this section contains service videos showing you how to replace service parts.

Sizing

This section is based on different fields of application and installation examples, and gives easy step-by-step instructions in how to

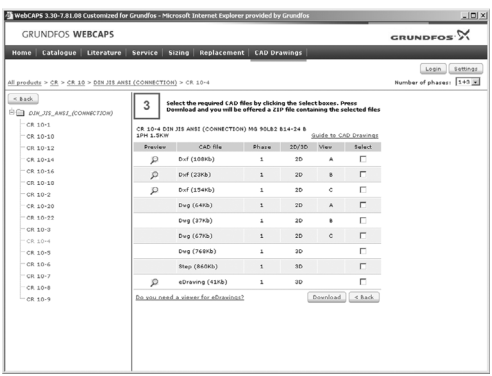
- select the most suitable and efficient pump for your installation
- carry out advanced calculations based on energy consumption, payback periods, load profiles, life cycle costs, etc.
- analyze your selected pump via the built-in life cycle cost tool
- determine the flow velocity in wastewater applications, etc.



Replacement

In this section you find a guide to selecting and comparing replacement data of an installed pump in order to replace the pump with a more efficient Grundfos pump.
The section contains replacement data of a wide range of pumps produced by other manufacturers than Grundfos.

Based on an easy step-by-step guide, you can compare Grundfos pumps with the one you have installed on your site. When you have specified the installed pump, the guide will suggest a number of Grundfos pumps which can improve both comfort and efficiency.



CAD drawings

In this section it is possible to download 2-dimensional (2D) and 3-dimensional (3D) CAD drawings of most Grundfos pumps.

These formats are available in WebCAPS:

2-dimensional drawings:

- .dxf, wireframe drawings
- .dwg, wireframe drawings.

3-dimensional drawings:

- .dwg, wireframe drawings (without surfaces)
- .stp, solid drawings (with surfaces)
- .eprt, E-drawings.

WinCAPS

Fig. 8 WinCAPS CD-ROM

WinCAPS is a **Win**dows-based **C**omputer **A**ided **P**roduct **S**election program containing detailed information on more than 185,000 Grundfos products in more than 20 languages.

The program contains the same features and functions as WebCAPS, but is an ideal solution if no Internet connection is available.

WinCAPS is available on CD-ROM and updated once a year.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-DSS-PG-01 0812	
ECM:	

GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario L6H 6C9
Canada
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

Bombas GRUNDFOS de Mexico S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. Mexico 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

ATTACHMENT B3

STS O&M Quotes

Lhoist West Business Unit
2900 W Horizon Ridge Pkwy #120
Henderson, NV 89052
Main office: 702 818 1575

To:	Golder Silver City, NM	
Attn:	Kristina Minchow	
CC:		**Date: June 21, 2019**
From:	**David Anderson**	

Lhoist North America is pleased to provide the following price for **1186 Hi-Calcium Hydrated Lime - small** utilized for your the operation in Silver, City, NV.

Lime Origin	Project Location	Quicklime	
Peach Springs, AZ (Nelson)	To: Silver City (Tyrone, Mine)	$150-160/ton	
	Freight (Rail from Nelson to Deming and truck from Deming, NM to Silver City, NM)	~$70/ton + 24%FSC	
		Est. $228/ton – truck	

*****Truck Fuel Surcharges are estimated at 24% of the truck shipping cost.***

*****Customer will be charged a 25 ton minimum on all truckloads or quicklime and 20 ton minimum on hydrated lime if they choose to order less than a full load.***

*****Freight is for rail from Nelson to Deming and then trucked from Deming to Silver City, NM.***

Ordering Lime: please call Lhoist NA Customer Service @ 800-423-1956

Lhoist NA requires that all orders be placed at least 48 hours in advance prior to delivery. Nelson Plant is available to load 24 hours per day / 7 days a week. The price quoted above is subject to all applicable taxes subsequent to this quotation. Payment Terms are NET 30 Days**.** See the below terms and conditions. Please call my cell phone or email me if you have any questions. **PRICING ABOVE IS ESITMATE ONLY.**

Regards,

David Anderson

David Anderson
Lhoist Sales Manger
david.anderson@lhoist.com
Mobile: 702-280-3122

Standard Terms and Conditions of
Lhoist North America of Arizona, Inc.

1. Acceptance of orders, whether oral or written, is based upon the express condition that buyer ("Buyer") agrees to all of the terms and conditions contained herein. These terms and conditions are intended by the parties as a final expression to their agreement with respect to such terms and also as a complete and exclusive statement of all terms, unless LHOIST NORTH AMERICA OF ARIZONA, INC. ("Seller") approves such change in terms and conditions explicitly and in writing signed by an authorized representative of Seller. No modification of these terms and conditions shall be affected by Seller's shipment of goods following receipt of Buyer's purchase order, shipping request, or similar forms containing printed terms and conditions which may be conflicting or inconsistent with the terms and conditions herein.

2. All taxes and excises of any nature whatsoever now or hereafter levied by any governmental authority, whether federal, state, or local, upon the sales, use, or transportation of any goods to Buyer shall be paid and borne by the Buyer.

3. All transportation costs and expenses for the delivery of any goods delivered by Seller to Buyer shall be for the account of Buyer. The number of net tons of goods delivered by Seller hereunder shall be determined as follows: (i) if delivered in railroad cars, the net weight of each carload shall be the difference between the gross and tare weight of the car and the gross weight shall be established by the carrier's bill of lading or weigh bill, or at Buyer's option and expense, by light weighing the car; or (ii) if delivered by trucks, the net weight of each truck load shall be the difference between the gross and light weight of the truck.. Seller shall establish the gross and light weights by weighing the truck on certified truck scales, which shall be shown on bills of lading, weigh bills or scale records.

4. Title to all goods sold and delivered to Buyer shall pass to Buyer upon delivery thereof to carrier. Delivery to carrier shall constitute delivery to Buyer and thereafter all risk of loss shall be borne by Buyer. Any claim by Buyer against Seller for shortage or damage occurring prior to such delivery shall be made within five (5) days after Buyer's receipt of such goods and shall be accompanied by an original transportation bill signed by the carrier which shall state that the carrier received goods from Seller in the condition claimed. In the event there is a claim against a carrier for shortage or damage occurring after such delivery or for transportation overcharges, Buyer may, and at Seller's request shall, forward such claim to Seller for processing with carrier, together with the original paid transportation bill signed by carrier and noting the shortage or damage if such is claimed. Buyer hereby agrees that Seller's responsibility shall be limited to crediting Buyer only to such adjustments in price as are allowed by carrier to Seller, and to which Buyer under the terms hereof is entitled.

5. Seller warrants that the goods sold to Buyer shall conform to the specifications, if any, attached hereto. **SELLER MAKES NO FURTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY INTENDED USE OR PURPOSE.**

   Seller is only selling such right or title to the goods being sold as Seller may have on the date on which Buyer requested delivery of the goods and disclaims any warranty of title to the goods. Buyer, in furnishing specifications to Seller, agrees to indemnify and hold Seller harmless against any claims by way of infringement or the like that arise out of compliance with the specifications. Seller has made no affirmation of fact or promise relating to the goods being sold that has become any basis of this bargain. Further, Seller has made no affirmation of fact or promise relating to the goods being sold that has become any basis of this bargain. Further, Seller has made no affirmation of fact or promise relating to the goods being sold that has created or amounted to an express warranty that the goods would conform to any such affirmation or promise.

The goods described in this agreement are sold on an "as is" basis, and Seller disclaims any implied warranties with respect to the goods, except for any express warranties which are contained in this paragraph.

Seller shall not be liable for incidental or consequential losses, damages, or expenses, directly or indirectly arising from the sale, handling, or use of the goods, or from any other cause relating thereto, and Seller's liability hereunder in any case is expressly limited to the replacement (in the form originally shipped) of goods not complying with applicable specifications, or, at Seller's election of the repayment of crediting Buyer with, an amount equal to the purchase price of such goods, whether such claims are for breach of warranty or negligence. Buyer hereby agrees to indemnify and hold Seller harmless for any incidental or consequential losses, damages, or expenses, directly or indirectly arising from Buyer's sale, handling, or use of the goods, or from any other cause relating thereto.

Any claim by Buyer with reference to the goods sold hereunder for any cause shall be deemed waived by the Buyer unless submitted to Seller in writing ten (10) days from the date Buyer received such goods or in the case of a breach of the express warranty under Paragraph 6 hereof within ninety (90) days from the date Buyer received such goods.

Seller shall not be liable under the express warranty contained in this Paragraph if any loss or damage is caused by improper application or use of the goods or if the goods are not applied and used according to the Seller's current printed directions and specifications free copies of which are available to Buyer or any other third party upon request.

6. Seller reserves the right to require payment for the goods in advance or satisfactory security, if the financial responsibility of Buyer becomes unsatisfactory to Seller, as determined by Seller in its sole discretion. If Buyer fails to make payment or fails to comply with any provisions hereof, Seller may, at its option, in addition to other remedies, cancel any unshipped portion of its order, and all sums owing from Buyer to Seller shall forthwith at Seller's option become due and payable, and Seller may bring an action at law or equity for any or all sums due or to become due from Buyer to Seller; and Buyer shall be liable to Seller for all of Seller's costs of collection, including, but not limited to, reasonable attorneys' fees, prejudgment interest at the maximum rate which the law allows, and post judgment interest at the maximum rate which the law allows. The exercise of any rights hereunder shall not be deemed a waiver by Seller of any other existing rights which Seller may have under applicable laws.

7. If the performance of any obligation of Seller hereunder is prevented, hindered or delayed by reason of acts of God or the public enemy; accidents, fires or floods; strikes, work stoppages, slowdowns; shortage of cars, fuel, electric power or labor; delays in transportation; plant closure; compliance with any governmental order or regulation; inability to obtain on reasonably acceptable terms any public or private license, permit or other authorization; curtailment or suspension of activities to remedy or avoid an actual or alleged, present or prospective enforcement of federal, state or local environmental standards; or any other similar or dissimilar contingency beyond the control of

Seller, then Seller shall be excused from such performance during the continuance of such contingency; provided that Seller notifies Buyer as promptly as is reasonably possible (i) of Seller's inability to perform and (ii) when, in Seller's reasonable judgment, full performance is likely to be resumed.

8. If extraordinary circumstances beyond the Seller's reasonable control significantly increase Seller's cost of performance of its obligations hereunder, upon the request of Seller, the parties shall adjust the conditions of related to Seller's obligations hereunder in order to reasonably alleviate the effect of such extraordinary circumstances. If the parties do not reach an agreement with regard to adjusted conditions occasioned by such extraordinary circumstances within thirty (30) days following the Seller's notification of the request, then Seller shall have the right, at its sole discretion, to terminate any obligation to Buyer upon thirty (30) days' notice to Buyer.

9. The purchase price shall be adjusted for all costs incurred by Seller hereunder in order to comply with any Federal, State or local law, regulation or order enacted, changed or amended after the date of the placement of any order by Buyer including, without limitation, fuel and other taxes, laws, regulations or orders relating to health, safety, conservation, reclamation, environmental protection, pollution control and air, water and soil standards but specifically excluding any and all income taxes. In the event that any Federal, State or local law, regulation or order is enacted, changed or amended after the date of the placement of any order by Buyer, Seller shall determine the cost per ton of goods sold hereuner to Seller in order to comply with such laws, regulations or orders and advise Buyer of such costs, verified by adequate supporting documentation. The amount so determined shall be added to the purchase price as an adjustment to become effective as and when such costs are incurred by Seller.

10. Buyer acknowledges and agrees that it is purchasing the goods from Seller for use in its operations, and that Buyer will not resell the goods to third parties at any time without the express written consent of Seller.

11. Buyer may not return either goods or orders or both once accepted by Buyer without Seller's prior written consent. If Seller consents to the return of goods hereunder, a cancellation fee shall be charged to Buyer in an amount equaling the total costs to Seller to restock such returned goods.

12. Unless otherwise stated, where bagged products are quoted or sold by weight, the weight shown shall include the containers.

13. Seller's obligation to perform hereunder is subject to the availability of goods sold hereunder at Seller's plant at the time shipment is required, and, in the event of shortage, Seller shall be obligated to sell and deliver only Buyer's pro rata share of goods available.

14. Prices quoted on annual contracts, if accepted within thirty (30) days by Buyer, shall be subject to revision unilaterally by Seller upon Seller's written notice thirty (30) days prior to the effective date of such revision.

15. Buyer shall not disclose any information related to the transaction between Buyer and Seller to any person, except to Seller's personnel as may reasonably be necessary to enable Seller to exercise its rights and perform its obligations. Notwithstanding the foregoing, Buyer may disclose any confidential information to the extent that disclosure is compelled in connection with legal or government proceedings or requests, or if the Buyer is required to report or disclose such confidential information by law or pursuant to the rules or regulations of any regulatory authority

having jurisdiction over the Buyer; provided, however, that should such disclosure be compelled or reporting required, the Buyer shall give notice to the Seller, as promptly as is reasonably practicable, before any such disclosure or reporting in order to permit the Seller to contest such disclosure or reporting.

16. Buyer and Seller acknowledge that the transaction contemplated hereunder bears a reasonable relation to the State of Arizona and agree that the internal law, and not the law of conflicts, of the State of Arizona will govern the rights and duties of Buyer and Seller hereunder. The Buyer and Seller specifically intend that the provisions of the Arizona Uniform Commercial Code shall control all aspects of the transaction between Buyer and Seller and its interpretation, and that all definitions contained in the Arizona Uniform Commercial Code shall be applicable here except when expressly provided otherwise herein.

17. These Standard Terms and Conditions reflect the negotiations of the Buyer and Seller. Language used herein shall be deemed to be the language chosen by the Buyer and Seller to express their mutual intent and no rule of strict construction shall be applied.

18. Whenever possible, each provision herein shall be interpreted in such a manner as to be effective and valid under applicable law; but if any provision herein is held to be prohibited by or invalid under applicable law, such prohibition or invalidity shall be effective only to the extent of such prohibition or invalidity without invalidating the remainder of the agreement between Buyer and Seller.

19. Buyer shall not assign any rights or obligations hereunder without Seller's prior written consent. The transaction between Buyer and Seller shall inure to the benefit of and be binding upon the Buyer and Seller and their respective permitted successors and assigns.

From: Brereton, Robert
To: Minchow, Kristina
Subject: Re: Chemical Quote update
Date: Thursday, May 30, 2019 1:33:27 AM
Attachments: image001.png
image001.png

EXTERNAL EMAIL

Hello Kristina,
Pricing has increased slightly in 2019.
For the 8182.15 the updated price is $3.36/lb and for the 8131.15 it is $0.93/lb. (.15 is our package code for drums)
Let me know if you need any additional info.

Best regards,
Robert Brereton
Global Mining-M2
208-848-6237

On May 29, 2019, at 10:23 AM, Minchow, Kristina <Kristina_Minchow@golder.com> wrote:

Robert,
My colleague Choolwe passed along your contact information.

Rolf helped us back in September providing a budgetary prices for a flocculant and coagulant. For an estimate on a similar project, can you tell us if the price of these chemicals (quote attached) has changed at all?

Flocculant 8182 aka 8872 is $3.29/lb in 55 gallon drums
Coagulant 8131 is $ 0.85/lb in 55 gallon drums

Thank you very much,
Kristina

<!--[if !vml]--><image003.jpg><!--[endif]-->**Kristina Minchow**
Environmental Process Engineer

44 Union Boulevard, Suite 300, Lakewood, Colorado, USA 80228
T: +1 303 980-0540 | **D:** +1 303 980-0540 x20552 | **golder.com**
LinkedIn | Facebook | Twitter

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<O&M Tab 2 - Flocculent.pdf>

From:	Amanda Billingsley
To:	Minchow, Kristina; Candy Fitzgerald
Cc:	bridgette.hendrick@golder.com
Subject:	RE: HCL price
Date:	Wednesday, May 29, 2019 11:55:37 AM
Attachments:	image002.png

Hi Kristina,
Product costs have not changed since October. You can still use the quote of 0.21# for bulk HCL 35%.

Thank you,

Amanda Billingsley
Commercial Support Lead - Energy
Univar Solutions
Office 801-933-6140

From: Minchow, Kristina <Kristina_Minchow@golder.com>
Sent: Wednesday, May 29, 2019 11:01 AM
To: Amanda Billingsley <amanda.billingsley@UnivarSolutions.com>; Candy Fitzgerald <candy.fitzgerald@UnivarSolutions.com>
Cc: bridgette.hendrick@golder.com
Subject: FW: HCL price

Amanda and Candy,

My original email to Tom bounced back. Can either of you help me with this estimate?
We were going to use the cost you provided us in October for an estimate on a similar project, can you tell us if the price of bulk HCl has changed at all?

The approximate delivery location would be the same, Silver City, NM.

Thank you very much,
Kristina

From: Tom Carroll <tom.carroll@univar.com>
Sent: Monday, October 1, 2018 1:57 PM
To: Hendricks, Bridgette <Bridgette_Hendricks@golder.com>
Cc: Amanda Billingsley <amanda.billingsley@univar.com>; Candy Fitzgerald <candy.fitzgerald@univar.com>
Subject: RE: HCL price

Hi Bridgette

HCL Totes
HYDROCHLORIC ACID 31% 20B 2600.0000 LB TK .3350/# FOB delivered

HCL Bulk
HCL 35% 22BE TECH LIQ 1 LB LB BULK .21/# 45,000# Truck Loads FOB Delivered

Thank you for the opportunity to quote on your chemical requirements

Tom Carroll
Account Manager
Univar Mining
19450 Hwy. 249, 3rd Floor, Houston, TX 77070
O 602 272 3272
M 602-684-7019
Tom.Carroll@univarusa.com

From: Candy Fitzgerald
Sent: Friday, September 28, 2018 11:25 AM
To: Tom Carroll
Cc: bridgette_hendricks@golder.com; Amanda Billingsley
Subject: FW: HCL price

Good Morning Tom,

Please quote Bridgette for a load of HCL delivering to Silver City New Mexico. She would like pricing on both bulk and totes.

Thanks and have a great day!

2018 Year of the CUSTOMER

Candy Fitzgerald
Customer Service Lead
Univar
Phoenix, AZ.
T (602) 455-4032

From: Hendricks, Bridgette [mailto:Bridgette_Hendricks@golder.com]
Sent: Friday, September 28, 2018 7:12 AM
To: Candy Fitzgerald
Subject: HCL price

Hi Candy,
I got your name from Alex Nowak at our office. I need a price for HCl delivered to Silver City New Mexico (zip code 88041). We're undecided yet whether we would use totes or bulk HCl at a usage of about 2 totes per week. Can you give me pricing for both totes and bulk delivery for concentrated HCl and also let me know what concentration.

Thanks for your help and let me know if you need additional information.
Bridgette

Bridgette Hendricks, MsChE
Senior Engineer

44 Union Boulevard, Suite 300, Lakewood, Colorado, USA 80228
T: +1 303 980-0540 | **D:** +1 303 980-0540 x20636 | **golder.com**
LinkedIn | Facebook | Twitter

From:	Minchow, Kristina
To:	Hendricks, Bridgette
Cc:	Elizabeth Travis (Elizabeth_Travis@golder.com)
Subject:	FW: Cost Estimation Southwest NM Water Treatment - Freight Estimate
Date:	Monday, June 17, 2019 10:10:00 AM
Attachments:	image003.png image004.png RSImage

Assuming the size of the shipment and the confirmation of prices from October 2018, the new shipping cost adds approximately $0.15 to the cost per pound. Adjusted costs are listed below and added to the overall spreadsheet.

MF High pH Cleaning Chemicals ($/lb)	=	$ 3.53	2019 Avista quote - pail price (assume bimonthly cleaning during high flows)
MF Low pH Cleaning Chemicals ($/lb)	=	$ 3.53	2019 Avista quote - pail price (assume bimonthly cleaning during high flows)
RO High pH Cleaning Chemicals ($/lb)	=	$ 7.52	2019 Avista quote - pail price (assume quarterly cleaning during high flows)
RO Low pH Cleaning Chemicals ($/lb)	=	$ 6.44	2019 Avista quote - pail price (assume quarterly cleaning during high flows)
Biocide ($/lb)	=	$ 8.15	2019 Avista quote - tote price
Antiscalant ($/lb)	=	$ 3.09	2019 Avista quote - tote price

-Kristina

From: Cheddy Tobias <ctobias@avistatech.com>
Sent: Tuesday, May 28, 2019 4:04 PM
To: Minchow, Kristina <Kristina_Minchow@golder.com>; Stuart Leak <sleak@avistatech.com>
Cc: Rob Goodlett <rgoodlett@avistatech.com>; Hendricks, Bridgette <Bridgette_Hendricks@golder.com>; Travis, Elizabeth <Elizabeth_Travis@golder.com>; Orders at Avista Technologies <orders@avistatech.com>
Subject: RE: Cost Estimation Southwest NM Water Treatment - Freight Estimate

EXTERNAL EMAIL

Hello Kristina,

Stuart Leak asked that an updated freight estimate be provided.

Freight estimate for 1 tote of Vitec 7000, 24 pails of cleaner and 1 tote of DB20 to ship from our CA warehouse 92069 to NM 88065 is $898.14 with a 3 business day transit via SAIA Quote#7862049. Please list quote number on applicable PO submitted.

Prepay and add freight quotes are estimates only provided by the carrier based on information available at the time. The actual freight charges reflected on our invoice may be different and will be based on the amount charged to Avista by the carrier.

Let us know if additional is needed.

Thanks and regards,

Cheddy Tobias
Inside Sales
O. +1 760.744.0536 ext. 124
avistatech.com

From: Minchow, Kristina <Kristina_Minchow@golder.com>
Sent: Tuesday, May 28, 2019 9:58 AM
To: Stuart Leak <sleak@avistatech.com>
Cc: Rob Goodlett <rgoodlett@avistatech.com>; Cheddy Tobias <ctobias@avistatech.com>; Hendricks, Bridgette <Bridgette_Hendricks@golder.com>; Travis, Elizabeth <Elizabeth_Travis@golder.com>
Subject: RE: Cost Estimation Southwest NM Water Treatment

Good Morning Stuart,
We were going to use the costs you provided us (see communication below) in October for an estimate on a similar project, can you tell us if the price of membrane chemicals has changed at all?

The approximate delivery location would be the similar, Silver City, NM 88065.

Thank you very much for your help,
Kristina

Kristina Minchow
Environmental Process Engineer

44 Union Boulevard, Suite 300, Lakewood, Colorado, USA 80228
T: +1 303 980-0540 | **D:** +1 303 980-0540 x20552 | **golder.com**
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Hello Alex,

Thank you for checking with Avista for budgetary estimates for the upcoming business, please keep in mind that these are estimates and we will need additional information to properly asses the site cost. Another note, Avista's antiscalant is typically injected between 2-3 ppm which can equate to ½ the chemical usage of other manufactures and our cleaners typically mix at a 2% Solution. This will all depend on the feed water and the severity of foulant on the membranes.

Freight estimates to ship product from our CA warehouse 92069 to NM 88036 is as follows via SAIA with a 3 day transit:

1. To ship all of below in one shipment = $1,077.53
2. To ship one tote of Vitec 7000 = $522.64
   2500 lb tote @ $2.94 suggested retail.
3. To ship one pallet of 24 pails of cleaner = $276.20
   45lb pails MF high/low cleaner $3.38 lb. suggested retail
   45lb pail RO low cleaner $6.29 lb. suggested retail
   45lb pail RO high cleaner $7.37 lb. suggested retail
4. To ship one tote of biocide = $463.48
   2500 lb tote@ $8.00 lb. suggested retail

Please let me know if you need any additional information or if there is any other application we are able to offer our support with.

Thank you and have a great day.

Best Regards,

Stuart Leak
Applications and Sales

Avista Technologies, Inc.
140 Bosstick Boulevard
San Marcos, California 92069

Tel. | +1.760.744.0536
Cell | +1.936.245.2482
Fax. | +1.760.744.0619
sleak@avistatech.com
www.avistatech.com

Avista TECHNOLOGIES *Creative Chemistry. Smart Solutions.*

A trusted expert in membrane system chemistry and global process support.

• REVERSE OSMOSIS • MICRO/ULTRA FILTRATION • MULTIMEDIA FILTRATION

From: Nowak, Alex <Alex_Nowak@golder.com>
Sent: Thursday, October 4, 2018 5:05 PM

To: Stuart Leak <sleak@avistatech.com>; Rob Goodlett <rgoodlett@avistatech.com>
Subject: Cost Estimation Southwest NM Water Treatment

Hello!
Thanks again for giving the seminar at Golder last week. I did come across a few items I was hoping you could assist me with or at least point me in the right direction. We are assembling quotes for a water treatment plant (focused on sulfate removal) that will be located near Silver City, NM and were hoping you had an idea of cost per pound+freight estimations for:
1. RO Antiscalant
2. MF/RO cleaning agents
3. Biocide
I don't need time consuming quotes for this, more of a high level budgetary estimate of commonly sold products, but let me know if you do need further detail to provide the information.

Best,

Alex Nowak
Water Treatment Operations Engineer

44 Union Boulevard, Suite 300, Lakewood, Colorado, USA 80228
T: +1 303 980-0540 | **golder.com**
LinkedIn | Facebook | Twitter

Work Safe, Home Safe

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

QUOTATION

Quote#: **1480**
Date: **10/5/2018**

Company:	Golder Associates	Project:	Water Quality Testing
Contact:	Alex Nowak	TAT:	5 working days
Address:	44 Union Blvd STE 300	QC Level:	LEVEL II
		Project Manager:	Andy Freeman
	Lakewood, CO 80228	Sales Rep:	
Phone:		Quote Expires:	12/31/2019
Fax:			

Item Description	Test	Matrix	Remarks	Qty	Unit Price	Total
EPA Method 300.0: Anions	E300	Aqueous	Cl, NO3, F, SO4	1	70.00	70.00
SM2320B: Alkalinity	SM2320B	Aqueous		1	25.00	25.00
SM2540C MOD: Total Dissolved S	M2540C	Aqueous		1	25.00	25.00
EPA Method 200.7: Metals	E200.7	Aqueous	Ca, Mg, Na, K, Al, Cd, Cr, Co, Fe, Mn, Mo, Ni, Ag, V, Zn	1	203.00	203.00
EPA 200.8: Metals	E200.8	Aqueous	As, Cu, Pb, Se	1	80.00	80.00

Sub Total:	$403.00
Misc:	$0.00
Surcharge:	0%
TOTAL:	**$403.00**

Sincerely,

Jackie Bell

Jackie Bolte
Administration
Phone: 505-345-3975
Email: jnb@hallenvironmental.com

Terms and Conditions:

Hall Environmental Analysis Laboratory (HEAL) will provide all sampling containers, coolers, chains of custody and labels. A standard data deliverables package and QC package will be provided with this report, including lab spikes and lab spike duplicates. NM State tax has not been included in this quotation. Thank you, for the opportunity to bid on this project. Please feel free to call with any questions (505) 345-3975.. Invoices can be paid via Visa, Master Card, American Express, Company Check or Cash.

ATTACHMENT B4

Water Conveyance Materials and Cost Backup Details

Tab 1: Water Management Variables Evaporative Treatment and Water Conveyance Systems

Description	Variable
RSMeans NM Discount Rate	0.847
Polyethylene Tank Life Expectancy (yr)	50
Steel Tank Life Expectancy (yr)	50
Lined Pond Life Expectancy (yr)	30
Pump Life Expectancy (yr)	20
HDPE Pipeline Life Expectancy (yr)	100
Reclamation Start Year (End of Year 2014)	0
Reclamation Finished (End of Year 2031)	17
Vegetation Established Assume stormwater released	12
Short-Term Evaporative Treatment System Start Year (Beginning of Year 2015)	1
Short-Term Evaporative Treatment System Finish Year (End of Year 2023)	9
Long-Term Evaporative Treatment System Start Year (Beginning of Year 2024)	10
Long-Term Evaporative Treatment System Finish Year (End of Year 2114)	100
TTS Water Treatment System Start Year (Beginning of Year 2029)	15
TTS Water Treatment System Finish Year (End of Year 2114)	100

Tab 2: WATER TREATMENT CONVEYANCE SYSTEM - CAPEX at Start of TTS (Beginning of Year 15 Following Closure)
Rev. 1

Created by: Arielle Dobrowolski
Checked by: Wade Wang
Approved by: JP Wu
Revised by: **Todd Stein (4/14/2020)**

Pipelines and Pumps CAPEX and Replacement Schedule

From	To	Length (ft)	Max Flow (gpm)	Replacement Material	Nom. Replacement Pipe Size (in)	Replacement Pipe Schedule	Existing Pipeline	Material and Installation Cost	Total Installed Direct Cost	CAPEX	Comments	Assumed Age at Start of TTS (Yr 15)	1st Relacement Year	2nd Relacement Year	3rd Relacement Year	4th Relacement Year	5th Relacement Year
Low TDS ansd Sulfate Sources to TTS																	
Main Pit	SX/EW PLS Feed Pond	13,800	693	HDPE PE4710	8	11	Yes	$15.66	$216,108	$0	RS Means bare costs for materials and installation (Line No. 331413350300)	25	90	NA	NA	NA	NA
Pit Interceptor Wells	TTS	14,600	300	HDPE PE4710	6	17	No	$10.93	$159,578	$159,578	RS Means bare costs for materials and installation (Line No. 331413350200)	0	NA	NA	NA	NA	NA
Copper Mountain Pit	North Racket Sump	1758	37	HDPE PE4710	2	9	Yes	$6.45	$11,339	$0	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	25	90	NA	NA	NA	NA
North Racket Sump	SX/EW PLS Feed Pond	13923	37	HDPE PE4710	2	9	Yes	$6.45	$89,803	$0		25	90	NA	NA	NA	NA
Gettysburg Pit	Gettysburg Highwall Tank	1369	60	HDPE PE4710	2	9	Yes	$6.45	$8,830	$0	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	25	90	NA	NA	NA	NA
Gettysburg Highwall Tank	EM Booster	2788	60	HDPE PE4710	2	9	Yes	$6.45	$17,983	$0		25	90	NA	NA	NA	NA
Savanna Pit	EM Booster	2277	11.2	HDPE PE4710	2	9	Yes	$6.45	$14,687	$0		25	90	NA	NA	NA	NA
EM Booster	SX/EW PLS Feed Pond	14500	71.2	HDPE PE4710	2	9	Yes	$6.45	$93,525	$0		25	90	NA	NA	NA	NA
1X1 Pond	No.3 PLS Overflow/No. 3 AST	14765	9.9	HDPE PE4710	2	17	Yes	$6.45	$95,234	$0	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	25	90	NA	NA	NA	NA
No. 3 Stockpile New Collection N. of Cnyn. 7	No.3 PLS Overflow/No. 3 AST	1884	2.71	HDPE PE4710	2	17	Yes	$6.45	$12,152	$0		25	90	NA	NA	NA	NA
No. 3 Stockpile New Collection N. of Cnyn. 10-11	No.3 PLS Overflow/No. 3 AST	5025	1.86	HDPE PE4710	2	17	Yes	$6.45	$32,411	$0		25	90	NA	NA	NA	NA
No.3 PLS Overflow/No. 3 AST	SX/EW PLS Feed Pond	6045	14.47	HDPE PE4710	2	9	Yes	$6.45	$38,990	$0		25	90	NA	NA	NA	NA
Oak Grove Pond	1A AST Overflow Pond	11470	3.3	HDPE PE4710	2	17	Yes	$6.45	$73,982	$0	RS Means bare costs for materials and installation, based on a curve fit of individual bare rate costs for pipe sizes provided in RS Means (Line No's. 331413350100 through 331413350900)	25	90	NA	NA	NA	NA
Oak Grove/Brick Kiln Pumpback Systems	1A AST Overflow Pond	5295	0.6	HDPE PE4710	2	17	Yes	$6.45	$34,153	$0		25	90	NA	NA	NA	NA
Future OGW Collection Trench	1A AST Overflow Pond	6744	31	HDPE PE4710	2	17	Yes	$6.45	$43,499	$43,499		8	NA	NA	NA	NA	NA
Future 1C Stockpile Area Extraction System	1A AST Overflow Pond	2190	50	HDPE PE4710	2	17	Yes	$6.45	$14,126	$14,126		8	NA	NA	NA	NA	NA
1A AST Overflow Pond	1B PLS Overflow Pond	3958	84.9	HDPE PE4710	4	17	Yes	$6.70	$26,519	$0	RS Means bare costs for materials and installation (Line No. 331413350100)	25	90	NA	NA	NA	NA
1B PLS Overflow Pond	SX/EW PLS Feed Pond	23419	84.9	HDPE PE4710	4	9	Yes	$6.77	$158,547	$0		25	90	NA	NA	NA	NA
							Total Piping:		**$1,141,464**	**$217,202**							

Tab 2: WATER TREATMENT CONVEYANCE SYSTEM - CAPEX at Start of TTS (Beginning of Year 15 Following Closure)
Rev. 1

Created by: Arielle Dobrowolski
Checked by: Wade Wang
Approved by: JP Wu
Revised by: Todd Stein (4/14/2020)

Pumps

From	To	Quantity	Design Flow Rate (gpm)	Total Head (ft)	Assumed Motor Rating, hp	Material Cost	Total Material	Installation Cost	Total Installed Direct Cost	CAPEX	Comments	Assumed Age at Start of TTS (Yr 15)	1st Relacement Year	2nd Relacement Year	3rd Relacement Year	4th Relacement Year	5th Relacement Year
Main Pit	SX/EW PLS Feed Pond	2	450	1200	75	$38,960	$77,920	$17,913	$95,833	$95,833	Sump pump estimate based on historical database of actual pump costs on various Golder projects. Unit hours required to install each pump were taken from Estimator Piping Man-Hour Manual Book, based on pump horse power. $85/hr was used for labor rate.	0	35	55	75	95	NA
Pit Interceptor Wells	TTS	4	320	1300	30	$21,008	$84,032	$9,852	$93,884	$93,884		0	35	55	75	95	NA
Copper Mountain Pit	North Racket Sump	1	50	300	5	$12,560	$12,560	$6,269	$18,829	$18,829		0	35	55	75	95	NA
North Racket Sump	SX/EW PLS Feed Pond	1	50	550	5	$12,560	$12,560	$6,269	$18,829	$18,829		0	35	55	75	95	NA
Gettysburg Pit	Gettysburg Highwall Tank	1	100	470	15	$15,728	$15,728	$6,269	$21,997	$21,997		0	35	55	75	95	NA
Gettysburg Highwall Tank	EM Booster	1	80	560	15	$15,728	$15,728	$6,269	$21,997	$21,997		0	35	55	75	95	NA
Savanna Pit	EM Booster	1	15	400	5	$12,560	$12,560	$6,269	$18,829	$18,829		0	35	55	75	95	NA
EM Booster	SX/EW PLS Feed Pond	1	80	460	15	$15,728	$15,728	$6,269	$21,997	$21,997		0	35	55	75	95	NA
1X1 Pond	No.3 PLS Overflow/No. 3 AST	1	16	75	1	$7,500	$7,500	$6,269	$13,769	$0		5	30	50	70	90	NA
No. 3 Stockpile New Collection N. of Cnyn. 7	No.3 PLS Overflow/No. 3 AST	5	5	200	0.5	$7,500	$37,500	$6,269	$43,769	$0		5	30	50	70	90	NA
No. 3 Stockpile New Collection N. of Cnyn. 10-11	No.3 PLS Overflow/No. 3 AST	7	5	230	0.5	$7,500	$52,500	$6,269	$58,769	$0		5	30	50	70	90	NA
No.3 PLS Overflow/No. 3 AST	SX/EW PLS Feed Pond	1	50	611	5	$12,560	$12,560	$6,269	$18,829	$18,829		0	35	55	75	95	NA
Oak Grove Pond	1A AST Overflow Pond	0	50	NA	NA	$0	$0	$0	$0	$0	Gravity System						NA
Oak Grove/Brick Kiln Pumpback Systems	1A AST Overflow Pond	4	5	70	0.5	$7,500	$30,000	$6,269	$36,269	$0	Sump pump estimate based on historical database of actual pump costs on various Golder projects. Unit hours required to install each pump were taken from Estimator Piping Man-Hour Manual Book, based on pump horse power. $85/hr was used for labor rate.	5	30	50	70	90	NA
Future OGW Collection Trench	1A AST Overflow Pond	1	45	70	1	$7,500	$7,500	$6,269	$13,769	$13,769		8	27	47	67	87	NA
Future 1C Stockpile Area Extraction System	1A AST Overflow Pond	1	62	50	1	$7,500	$7,500	$6,269	$13,769	$13,769		8	27	47	67	87	NA
1A AST Overflow Pond	1B PLS Overflow Pond	1	100	141	10	$15,000	$15,000	$9,852	$24,852	$24,852		0	35	55	75	95	NA
1B PLS Overflow Pond	SX/EW PLS Feed Pond	1	100	512	15	$15,728	$15,728	$6,269	$21,997	$21,997		0	35	55	75	95	NA

Total Pumps:	**$557,992**	**$405,414**
ALLOWANCE FOR MINOR MECHANICAL, ELECTRICAL, INSTRUMENTATION, AND UNDEFINED SCOPE (5%):	**$84,973**	**$31,131**
TOTAL DIRECT COST:	**$1,784,428**	**$653,747**
TOTAL CONSTRUCTION COST:	**$1,785,000**	**$654,000**

Notes:
Pump Life Expectancy – 20 years
HDPE Pipeline Life Expectancy – 100 years
NA - Not applicable
Pump Life Expectancy – 20 years
HDPE Pipeline Life Expectancy – 100 years
NA - Not applicable
1. Pump estimates derived from averages of previous quotes with similar specifications in Golder pump database.
2. Installation cost of pump assumes labor cost of $85/hr using Flour Estimating manual to calculate number of hours based on pump size. Crane equipment cost of $146/day is added assuming a 4 man crew.
3. Golder assumes any pump motor above 70hp to be a centrifugal pump and any below 70hp a vertical submersible pump. Second Quarter 2019 RS Means used for all pipe costs.

Tab 3: WATER TREATMENT CONVEYANCE SYSTEM - CAPEX at Start of TTS (Beginning of Year 15 Following Closure)
Rev. 1

Created by: Todd Stein
Date: 4/14/2020

Reservoirs and Tanks CAPEX and Replacement Schedule

Reservoir/Tank ID	Current Size (ac)	New/Replacement Size (ac)	New/Replacement Size (sf)	New/Replacement Cost	Assumed Age at Start of TTS (Yr 15)	CAPEX	1st Relacement Year	2nd Relacement Year	3rd Relacement Year
1X1 Pond	0.75	0.75	32,670	$ 48,352	25		20	50	80
SX/EW PLS Feed Pond	0.34	0.34	14,810	$ 21,919	25		20	50	80
New AST for 3A Seepage Water (No. 3 AST)	NA	NA	NA	$ 32,000	6	$32,000	9	59	NA
1A AST Overflow Pond	1.0	1.0	43,560	$ 64,469	25		20	50	80
1B PLS Overflow Pond	1.37	1.37	59,677	$ 88,322	25		20	50	80
Oak Grove Pond	0.25	0.25	10,890	$ 16,117	25		20	50	80
1 AST Overflow Pond	0.12	0.12	5,227	$ 7,736	25		20	50	80
Well	**Depth (ft)**	**Number of Wells**	**Total Footage (ft)**	**New/Replacement Cost**	**Assumed Age at Start of TTS (Yr 15)**	**CAPEX**	**1st Relacement Year**	**2nd Relacement Year**	**3rd Relacement Year**
Pit Interceptor Wells	220	4	880	$ 59,629	0	$ 59,629	NA	NA	NA
Total for Complete System:				**$ 338,544**		**$ 32,000**	Yr 9		
						$ 59,629	Yr14		

Notes:

Heavy Duty Plastic Tank Life Expectancy (yr)	50		
Steel Tank Life Expectancy (yr)	50		
Lined Pond Life Expectancy (yr)	30		
Well Drilling and Installation	67.76	$/FT	Telesto Solutions, Inc. 2019. Appendix A Cost Spreadsheet "20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE.xlsx"
80 mil Geomembrane Liner	$ 1.48	$/SF	Second Quarter 2019 RS Means 310519531100-310519531300 (1500 sf daily output), Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 80 mil thick, per S.F.

Norwesco 20000 Gallon Heavy Duty Vertical Liquid Storage Tank July 2019 online quote ($24,000 = assumed $3,000 shipping and $5,000 installation. Total = $32,000)

Tabl 4: TTS Treated Water DischargeSystem - CAPEX
Rev.1

Created by: Arielle Dobrowolski
Checked by: Wade Wang
Approved by: JP Wu
Revised: T. Stein (4/14/2020)
Note: Originally developed for the Chino CCP Update and modified for the TTS

Pipeline

From	To	Length (ft)	Material	Nom. Pipe Size[2] (in)	Pipe Schedule	Material and Installation Unit Cost[1,2]	Total Installed Direct Cost	Comments
TTS Water Treatment Plant	Tributary Arroyo to Mangas Wash between the 3A Leach Stockpile and the reclaimed 1 Series Tailing Impoundment	2900	HDPE PE4710	14	DR17	$31.78	$92,162	RS Means bare costs for materials and installation (Line No. 331413350600) open shop, Las Cruces, 2019 Q2.

Tank

Location	Quantity	Total Retention Time (min)	Retention Volume (gal)	Tank height (ft)	Tank Diameter (ft)	Material Cost	Installation Cost	Total Installed Direct Cost	Comments
TTS Water Treatment Plant	1	0	0	0	0	$66,867	$37,016	$103,883	Carbon Steel Tank estimate based on historical data (Tank material + installation cost = 86,606 in 2013), escalated 3% per year up to the EOY 2018

Articulated Concrete Block (ACB) Energy Dissipation Structure (costs and energy dissipation details from Telesto Earthworks reclamation cost estimate)

Location	Component	Area (sf)	Volume (cf)	Unit Cost[3]	Total Installed Direct Cost	Comments
Tributary Arroyo to Mangas Wash between the 3A Stockpile and the reclaimed 1 Series Tailing Impoundment	70T ACB	500	---	$10.65	$5,325	See Telesto's Downdrain Unit Cost Detail Sheet for the 2019 Chino CCP Update Revision for Additional Specifications
	Installation	500	---	$4.63	$2,315	
	40T ACB	600	---	$7.42	$4,452	
	Installation	600	---	$4.63	$2,778	
	Cutoff Wall (cast in-place concrete)	---	14	$254.97	$3,570	
Grand Total:					$18,440	

TOTAL DIRECT COST: **$214,484**

TOTAL CONSTRUCTION COST: **$214,490**

Notes:
1. Pipe material cost based on $1.3 per lb
2. Piping and energy dissipator structure sized for estimated flows plus a 30% contingency.
3. Quote from Contech ES 2018; Downdrain ACB installation includes fine grade base/subgrade soils (assuming subgrade at + 0.5 ft); equipment is D6 LGP dozer with Power Angle Tilt Blade (PAT) and GPS Blade Control

Tab 5: Energy Dissipation Structure Cost Estimate Details

From Telesto Solutions, Inc, Chino CCP Reclamation Cost Estimate

Downdrain Unit Cost

Rough Grade

Task Description	Equipment	Productivity (cy/hr)	Material Factor[5]	Grade Factor[5]	Soil Weight[5] (lb/cy)	Production Method/Blade Factor[5]	Centroid to Centroid Push Distance[5] (ft)	Normal Production (cy/hr)	Operator Factor[5]	Work Hour[5] (min/hr)	Visibility Factor[5]	Elevation Factor[5]	Transmission Factor[5]	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Equipment w/o Fuel Cost ($/ft)	Fuel Cost ($/ft)	Total Excavation Cost ($/ft)
Excavate	Cat D11T CD	1731	1.2	1.6	2900	1.0	175	1851	0.75	50	1.0	1.0	1.0	1.9	0.0011	$69.62	$254.44	$27.41	$281.85	$0.31	0.0774689	$0.39
Waste	Cat D11T CD	1542	1.2	1.6	2900	1.0	200	1649	0.75	50	1.0	1.0	1.0	1.9	0.0012	$69.62	$254.44	$27.41	$281.85	0.4521481	0.088975	$0.44
																				$0.67	$0.16	$0.83

Finish Grade & Place ACB

	Area (sf/ft)	Unit Cost ($/sf)	$/ft
Downdrain ACBs			
40T[1]	31	$7.42	$230.02
Installation[1]	31	$4.63	$143.53
		ACB Cost/ft	$373.55

Total Downdrain Cost ($/ft)	$374.38

Place ACB

Dissipater ACBs	Area (sf)	Unit Cost ($/sf)	$/sf
30T[1]	320	$10.65	$3,408.00
Installation[1]	320	$4.63	$1,481.60
40T[1]	506	$7.42	$3,754.52
Installation[1]	506	$4.63	$2,342.78
		ACB Cost per Dissipater	$10,986.90

Install Cutoff Wall

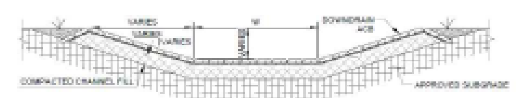
Cutoff Wall (cast in place concrete)	cubic yard	$/cubic yard	$/dissipater[3]
RSMeans (2018)	14	$ 254.97	$3,569.58

Total Dissipater Cost ($/each)	$14,556.48

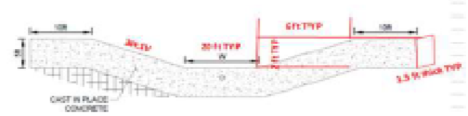
	Downdrains Lengths[2] (ft)	Downdrain Dissipators[2] (ft)
South	6474	2
STS2	0	0
Main LB	9299	4
South LB	0	0
West	4493	4
NW	0	0
LH	0	0
NE	0	0
N	0	0
3A	0	0
Santa Rita	0	0
Upper South	0	0
Triangle	0	0
Ashflow	0	0
TP7	2280	0
TP-6W & TP-6E	319	0
	22866	10

DOWNDRAIN Dimensions:		
Left Side Slope:[2]	3	H:1V
Left Side Slope:[2]	3	H:1V
Depth:[2]	2	ft
Perimeter:[2]	31	ft
Excavation Area[2]	52	sf
ACB Area[2]	31	sf

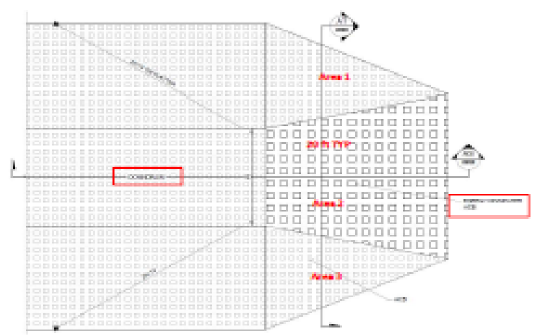
DISSIPATERS		ACB[2]				Cutoff Wall[3,4]		
		Surface Area 1 (sf)	Surface Area 2 (sf)	Surface Area 3 (sf)	Total (sf)	Cross-Sectional Area (sf)	Thickness (ft)	Volume (cy)
Main Lampbright Stockpile	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14
	3	253	320	253	825	260	1.5	14
	4	253	320	253	825	260	1.5	14
West Stockpile	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14
	3	253	320	253	825	260	1.5	14
	4	253	320	253	825	260	1.5	14
South Stockpile	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14



TYPICAL DOWNDRAIN SECTION



TYPICAL CUTOFF WALL SECTION



TYPICAL TOE ENERGY DISSIPATOR PLANFORM

1. Quote from Contech ES 2018; Downdrain ACB installation includes fine grade base/subgrade soils (assuming subgrade at + 0.5 ft); equipment is D6 LGP dozer with Power Angle Tilt Blade (PAT) and GPS Blade Control
2. Data from Golder Takeoffs Spreadsheet 2018
3. One cutoff wall per dissipator
4. Typical flow depth is 2'; concrete depth is 5' (diagram is not drawn to scale); concrete thickness is 1.5'
5. Data from Table 3 and 4 of the Process Summary (SOW), Nov 2017 (Telesto)
6. Excavation volume is smaller than SOW because ACB's require less excavation than riprap

ATTACHMENT B5

Sludge and Salt Disposal Cost Backup Details

Tab 1:
Salt and Sludge Disposal Construction Cost Details

Stage	Line No.	Direct / Indirect	Item Name	Neat Qty	Qty UoM	Composite Cost/Unit	Composite Cost $/UoM	Cost	Cost Source / Remarks
	1	2	3	4	5	6	7	8	9
Sludge Disposal Facility									
1000 Sitework					**Sludge Disposal Facility Sub-total:**			**$142,305**	
	1	Direct	Diversion Ditch	4,758	CY	$ 1.25	$/CY	$5,948	
	2	Direct	Compact Surface (prep below sludge, evap, berm, ditch	1,303,656	SF	$ 0.17	$/SF	$4,101	
	3	Direct	Evap Berm	4,111	CY		$/CY	$0	Place ditch excavation to build berm
	4	Direct	Evap Pond					-	
	4A	Direct	80-mil HDPE Liner	88,800	SF	$ 1.48	$/SF	$131,424	
	4B	Direct	Anchor Trench	176	CY	$ 4.72	$/CY	$832	
Salt Disposal Facility									
3000 Sitework					**Salt Disposal Facility : Sub-total:**			**$987,991**	
	3	Direct	Evap Berm	3,208	CY	$ 1.25	$/CY	$4,010	
	2	Direct	Compact Stockpile Surface (prep below salt, berm)	663,204	SF	$ 0.17	$/SF	$2,086	
	4A	Direct	80-mil HDPE Liner	663,204	SF	$ 1.48	$/SF	$981,542	
	4B	Direct	Anchor Trench	505	CY	$ 4.72	$/CY	$353	
						Total:		**$1,130,296**	

Tab 2:
Rollup Cost Estimate Details For Sludge Disposal and Salt Disposal Facilities (Construction and Reclamation)

Stage	Line No.	Direct / Indirect	Item Name	Neat Qty	Qty UoM	Composite Cost/Unit	Composite Cost $/UoM	Cost	Cost Source / Remarks
	1	2	3	4	5	6	7	8	9
Sludge Disposal Facility									
1000 Sitework						Sludge Disposal Facility Sub-total:		$350,503	
Construction	1	Direct	Diversion Ditch	4,758	CY	$ 1.25	$/CY	$5,948	$142,305
Construction	2	Direct	Compact Surface (prep below sludge, evap, berm, ditch	1,303,656	SF	$ 0.17	$/SF	$4,101	
Construction	3	Direct	Evap Berm	4,111	CY		$/CY	$0	Place ditch excavation to build berm
Reclamation	4	Direct	Cell #1					-	
Reclamation	5	Direct	Cover Pit Sludge Cell #1 (load & haul)	30,250	CY	$ 1.00	$/CY	$39,628	$46,311
Reclamation	6	Direct	Cover Pit Sludge Cell #1 (spread)	6.3	AC	$ 47.65	$/AC	$298	
Reclamation	7	Direct	Revegetate Sludge Cell #1	6.3	AC	$ 823.97	$/AC	$5,150	
Reclamation	8	Direct	Maintain Sludge Cell #1 Vegetation	1.5	AC	$ 823.97	$/AC	$1,236	Assume 24% of initial acreage
Reclamation	9	Direct	Cell #2					-	
Reclamation	10	Direct	Cover Pit Sludge Cell #2 (load & haul)	30,250	CY	$ 1.00	$/CY	$39,628	$46,311
Reclamation	11	Direct	Cover Pit Sludge Cell #2 (spread)	6.3	AC	$ 47.65	$/AC	$298	
Reclamation	12	Direct	Revegetate Sludge Cell #2	6.3	AC	$ 823.97	$/AC	$5,150	
Reclamation	13	Direct	Maintain Sludge Cell #2 Vegetation	1.5	AC	$ 823.97	$/AC	$1,236	Assume 24% of initial acreage
Reclamation	14	Direct	Cell #3					-	
Reclamation	15	Direct	Cover Pit Sludge Cell #3 (load & haul)	30,250	CY	$ 1.00	$/CY	$39,628	$46,311
Reclamation	16	Direct	Cover Pit Sludge Cell #3 (spread)	6.3	AC	$ 47.65	$/AC	$298	
Reclamation	17	Direct	Revegetate Sludge Cell #3	6.3	AC	$ 823.97	$/AC	$5,150	
Reclamation	18	Direct	Maintain Sludge Cell #3 Vegetation	1.5	AC	$ 823.97	$/AC	$1,236	Assume 24% of initial acreage
Reclamation	19	Direct	Cell #4					-	
Reclamation	20	Direct	Cover Pit Sludge Cell #4 (load & haul)	30,250	CY	$ 1.00	$/CY	$39,628	$46,311
Reclamation	21	Direct	Cover Pit Sludge Cell #4 (spread)	6.3	AC	$ 47.65	$/AC	$298	
Reclamation	22	Direct	Revegetate Sludge Cell #4	6.3	AC	$ 823.97	$/AC	$5,150	
Reclamation	23	Direct	Maintain Sludge Cell #4 Vegetation	1.5	AC	$ 823.97	$/AC	$1,236	Assume 24% of initial acreage
	24	Direct	Evap Pond					-	
Construction	25	Direct	80-mil HDPE Liner	88,800	SF	$ 1.48	$/SF	$131,424	
Construction	26	Direct	Anchor Trench	176	CY	$ 4.72	$/CY	$832	$23,786
Reclamation	27	Direct	Backfill Evap Pond to within 3 FT of Surface Prior to Cover	8,500	CY	$ 1.00	$/CY	$8,494	
Reclamation	28	Direct	Grade Evap Pond Backfill	2.0	AC	$ 47.65	$/AC	$97	
Reclamation	29	Direct	Cover Evap Pond (load & haul)	9,300	CY	$ 1.00	$/CY	$12,183	
Reclamation	30	Direct	Cover Evap Pond (spread)	2.0	AC	$ 47.65	$/AC	$97	
Reclamation	31	Direct	Revegetate Evap Pond	2.0	AC	$ 823.97	$/AC	$1,680	
Reclamation	32	Direct	Maintain Vegetation	0.5	AC	$ 823.97	$/AC	$403	Assume 24% of initial acreage

Tab 2:
Rollup Cost Estimate Details For Sludge Disposal and Salt Disposal Facilities (Construction and Reclamation)

Stage	Line No.	Direct / Indirect	Item Name	Neat Qty	Qty UoM	Composite Cost/Unit	Composite Cost $/UoM	Cost	Cost Source / Remarks
	1	2	3	4	5	6	7	8	9
Salt Disposal Facility									
3000 Sitework					**Salt Disposal Facility : Sub-total:**			**$1,102,837**	
Construction	33	Direct	Evap Berm	3,208	CY	$ 1.25	$/CY	$4,010	$990,022
Construction	34	Direct	Compact Stockpile Surface (prep below salt, berm)	663,204	SF	$ 0.17	$/SF	$2,086	
Construction	35	Direct	80-mil HDPE Liner	663,204	SF	$ 1.48	$/SF	$981,542	
Construction	36	Direct	Anchor Trench	505	CY	$ 4.72	$/CY	$2,384	
Reclamation	37	Direct	Cell #1					-	
Reclamation	38	Direct	Cover Pit Sludge Cell #1 (load & haul)	18,422	CY	$ 1.00	$/CY	$24,133	$28,204
Reclamation	39	Direct	Cover Pit Sludge Cell #1 (spread)	3.8	AC	$ 47.65	$/AC	$181	
Reclamation	40	Direct	Revegetate Sludge Cell #1	3.8	AC	$ 823.97	$/AC	$3,136	
Reclamation	41	Direct	Maintain Sludge Cell #1 Vegetation	0.9	AC	$ 823.97	$/AC	$753	Assume 24% of initial acreage
Reclamation	42	Direct	Cell #2					-	
Reclamation	43	Direct	Cover Pit Sludge Cell #2 (load & haul)	18,422	CY	$ 1.00	$/CY	$24,133	$28,204
Reclamation	44	Direct	Cover Pit Sludge Cell #2 (spread)	3.8	AC	$ 47.65	$/AC	$181	
Reclamation	45	Direct	Revegetate Sludge Cell #2	3.8	AC	$ 823.97	$/AC	$3,136	
Reclamation	46	Direct	Maintain Sludge Cell #2 Vegetation	0.9	AC	$ 823.97	$/AC	$753	Assume 24% of initial acreage
Reclamation	47	Direct	Cell #3					-	
Reclamation	48	Direct	Cover Pit Sludge Cell #3 (load & haul)	18,422	CY	$ 1.00	$/CY	$24,133	$28,204
Reclamation	49	Direct	Cover Pit Sludge Cell #3 (spread)	3.8	AC	$ 47.65	$/AC	$181	
Reclamation	50	Direct	Revegetate Sludge Cell #3	3.8	AC	$ 823.97	$/AC	$3,136	
Reclamation	51	Direct	Maintain Sludge Cell #3 Vegetation	0.9	AC	$ 823.97	$/AC	$753	Assume 24% of initial acreage
Reclamation	52	Direct	Cell #4					-	
Reclamation	53	Direct	Cover Pit Sludge Cell #4 (load & haul)	18,422	CY	$ 1.00	$/CY	$24,133	$28,204
Reclamation	54	Direct	Cover Pit Sludge Cell #4 (spread)	3.8	AC	$ 47.65	$/AC	$181	
Reclamation	55	Direct	Revegetate Sludge Cell #4	3.8	AC	$ 823.97	$/AC	$3,136	
Reclamation	56	Direct	Maintain Sludge Cell #4 Vegetation	0.9	AC	$ 823.97	$/AC	$753	Assume 24% of initial acreage

Tab 3
Unit Rate Buildups for Sludge Disposal and Salt Disposal Facilites

Sludge Disposal Facility	Bare Rate		Unit of Measure	Reference	Comment
Ditch Excavation / Berm Placement					
Excavate	$	1.25	$/CY	Second Quarter 2019 RS Means 312316420250	1000 CY per day, Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 125 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading
Cover					
Load, Haul & Place					
Load/Haul		1.00	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, EarthSum Tab
Spread	$	47.65	$/acre	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, EarthSum Tab
Revegetation					
Revegetate	$	823.97	$/acre	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Unit Rates Tab
Surface Prep Evap Pond					
Compaction					
Compaction		0.14	$/ECY	Second Quarter 2019 RS Means 312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts
Water Truck		$0.03	$/ECY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Equipment and EarthSum Tabs
Total	$	0.17	$/ECY		
Geomembrane					
80 mil	$	1.48	$/SF	Second Quarter 2019 RS Means 310519531100-310519531300	RSMeans 2019 (1500 sf daily output), Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 80 mil thick, per S.F.
Anchor Trench Fill					
Excavate Trench					
Excavate	$	3.93	$/BCY	Second Quarter 2019 RS Means 2019312316130060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering
Backfill:					
Loader		0.35	$/LCY	Second Quarter 2019 RS Means 312316430200	Excavating, large volume projects,200,000 B.C.Y., 8 C.Y. bucket, loader, 110% fill factor, unrestricted operation
Compaction					
Compaction	$	0.41	$/ECY	Second Quarter 2019 RS Means 312323237200	Compaction, 2 passes, 21" wide,12" lifts, walk behind, vibrating plate
Water Truck		$0.03	$/ECY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Equipment and EarthSum Tabs
Total	$	4.72	$/CY		
Geomembrane					
80 mil	$	1.48	$/SF	Second Quarter 2019 RS Means 310519531100-310519531300	RSMeans 2019 (1500 sf daily output), Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 80 mil thick, per S.F.
Sludge Excavation and Disposal					
Load, Haul & Place					
Excavate		0	$/BCY	RS Means 312316466040	There would'nt be any excavation associtaed with the sludge, would be directly loading from a stockpile or from a hopper.
Load	$	0.28	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Riprap_Gravel_UC Tab
Round Trip Haul Distan		9900			TTS to sludge disposal facility on top of the 3A Stockpile 4,950'*2 = 9,900'
Haul		0.79	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Riprap_Gravel_UC Tab
Place		1.96	$/BCY	Second Quarter 2019 RS Means 312316465540	Excavating, bulk, dozer, open site, bank measure, common earth, 460 HP dozer, 150' haul
	$	3.03	$/LCY		

Tab 3
Unit Rate Buildups for Sludge Disposal and Salt Disposal Facilites

Salt Disposal Facility	Bare Rate	Unit of Measure	Reference	Comment
Ditch Excavation / Berm Placement				
Excavate	$ 1.25	$/CY	Second Quarter 2019 RS Means 312316420250	1000 CY per day, Excavating, bulk bank measure, 1-1/2 C.Y. capacity = 125 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading
Surface Prep Evap Pond				
Compaction				
Compaction	0.14	$/ECY	Second Quarter 2019 RS Means 312323235060	Compaction, riding, vibrating roller, 2 passes, 12" lifts
Water Truck	$0.03	$/ECY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Equipment and EarthSum Tabs
Total	$ 0.17	$/ECY		
Anchor Trench Fill				
Excavate Trench				
Excavate	$ 3.93	$/BCY	Second Quarter 2019 RS Means 2019312316130060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering
Backfill:				
Loader	0.35	$/LCY	Second Quarter 2019 RS Means 312316430200	Excavating, large volume projects,200,000 B.C.Y., 8 C.Y. bucket, loader, 110% fill factor, unrestricted operation
Compaction				
Compaction	$ 0.41	$/ECY	Second Quarter 2019 RS Means 312323237200	Compaction, 2 passes, 21" wide,12" lifts, walk behind, vibrating plate
Water Truck	$0.03	$/ECY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Equipment and EarthSum Tabs
Total	$ 4.72	$/CY		
Geomembrane				
80 mil	$ 1.48	$/SF	Second Quarter 2019 RS Means 310519531100-310519531300	RSMeans 2019 (1500 sf daily output), Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 80 mil thick, per S.F.
Salt Excavation and Disposal				
Load, Haul & Place				
Excavate	2.60	$/BCY	Second Quarter 2019 RS Means 312316466040	Excavating, bulk, dozer, open site, bank measure, common earth, 700 HP dozer, 150' haul
Load	$ 0.28	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Riprap_Gravel_UC Tab
Round Trip Haul Distan	4350			Average distance between Evap Pond #1 and SDF (1,600') and Evap Pond #2 and SDF (2,750') = 2,175'*2 = 4,350'
Haul	0.79	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Riprap_Gravel_UC Tab
Place	1.96	$/BCY	Second Quarter 2019 RS Means 312316465540	Excavating, bulk, dozer, open site, bank measure, common earth, 460 HP dozer, 150' haul
	$ 5.63			
Cover				
Load, Haul & Place				
Load/Haul	1.00	$/LCY	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, EarthSum Tab
Spread	$ 47.65	$/acre	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, EarthSum Tab
Revegetation				
Revegetate	$ 823.97	$/acre	Telesto 5/1/2019	From Telesto 20190501_Tyrone_Stockpile_Tailing_Earthwork_RCE_Unlocked.xlsm RCE cost spreadsheet dated May 1, 2019, Unit Rates Tab

Tab 4
Calculating Quantities for Sludge Disposal and Salt Disposal Facilites

Sludge Disposal Facility Construction			
3D SA of Sludge Top/Slopes	1,089,000	SF	End of life: surface area - top of sludge (25 acres)
3D SA of Prep Below Sludge	1,089,000	SF	Surface prep under SDF, prior to waste dumping (25 acres)
Perimeter (ft)	4,370	FT	Length around just the SDF
Haul Distance to Stockpile			
Haul Distance	8,000	FT	Haul Distance to 5A Stockpile from TTS
Evap Pond			
Graded SA HDPE (sqft)	88,800	SF	Prep SA before HDPE Liner under evap pond
Anchor trench (ft)	1,190	FT	Perimeter of pond
Anchor trench (ft)	176	CY	Assume 2' x 2' Anchor Trench
Ditch			3 feet deep, 2:1 side slope berm, 2 feet bottom width
X-sect Area (sqft)	29	SF	X-sectional area
Perimeter Length (ft)	4,370	FT	Length around SDF, empty into evap pond
Bottom length (ft)	15	FT	X-sectional top length of berm
Entire surface of ditch (sqft)	67,298	SF	Aerial/overhead surface area of prep
Berm			3 feet high, 2:1 side slope berm
X-sect Area (sqft)	25	SF	X-sectional area
Perimeter Length (ft)	4,370	FT	Length around entire SDF and Evap Pond
Top length (ft)	13	FT	X-sectional top length of berm
Entire surface area of berm (sqft)	58,558	SF	Aerial/overhead surface area of prep

Tab 4

Calculating Quantities for Sludge Disposal and Salt Disposal Facilites

Sludge Disposal Facility Reclamation

Structural Excavation			
Structural Backfill			
Diversion Ditch	4,758	CY	
Evap Berm	4,111	CY	
Cell #1			
Cover Pit Sludge Cell #1	30,250	CY	
Revegetate Sludge Cell #1	6.3	AC	
Maintain Sludge Cell #1 Vegetation	1.5	AC	Assume 2% failure rate for 12 years
Cell #2			
Cover Pit Sludge Cell #2	30,250	CY	
Revegetate Sludge Cell #2	6.3	AC	
Maintain Sludge Cell #2 Vegetation	1.5	AC	Assume 2% failure rate for 12 years
Cell #3			
Cover Pit Sludge Cell #3	30,250	CY	
Revegetate Sludge Cell #3	6.3	AC	
Maintain Sludge Cell #3 Vegetation	1.5	AC	Assume 2% failure rate for 12 years
Cell #4			
Cover Pit Sludge Cell #4	30,250	CY	
Revegetate Sludge Cell #4	6.3	AC	
Maintain Sludge Cell #4 Vegetation	1.5	AC	Assume 2% failure rate for 12 years
Rip Stockpile Surface	1,303,656	SF	
Compact Stockpile Surface	1,303,656	SF	
HDPE Liner	88,800	SF	
Anchor Trench	1,190	FT	
Backfill Evap Pond to within 3 feet of Surface Prior to Cover	8,500	CY	
Cover Evap Pond	9,300	CY	
Revegetate Sludge Evap Pond	2.0	AC	
Maintain Sludge Cell #1 Vegetation	0.5	AC	Assume 2% failure rate for 12 years

Tab 4

Calculating Quantities for Sludge Disposal and Salt Disposal Facilites

Salt Disposal Facility Construction			
3D SA of Waste Top/Slopes (sqft)	663,204	SF	End of life: surface area - top of sludge
Perimeter (ft)	3,410	SF	Surface prep under SDF, prior to waste dumping
2D SA of Prep, salt and berm	663,204	SF	SDF only
	15.23	AC	
Haul Distance	14,840	FT	Haul Distance to Upper South Stockpile from Evaporation Pond #1
	Berm		3 feet high, 2:1 side slope berm
X-sect Area (sqft)	25	SF	X-sectional area
Length (ft)	3,410	FT	Length around entire Salt Disposal Facility

Salt Disposal Facility Reclamation			
Structural Excavation			
Structural Backfill			
Diversion Ditch	NA	CY	
Evap Berm	3,208	CY	
Cell #1			
Cover Pit Sludge Cell #1	18,422	CY	
Revegetate Sludge Cell #1	3.8	AC	
Maintain Sludge Cell #1 Vegetation	0.9	AC	Assume 2% failure rate for 12 years
Cell #2			
Cover Pit Sludge Cell #2	18,422	CY	
Revegetate Sludge Cell #2	3.8	AC	
Maintain Sludge Cell #2 Vegetation	0.9	AC	Assume 2% failure rate for 12 years
Cell #3			
Cover Pit Sludge Cell #3	18,422	CY	
Revegetate Sludge Cell #3	3.8	AC	
Maintain Sludge Cell #3 Vegetation	0.9	AC	Assume 2% failure rate for 12 years
Cell #4			
Cover Pit Sludge Cell #4	18,422	CY	
Revegetate Sludge Cell #4	3.8	AC	
Maintain Sludge Cell #4 Vegetation	0.9	AC	Assume 2% failure rate for 12 years
Rip Stockpile Surface	663,204	SF	
Compact Stockpile Surface	663,204	SF	
HDPE Liner for Disposal Facility	663,204	SF	15.23 AC
Anchor Trench	3,410	FT	
Anchor Trench	505	CY	Assume 2' x 2' Anchor Trench
Evap Pond	NA		
Cover Evap Pond	NA		
Revegetate Evap Pond	NA		
Maintain Vegetation	NA		
Maintain Evap Pond Vegetation (5%/yr for 5 yrs)	NA		

ATTACHMENT C

Water Management and Treatment Cost Estimate Tables

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Capital and O&M Cost Summary Table
Project Short Title: Tyrone Mine Closure Closeout Plan

SUMMARY BY SYSTEM

Indirect		**Inputs**
Capital Cost		30.0%
O&M Cost (commodities, labor routine maint, replacement)		17.5%
Capital Cost Elements		**2019 Tyrone CCP Update**
Short-Term Evaporative Treatment System (ETS)	$	1,331,300
Long-Term ETS	$	1,257,312
Tyrone Water Treatment System (TTS)	$	7,232,445
Water Collection/Conveyance for TTS	$	959,861
Sludge Disposal Facility for TTS	$	142,305
Salt Disposal Facility for ETS	$	990,022
Subtotal, Capital	$	11,913,245
Indirect Costs, Capital	*$*	*3,573,974*
Total, Capital	**$**	**15,487,219**
O&M Costs - Commodities (Reagents, Analytical, Power)		
Short-Term ETS	$	17,063,019
Long-Term ETS	$	7,559,079
Tyrone Water Treatment System (TTS)	$	100,303,736
Water Collection/Conveyance for TTS	$	6,618,316
Sludge Disposal Facility for TTS	$	-
Salt Disposal Facility for ETS	$	-
Subtotal, O&M Commodities	$	131,544,149
Indirect Costs, O&M Commodities	*$*	*23,020,226*
Total, O&M Commodities	**$**	**154,564,375**
O&M Costs - Replacement O&M, Routine Maintenance, Labor		
Short-Term ETS	$	1,336,899
Long-Term ETS	$	6,351,324
Tyrone Water Treatment System (TTS)	$	105,570,872
Water Collection/Conveyance for TTS	$	6,633,702
Sludge Disposal Facility for TTS	$	5,142,346
Salt Disposal Facility for ETS	$	7,352,255
Subtotal, Replacement O&M, Routine Maintenance, Labor	$	132,387,399
Indirect Costs, Replacement O&M, Routine Maintenance, Labor	*$*	*23,167,795*
Total, O&M Labor, Routine Maintenance	**$**	**155,555,194**
Total, O&M	**$**	**310,119,569**
Total, Capital and O&M in Current Costs	**$**	**325,606,787**

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417

Subject: Summary Cash Flow in Current Costs
Project Short Title: Tyrone Mine Closure Closeout Plan

Indirect	Inputs
Capital Cost	30.0%
O&M Cost (power, reagents, analytical)	17.5%
O&M Cost (replacement O&M, labor, routine maintenance)	17.5%

	Short-Term ETS			Long-Term ETS			TTS			Water Conveyance			Sludge Disposal Facility		Salt Disposal Facility		Total						
Year	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Reagents, Analytical, Power	Replacement O&M, Routine Maintenance, Labor	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Replacement O&M, Routine Maintenance, Labor	Capital	Replacement O&M, Routine Maintenance, Labor	Capital Cost Subtotal	Capital Cost Indirects	O&M Cost Subtotal (Reagents, Analytical, Power)	O&M Subtotal (Reagents, Analytical, Power) Indirects	O&M Subtotal (Replacement O&M, Routine Maintenance, Labor)	O&M Subtotal (Replacement O&M, Routine Maintenance, Labor) Indirects	Total Cost
0	$ 1,331,300	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,331,300	$ 399,390	$ -	$ -	$ -	$ -	$ 1,730,690
1	$ -	$ 2,570,345	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,573,569	$ 450,375	$ 148,544	$ 25,995	$ 3,198,484
2	$ -	$ 2,741,916	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,745,140	$ 480,399	$ 148,544	$ 25,995	$ 3,400,079
3	$ -	$ 2,476,186	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,479,410	$ 433,897	$ 148,544	$ 25,995	$ 3,087,847
4	$ -	$ 2,209,899	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,213,123	$ 387,296	$ 148,544	$ 25,995	$ 2,774,959
5	$ -	$ 1,942,893	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,946,117	$ 340,571	$ 148,544	$ 25,995	$ 2,461,227
6	$ -	$ 1,675,968	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,679,192	$ 293,859	$ 148,544	$ 25,995	$ 2,147,590
7	$ -	$ 1,415,503	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,418,727	$ 248,277	$ 148,544	$ 25,995	$ 1,841,544
8	$ -	$ 1,148,577	$ 148,544	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,151,801	$ 201,565	$ 148,544	$ 25,995	$ 1,527,906
9	$ -	$ 881,731	$ 148,544	$ 709,540	$ -	$ -	$ -	$ 3,224	$ -	$ 32,000	$ -	$ -	$ -	$ -	$ 990,022	$ -	$ 1,731,562	$ 519,469	$ 884,955	$ 154,867	$ 148,544	$ 25,995	$ 3,465,393
10	$ -	$ -	$ -	$ -	$ 502,203	$ 69,795	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 528,543	$ -	$ -	$ 505,427	$ 88,450	$ 598,338	$ 104,709	$ 1,296,924
11	$ -	$ -	$ -	$ -	$ 501,063	$ 69,795	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 443,884	$ -	$ -	$ 504,287	$ 88,250	$ 513,679	$ 89,894	$ 1,196,111
12	$ -	$ -	$ -	$ -	$ 499,926	$ 69,795	$ -	$ 3,224	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 360,410	$ -	$ -	$ 503,150	$ 88,051	$ 430,205	$ 75,286	$ 1,096,692
13	$ -	$ -	$ -	$ -	$ 433,823	$ 69,795	$ -	$ 1,612	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 265,483	$ -	$ -	$ 435,435	$ 76,201	$ 335,278	$ 58,674	$ 905,588
14	$ -	$ -	$ -	$ 547,772	$ 425,628	$ 69,795	$ 7,232,445	$ 1,612	$ -	$ 927,861	$ -	$ -	$ 142,305	$ -	$ -	$ 187,774	$ 8,850,383	$ 2,655,115	$ 427,240	$ 74,767	$ 257,569	$ 45,074	$ 12,310,148
15	$ -	$ -	$ -	$ -	$ 73,992	$ 69,795	$ -	$ 1,461,543	$ 1,430,816	$ -	$ 87,682	$ 77,136	$ -	$ 75,916	$ -	$ 79,942	$ -	$ -	$ 1,623,217	$ 284,063	$ 1,733,605	$ 303,381	$ 3,944,267
16	$ -	$ -	$ -	$ -	$ 73,948	$ 69,795	$ -	$ 1,446,858	$ 1,430,816	$ -	$ 87,152	$ 77,136	$ -	$ 75,089	$ -	$ 79,031	$ -	$ -	$ 1,607,959	$ 281,393	$ 1,731,868	$ 303,077	$ 3,924,296
17	$ -	$ -	$ -	$ -	$ 73,904	$ 69,795	$ -	$ 1,432,309	$ 1,430,816	$ -	$ 86,625	$ 77,136	$ -	$ 74,271	$ -	$ 78,123	$ -	$ -	$ 1,592,838	$ 278,747	$ 1,730,140	$ 302,775	$ 3,904,500
18	$ -	$ -	$ -	$ -	$ 72,084	$ 69,795	$ -	$ 1,417,891	$ 1,430,816	$ -	$ 86,099	$ 77,136	$ -	$ 73,460	$ -	$ 77,216	$ -	$ -	$ 1,576,074	$ 275,813	$ 1,728,423	$ 302,474	$ 3,882,784
19	$ -	$ -	$ -	$ -	$ 72,040	$ 69,795	$ -	$ 1,403,622	$ 1,430,816	$ -	$ 85,576	$ 77,136	$ -	$ 72,658	$ -	$ 76,312	$ -	$ -	$ 1,561,238	$ 273,217	$ 1,726,717	$ 302,176	$ 3,863,348
20	$ -	$ -	$ -	$ -	$ 70,220	$ 69,795	$ -	$ 1,389,500	$ 1,430,816	$ -	$ 85,056	$ 77,136	$ -	$ 71,864	$ -	$ 75,411	$ -	$ -	$ 1,544,776	$ 270,336	$ 1,725,023	$ 301,879	$ 3,842,013
21	$ -	$ -	$ -	$ -	$ 70,176	$ 69,795	$ -	$ 1,375,846	$ 1,430,816	$ -	$ 84,551	$ 77,136	$ -	$ 71,097	$ -	$ 74,520	$ -	$ -	$ 1,530,573	$ 267,850	$ 1,723,364	$ 301,589	$ 3,823,376
22	$ -	$ -	$ -	$ -	$ 69,244	$ 69,795	$ -	$ 1,363,073	$ 1,430,816	$ -	$ 84,077	$ 77,136	$ -	$ 70,378	$ -	$ 73,649	$ -	$ -	$ 1,516,394	$ 265,369	$ 1,721,775	$ 301,311	$ 3,804,848
23	$ -	$ -	$ -	$ -	$ 68,312	$ 69,795	$ -	$ 1,351,077	$ 1,430,816	$ -	$ 83,632	$ 77,136	$ -	$ 69,703	$ -	$ 72,796	$ -	$ -	$ 1,503,020	$ 263,029	$ 1,720,246	$ 301,043	$ 3,787,338
24	$ -	$ -	$ -	$ -	$ 68,268	$ 69,795	$ -	$ 1,339,787	$ 1,430,816	$ -	$ 83,213	$ 77,136	$ -	$ 69,067	$ -	$ 71,959	$ -	$ -	$ 1,491,268	$ 260,972	$ 1,718,773	$ 300,785	$ 3,771,798
25	$ -	$ -	$ -	$ -	$ 67,336	$ 69,795	$ -	$ 1,329,089	$ 1,309,432	$ -	$ 82,815	$ 77,136	$ -	$ 68,464	$ -	$ 71,134	$ -	$ -	$ 1,479,240	$ 258,867	$ 1,595,961	$ 279,293	$ 3,613,362
26	$ -	$ -	$ -	$ -	$ 66,404	$ 69,795	$ -	$ 1,318,926	$ 1,309,432	$ -	$ 82,438	$ 77,136	$ -	$ 67,890	$ -	$ 70,322	$ -	$ -	$ 1,467,768	$ 256,859	$ 1,594,576	$ 279,051	$ 3,598,254
27	$ -	$ -	$ -	$ -	$ 66,360	$ 69,795	$ -	$ 1,309,260	$ 1,309,432	$ -	$ 82,080	$ 77,136	$ -	$ 67,345	$ -	$ 69,521	$ -	$ -	$ 1,457,700	$ 255,097	$ 1,593,229	$ 278,815	$ 3,584,841
28	$ -	$ -	$ -	$ -	$ 65,428	$ 69,795	$ -	$ 1,300,056	$ 1,309,432	$ -	$ 81,739	$ 77,136	$ -	$ 66,825	$ -	$ 68,731	$ -	$ -	$ 1,447,223	$ 253,264	$ 1,591,918	$ 278,586	$ 3,570,991
29	$ -	$ -	$ -	$ -	$ 64,496	$ 69,795	$ -	$ 1,291,280	$ 1,309,432	$ -	$ 81,415	$ 77,136	$ -	$ 66,328	$ -	$ 67,950	$ -	$ -	$ 1,437,190	$ 251,508	$ 1,590,641	$ 278,362	$ 3,557,702
30	$ -	$ -	$ -	$ -	$ 63,563	$ 69,795	$ -	$ 1,282,906	$ 1,309,432	$ -	$ 81,106	$ 77,136	$ -	$ 65,855	$ -	$ 67,178	$ -	$ -	$ 1,427,576	$ 249,826	$ 1,589,395	$ 278,144	$ 3,544,941
31	$ -	$ -	$ -	$ -	$ 63,520	$ 69,795	$ -	$ 1,274,893	$ 1,309,432	$ -	$ 80,811	$ 77,136	$ -	$ 65,401	$ -	$ 66,413	$ -	$ -	$ 1,419,223	$ 248,364	$ 1,588,177	$ 277,931	$ 3,533,696
32	$ -	$ -	$ -	$ -	$ 62,588	$ 69,795	$ -	$ 1,267,210	$ 1,309,432	$ -	$ 80,528	$ 77,136	$ -	$ 64,966	$ -	$ 65,657	$ -	$ -	$ 1,410,326	$ 246,807	$ 1,586,985	$ 277,722	$ 3,521,841
33	$ -	$ -	$ -	$ -	$ 62,588	$ 69,795	$ -	$ 1,248,149	$ 1,309,432	$ -	$ 80,258	$ 77,136	$ -	$ 64,548	$ -	$ 65,503	$ -	$ -	$ 1,390,994	$ 243,424	$ 1,586,414	$ 277,622	$ 3,498,455
34	$ -	$ -	$ -	$ -	$ 62,588	$ 69,795	$ -	$ 1,241,052	$ 1,309,432	$ -	$ 79,997	$ 77,136	$ -	$ 64,145	$ -	$ 65,356	$ -	$ -	$ 1,383,637	$ 242,137	$ 1,585,865	$ 277,526	$ 3,489,165
35	$ -	$ -	$ -	$ -	$ 62,588	$ 69,795	$ -	$ 1,234,222	$ 1,309,432	$ -	$ 79,748	$ 77,136	$ -	$ 63,758	$ -	$ 65,215	$ -	$ -	$ 1,376,557	$ 240,898	$ 1,585,336	$ 277,434	$ 3,480,225
36	$ -	$ -	$ -	$ -	$ 61,699	$ 69,795	$ -	$ 1,227,632	$ 1,309,432	$ -	$ 79,507	$ 77,136	$ -	$ 63,383	$ -	$ 65,079	$ -	$ -	$ 1,368,838	$ 239,547	$ 1,584,826	$ 277,344	$ 3,470,555
37	$ -	$ -	$ -	$ -	$ 61,699	$ 69,795	$ -	$ 1,221,263	$ 1,309,432	$ -	$ 79,275	$ 77,136	$ -	$ 63,022	$ -	$ 64,948	$ -	$ -	$ 1,362,238	$ 238,392	$ 1,584,333	$ 277,258	$ 3,462,220
38	$ -	$ -	$ -	$ -	$ 61,699	$ 69,795	$ -	$ 1,215,106	$ 1,309,432	$ -	$ 79,052	$ 77,136	$ -	$ 62,672	$ -	$ 64,822	$ -	$ -	$ 1,355,857	$ 237,275	$ 1,583,856	$ 277,175	$ 3,454,163
39	$ -	$ -	$ -	$ -	$ 61,699	$ 69,795	$ -	$ 1,209,144	$ 1,309,432	$ -	$ 78,836	$ 77,136	$ -	$ 62,333	$ -	$ 64,700	$ -	$ -	$ 1,349,679	$ 236,194	$ 1,583,395	$ 277,094	$ 3,446,362
40	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,203,369	$ 1,309,432	$ -	$ 78,627	$ 77,136	$ -	$ 62,004	$ -	$ 64,582	$ -	$ -	$ 1,342,806	$ 234,991	$ 1,582,948	$ 277,016	$ 3,437,762
41	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,197,770	$ 1,309,432	$ -	$ 78,425	$ 77,136	$ -	$ 61,685	$ -	$ 64,467	$ -	$ -	$ 1,337,005	$ 233,976	$ 1,582,515	$ 276,940	$ 3,430,437
42	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,192,340	$ 1,188,048	$ -	$ 78,229	$ 77,136	$ -	$ 61,376	$ -	$ 64,357	$ -	$ -	$ 1,331,380	$ 232,991	$ 1,460,711	$ 255,624	$ 3,280,707
43	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,187,070	$ 1,188,048	$ -	$ 78,040	$ 77,136	$ -	$ 61,076	$ -	$ 64,250	$ -	$ -	$ 1,325,921	$ 232,036	$ 1,460,304	$ 255,553	$ 3,273,815
44	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,181,955	$ 1,188,048	$ -	$ 77,857	$ 77,136	$ -	$ 60,784	$ -	$ 64,146	$ -	$ -	$ 1,320,623	$ 231,109	$ 1,459,909	$ 255,484	$ 3,267,124
45	$ -	$ -	$ -	$ -	$ 60,811	$ 69,795	$ -	$ 1,176,986	$ 1,188,048	$ -	$ 77,679	$ 77,136	$ -	$ 60,501	$ -	$ 64,046	$ -	$ -	$ 1,315,476	$ 230,208	$ 1,459,525	$ 255,417	$ 3,260,626
46	$ -	$ -	$ -	$ -	$ 59,922	$ 69,795	$ -	$ 1,172,153	$ 1,188,048	$ -	$ 77,507	$ 77,136	$ -	$ 60,225	$ -	$ 63,948	$ -	$ -	$ 1,309,582	$ 229,177	$ 1,459,151	$ 255,351	$ 3,253,261
47	$ -	$ -	$ -	$ -	$ 59,922	$ 69,795	$ -	$ 1,167,455	$ 1,188,048	$ -	$ 77,340	$ 77,136	$ -	$ 59,956	$ -	$ 63,854	$ -	$ -	$ 1,304,717	$ 228,325	$ 1,458,789	$ 255,288	$ 3,247,119
48	$ -	$ -	$ -	$ -	$ 59,922	$ 69,795	$ -	$ 1,162,873	$ 1,188,048	$ -	$ 77,177	$ 77,136	$ -	$ 59,695	$ -	$ 63,761	$ -	$ -	$ 1,299,972	$ 227,495	$ 1,458,435	$ 255,226	$ 3,241,128
49	$ -	$ -	$ -	$ -	$ 59,922	$ 69,795	$ -	$ 1,158,410	$ 1,188,048	$ -	$ 77,019	$ 77,136	$ -	$ 59,440	$ -	$ 63,672	$ -	$ -	$ 1,295,352	$ 226,687	$ 1,458,090	$ 255,166	$ 3,235,294
50	$ -	$ -	$ -	$ -	$ 59,922	$ 69,795	$ -	$ 1,152,588	$ 1,188,048	$ -	$ 76,798	$ 77,136	$ -	$ 59,111	$ -	$ 63,548	$ -	$ -	$ 1,289,309	$ 225,629	$ 1,457,638	$ 255,087	$ 3,227,663
51	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,146,385	$ 1,188,048	$ -	$ 76,382	$ 77,136	$ -	$ 58,825	$ -	$ 63,317	$ -	$ -	$ 1,281,802	$ 224,315	$ 1,457,121	$ 254,996	$ 3,218,234
52	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,142,954	$ 1,188,048	$ -	$ 76,241	$ 77,136	$ -	$ 58,635	$ -	$ 63,239	$ -	$ -	$ 1,278,229	$ 223,690	$ 1,456,853	$ 254,949	$ 3,213,721
53	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,139,609	$ 1,188,048	$ -	$ 76,103	$ 77,136	$ -	$ 58,449	$ -	$ 63,163	$ -	$ -	$ 1,274,746	$ 223,081	$ 1,456,591	$ 254,903	$ 3,209,321
54	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,136,351	$ 1,188,048	$ -	$ 75,969	$ 77,136	$ -	$ 58,269	$ -	$ 63,089	$ -	$ -	$ 1,271,354	$ 222,487	$ 1,456,336	$ 254,859	$ 3,205,036
55	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,133,175	$ 1,188,048	$ -	$ 75,839	$ 77,136	$ -	$ 58,093	$ -	$ 63,016	$ -	$ -	$ 1,268,047	$ 221,908	$ 1,456,088	$ 254,815	$ 3,200,859
56	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,130,077	$ 1,188,048	$ -	$ 75,711	$ 77,136	$ -	$ 57,921	$ -	$ 62,946	$ -	$ -	$ 1,264,822	$ 221,344	$ 1,455,846	$ 254,773	$ 3,196,785
57	$ -	$ -	$ -	$ -	$ 59,034	$ 69,795	$ -	$ 1,127,059	$ 1,188,048	$ -	$ 75,587	$ 77,136	$ -	$ 57,754	$ -	$ 62,877	$ -	$ -	$ 1,261,680	$ 220,794	$ 1,455,610	$ 254,732	$ 3,192,815
58	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,124,112	$ 1,188,048	$ -	$ 75,466	$ 77,136	$ -	$ 57,591	$ -	$ 62,810	$ -	$ -	$ 1,257,724	$ 220,102	$ 1,455,379	$ 254,691	$ 3,187,896
59	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,121,236	$ 1,188,048	$ -	$ 75,348	$ 77,136	$ -	$ 57,431	$ -	$ 62,745	$ -	$ -	$ 1,254,730	$ 219,578	$ 1,455,155	$ 254,652	$ 3,184,114
60	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,118,436	$ 1,188,048	$ -	$ 75,233	$ 77,136	$ -	$ 57,276	$ -	$ 62,681	$ -	$ -	$ 1,251,815	$ 219,068	$ 1,454,936	$ 254,614	$ 3,180,432
61	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,115,694	$ 1,188,048	$ -	$ 75,121	$ 77,136	$ -	$ 57,124	$ -	$ 62,619	$ -	$ -	$ 1,248,961	$ 218,568	$ 1,454,721	$ 254,576	$ 3,176,826
62	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,113,020	$ 1,188,048	$ -	$ 75,011	$ 77,136	$ -	$ 56,975	$ -	$ 62,558	$ -	$ -	$ 1,246,177	$ 218,081	$ 1,454,512	$ 254,540	$ 3,173,310
63	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,110,408	$ 1,188,048	$ -	$ 74,905	$ 77,136	$ -	$ 56,830	$ -	$ 62,499	$ -	$ -	$ 1,243,458	$ 217,605	$ 1,454,308	$ 254,504	$ 3,169,875
64	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,107,850	$ 1,188,048	$ -	$ 74,800	$ 77,136	$ -	$ 56,689	$ -	$ 62,441	$ -	$ -	$ 1,240,796	$ 217,139	$ 1,454,108	$ 254,469	$ 3,166,512
65	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,105,356	$ 1,188,048	$ -	$ 74,698	$ 77,136	$ -	$ 56,550	$ -	$ 62,385	$ -	$ -	$ 1,238,199	$ 216,685	$ 1,453,913	$ 254,435	$ 3,163,232
66	$ -	$ -	$ -	$ -	$ 58,145	$ 69,795	$ -	$ 1,102,919	$ 1,188,048	$ -	$ 74,598	$ 77,136	$ -	$ 56,415	$ -	$ 62,329	$ -	$ -	$ 1,235,662	$ 216,241	$ 1,453,723	$ 254,402	$ 3,160,028
67	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,100,532	$ 1,188,048	$ -	$ 74,501	$ 77,136	$ -	$ 56,282	$ -	$ 62,276	$ -	$ -	$ 1,232,290	$ 215,651	$ 1,453,536	$ 254,369	$ 3,155,846
68	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,098,190	$ 1,188,048	$ -	$ 74,405	$ 77,136	$ -	$ 56,152	$ -	$ 62,223	$ -	$ -	$ 1,229,853	$ 215,224	$ 1,453,354	$ 254,337	$ 3,152,767
69	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,095,905	$ 1,188,048	$ -	$ 74,312	$ 77,136	$ -	$ 56,025	$ -	$ 62,171	$ -	$ -	$ 1,227,475	$ 214,808	$ 1,453,175	$ 254,306	$ 3,149,763

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417

Subject: Summary Cash Flow in Current Costs
Project Short Title: Tyrone Mine Closure Closeout Plan

Indirect	Inputs
Capital Cost	30.0%
O&M Cost (power, reagents, analytical)	17.5%
O&M Cost (replacement O&M, labor, routine maintenance)	17.5%

	Short-Term ETS			Long-Term ETS			TTS		
Year	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Reagents, Analytical, Power	Replacement O&M, Routine Maintenance, Labor
70	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,093,669	$ 1,188,048
71	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,091,481	$ 1,188,048
72	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,089,336	$ 1,188,048
73	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,087,244	$ 1,188,048
74	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,085,339	$ 1,188,048
75	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,083,478	$ 1,188,048
76	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,081,643	$ 1,188,048
77	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,079,843	$ 1,188,048
78	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,078,073	$ 1,188,048
79	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,076,331	$ 1,188,048
80	$ -	$ -	$ -	$ -	$ 57,257	$ 69,795	$ -	$ 1,074,615	$ 1,188,048
81	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,072,916	$ 1,188,048
82	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,071,242	$ 1,188,048
83	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,069,597	$ 1,188,048
84	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,067,982	$ 1,188,048
85	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,066,382	$ 1,188,048
86	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,064,797	$ 1,188,048
87	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,063,245	$ 1,188,048
88	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,061,712	$ 1,188,048
89	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,060,204	$ 1,188,048
90	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,058,716	$ 1,188,048
91	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,057,251	$ 1,188,048
92	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,055,813	$ 1,066,664
93	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,054,397	$ 1,066,664
94	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,052,993	$ 1,066,664
95	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,051,617	$ 1,066,664
96	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,050,251	$ 1,066,664
97	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,048,905	$ 1,066,664
98	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,047,577	$ 1,066,664
99	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,046,266	$ 1,066,664
100	$ -	$ -	$ -	$ -	$ 56,369	$ 69,795	$ -	$ 1,044,978	$ 1,066,664
Total	$ 1,331,300	$ 17,063,019	$ 1,336,899	$ 1,257,312	$ 7,559,079	$ 6,351,324	$ 7,232,445	$ 100,303,736	$ 105,570,872

	Water Conveyance			Sludge Disposal Facility		Salt Disposal Facility	
Year	Capital	Power	Replacement O&M, Routine Maintenance, Labor	Capital	Replacement O&M, Routine Maintenance, Labor	Capital	Replacement O&M, Routine Maintenance, Labor
70	$ -	$ 74,221	$ 77,136	$ -	$ 55,901	$ -	$ 62,121
71	$ -	$ 74,132	$ 77,136	$ -	$ 55,780	$ -	$ 62,071
72	$ -	$ 74,045	$ 77,136	$ -	$ 55,660	$ -	$ 62,023
73	$ -	$ 73,960	$ 77,136	$ -	$ 55,544	$ -	$ 61,976
74	$ -	$ 73,888	$ 77,136	$ -	$ 55,436	$ -	$ 61,936
75	$ -	$ 73,818	$ 77,136	$ -	$ 55,331	$ -	$ 61,898
76	$ -	$ 73,750	$ 77,136	$ -	$ 55,226	$ -	$ 61,860
77	$ -	$ 73,682	$ 77,136	$ -	$ 55,124	$ -	$ 61,822
78	$ -	$ 73,616	$ 77,136	$ -	$ 55,024	$ -	$ 61,786
79	$ -	$ 73,552	$ 77,136	$ -	$ 54,925	$ -	$ 61,750
80	$ -	$ 73,488	$ 77,136	$ -	$ 54,827	$ -	$ 61,715
81	$ -	$ 73,426	$ 77,136	$ -	$ 54,731	$ -	$ 61,680
82	$ -	$ 73,364	$ 77,136	$ -	$ 54,635	$ -	$ 61,646
83	$ -	$ 73,304	$ 77,136	$ -	$ 54,542	$ -	$ 61,612
84	$ -	$ 73,245	$ 77,136	$ -	$ 54,450	$ -	$ 61,579
85	$ -	$ 73,186	$ 77,136	$ -	$ 54,359	$ -	$ 61,547
86	$ -	$ 73,129	$ 77,136	$ -	$ 54,269	$ -	$ 61,514
87	$ -	$ 73,072	$ 77,136	$ -	$ 54,180	$ -	$ 61,483
88	$ -	$ 73,017	$ 77,136	$ -	$ 54,093	$ -	$ 61,452
89	$ -	$ 72,962	$ 77,136	$ -	$ 54,007	$ -	$ 61,421
90	$ -	$ 72,909	$ 77,136	$ -	$ 53,922	$ -	$ 61,391
91	$ -	$ 72,856	$ 77,136	$ -	$ 53,838	$ -	$ 61,362
92	$ -	$ 72,805	$ 77,136	$ -	$ 53,756	$ -	$ 61,333
93	$ -	$ 72,755	$ 77,136	$ -	$ 53,675	$ -	$ 61,305
94	$ -	$ 72,705	$ 77,136	$ -	$ 53,595	$ -	$ 61,277
95	$ -	$ 72,656	$ 77,136	$ -	$ 53,516	$ -	$ 61,249
96	$ -	$ 72,608	$ 77,136	$ -	$ 53,438	$ -	$ 61,222
97	$ -	$ 72,561	$ 77,136	$ -	$ 53,361	$ -	$ 61,195
98	$ -	$ 72,514	$ 77,136	$ -	$ 53,284	$ -	$ 61,169
99	$ -	$ 72,468	$ 77,136	$ -	$ 53,209	$ -	$ 61,143
100	$ -	$ 72,423	$ 77,136	$ -	$ 53,135	$ -	$ 61,118
Total	$ 959,861	$ 6,618,316	$ 6,633,702	$ 142,305	$ 5,142,346	$ 990,022	$ 7,352,255

	Total						
Year	Capital Cost Subtotal	Capital Cost Indirects	O&M Cost Subtotal (Reagents, Analytical, Power)	O&M Subtotal (Reagents, Analytical, Power) Indirects	O&M Subtotal (Replacement O&M, Routine Maintenance, Labor)	O&M Subtotal (Replacement O&M, Routine Maintenance, Labor) Indirects	Total Cost
70	$ -	$ -	$ 1,225,147	$ 214,401	$ 1,453,000	$ 254,275	**$ 3,146,823**
71	$ -	$ -	$ 1,222,871	$ 214,002	$ 1,452,830	$ 254,245	**$ 3,143,948**
72	$ -	$ -	$ 1,220,639	$ 213,612	$ 1,452,662	$ 254,216	**$ 3,141,128**
73	$ -	$ -	$ 1,218,461	$ 213,231	$ 1,452,499	$ 254,187	**$ 3,138,377**
74	$ -	$ -	$ 1,216,485	$ 212,885	$ 1,452,351	$ 254,161	**$ 3,135,882**
75	$ -	$ -	$ 1,214,553	$ 212,547	$ 1,452,207	$ 254,136	**$ 3,133,443**
76	$ -	$ -	$ 1,212,649	$ 212,214	$ 1,452,065	$ 254,111	**$ 3,131,039**
77	$ -	$ -	$ 1,210,782	$ 211,887	$ 1,451,925	$ 254,087	**$ 3,128,681**
78	$ -	$ -	$ 1,208,947	$ 211,566	$ 1,451,788	$ 254,063	**$ 3,126,364**
79	$ -	$ -	$ 1,207,140	$ 211,249	$ 1,451,654	$ 254,039	**$ 3,124,082**
80	$ -	$ -	$ 1,205,360	$ 210,938	$ 1,451,521	$ 254,016	**$ 3,121,835**
81	$ -	$ -	$ 1,202,711	$ 210,474	$ 1,451,389	$ 253,993	**$ 3,118,568**
82	$ -	$ -	$ 1,200,975	$ 210,171	$ 1,451,260	$ 253,970	**$ 3,116,376**
83	$ -	$ -	$ 1,199,269	$ 209,872	$ 1,451,133	$ 253,948	**$ 3,114,222**
84	$ -	$ -	$ 1,197,595	$ 209,579	$ 1,451,008	$ 253,926	**$ 3,112,108**
85	$ -	$ -	$ 1,195,937	$ 209,289	$ 1,450,884	$ 253,905	**$ 3,110,015**
86	$ -	$ -	$ 1,194,295	$ 209,002	$ 1,450,762	$ 253,883	**$ 3,107,941**
87	$ -	$ -	$ 1,192,686	$ 208,720	$ 1,450,642	$ 253,862	**$ 3,105,909**
88	$ -	$ -	$ 1,191,098	$ 208,442	$ 1,450,523	$ 253,842	**$ 3,103,905**
89	$ -	$ -	$ 1,189,535	$ 208,169	$ 1,450,407	$ 253,821	**$ 3,101,931**
90	$ -	$ -	$ 1,187,994	$ 207,899	$ 1,450,292	$ 253,801	**$ 3,099,985**
91	$ -	$ -	$ 1,186,476	$ 207,633	$ 1,450,179	$ 253,781	**$ 3,098,069**
92	$ -	$ -	$ 1,184,986	$ 207,373	$ 1,328,683	$ 232,520	**$ 2,953,562**
93	$ -	$ -	$ 1,183,521	$ 207,116	$ 1,328,574	$ 232,500	**$ 2,951,711**
94	$ -	$ -	$ 1,182,067	$ 206,862	$ 1,328,466	$ 232,481	**$ 2,949,875**
95	$ -	$ -	$ 1,180,642	$ 206,612	$ 1,328,359	$ 232,463	**$ 2,948,076**
96	$ -	$ -	$ 1,179,227	$ 206,365	$ 1,328,254	$ 232,444	**$ 2,946,291**
97	$ -	$ -	$ 1,177,835	$ 206,121	$ 1,328,150	$ 232,426	**$ 2,944,532**
98	$ -	$ -	$ 1,176,460	$ 205,880	$ 1,328,048	$ 232,408	**$ 2,942,796**
99	$ -	$ -	$ 1,175,103	$ 205,643	$ 1,327,947	$ 232,391	**$ 2,941,083**
100	$ -	$ -	$ 1,173,770	$ 205,410	$ 1,327,847	$ 232,373	**$ 2,939,400**
Total	$ 11,913,245	$ 3,573,974	$ 131,544,149	$ 23,020,226	$ 132,387,399	$ 23,167,795	$ 325,606,787

Notes:

GOLDER

Date:	REV 0 July 29, 2019
Project No.:	18106417
Subject:	Short Term ETS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title:	Tyrone Mine Closure Closeout Plan

Inputs	
New Cost $	**1,331,300**
Replacement O&M Percentage	**0.0%**
Routine Maintenance Percentage	**1.5%**
Avg ($/kWh) Year 1 through 14 $	**0.045**
Avg ($/kWh) Year 15 through 100 $	**0.045**

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[1]	O&M Labor	Annual Power Usage (kWh)	Electricity Annual Cost	Total Annual Cost
0	2014	$ 1,331,300	$ -	$ -	$ -	0	$ -	$ 1,331,300
1	2015	$ -	$ -	$ 19,970	$ 128,575	57,509,400	$ 2,570,345	$ 2,718,890
2	2016	$ -	$ -	$ 19,970	$ 128,575	61,348,144	$ 2,741,916	$ 2,890,460
3	2017	$ -	$ -	$ 19,970	$ 128,575	55,402,667	$ 2,476,186	$ 2,624,731
4	2018	$ -	$ -	$ 19,970	$ 128,575	49,444,698	$ 2,209,899	$ 2,358,443
5	2019	$ -	$ -	$ 19,970	$ 128,575	43,470,665	$ 1,942,893	$ 2,091,438
6	2020	$ -	$ -	$ 19,970	$ 128,575	37,498,418	$ 1,675,968	$ 1,824,512
7	2021	$ -	$ -	$ 19,970	$ 128,575	31,670,736	$ 1,415,503	$ 1,564,047
8	2022	$ -	$ -	$ 19,970	$ 128,575	25,698,488	$ 1,148,577	$ 1,297,122
9	2023	$ -	$ -	$ 19,970	$ 128,575	19,728,025	$ 881,731	$ 1,030,276
10	2024	$ -	$ -	$ -	$ -	0	$ -	$ -
11	2025	$ -	$ -	$ -	$ -	0	$ -	$ -
12	2026	$ -	$ -	$ -	$ -	0	$ -	$ -
13	2027	$ -	$ -	$ -	$ -	0	$ -	$ -
14	2028	$ -	$ -	$ -	$ -	0	$ -	$ -
15	2029	$ -	$ -	$ -	$ -	0	$ -	$ -
16	2030	$ -	$ -	$ -	$ -	0	$ -	$ -
17	2031	$ -	$ -	$ -	$ -	0	$ -	$ -
18	2032	$ -	$ -	$ -	$ -	0	$ -	$ -
19	2033	$ -	$ -	$ -	$ -	0	$ -	$ -
20	2034	$ -	$ -	$ -	$ -	0	$ -	$ -
21	2035	$ -	$ -	$ -	$ -	0	$ -	$ -
22	2036	$ -	$ -	$ -	$ -	0	$ -	$ -
23	2037	$ -	$ -	$ -	$ -	0	$ -	$ -
24	2038	$ -	$ -	$ -	$ -	0	$ -	$ -
25	2039	$ -	$ -	$ -	$ -	0	$ -	$ -
26	2040	$ -	$ -	$ -	$ -	0	$ -	$ -
27	2041	$ -	$ -	$ -	$ -	0	$ -	$ -
28	2042	$ -	$ -	$ -	$ -	0	$ -	$ -
29	2043	$ -	$ -	$ -	$ -	0	$ -	$ -
30	2044	$ -	$ -	$ -	$ -	0	$ -	$ -
31	2045	$ -	$ -	$ -	$ -	0	$ -	$ -
32	2046	$ -	$ -	$ -	$ -	0	$ -	$ -
33	2047	$ -	$ -	$ -	$ -	0	$ -	$ -
34	2048	$ -	$ -	$ -	$ -	0	$ -	$ -
35	2049	$ -	$ -	$ -	$ -	0	$ -	$ -
36	2050	$ -	$ -	$ -	$ -	0	$ -	$ -
37	2051	$ -	$ -	$ -	$ -	0	$ -	$ -
38	2052	$ -	$ -	$ -	$ -	0	$ -	$ -
39	2053	$ -	$ -	$ -	$ -	0	$ -	$ -
40	2054	$ -	$ -	$ -	$ -	0	$ -	$ -
41	2055	$ -	$ -	$ -	$ -	0	$ -	$ -
42	2056	$ -	$ -	$ -	$ -	0	$ -	$ -
43	2057	$ -	$ -	$ -	$ -	0	$ -	$ -
44	2058	$ -	$ -	$ -	$ -	0	$ -	$ -
45	2059	$ -	$ -	$ -	$ -	0	$ -	$ -
46	2060	$ -	$ -	$ -	$ -	0	$ -	$ -
47	2061	$ -	$ -	$ -	$ -	0	$ -	$ -
48	2062	$ -	$ -	$ -	$ -	0	$ -	$ -
49	2063	$ -	$ -	$ -	$ -	0	$ -	$ -
50	2064	$ -	$ -	$ -	$ -	0	$ -	$ -
51	2065	$ -	$ -	$ -	$ -	0	$ -	$ -
52	2066	$ -	$ -	$ -	$ -	0	$ -	$ -
53	2067	$ -	$ -	$ -	$ -	0	$ -	$ -
54	2068	$ -	$ -	$ -	$ -	0	$ -	$ -
55	2069	$ -	$ -	$ -	$ -	0	$ -	$ -
56	2070	$ -	$ -	$ -	$ -	0	$ -	$ -
57	2071	$ -	$ -	$ -	$ -	0	$ -	$ -
58	2072	$ -	$ -	$ -	$ -	0	$ -	$ -
59	2073	$ -	$ -	$ -	$ -	0	$ -	$ -
60	2074	$ -	$ -	$ -	$ -	0	$ -	$ -
61	2075	$ -	$ -	$ -	$ -	0	$ -	$ -
62	2076	$ -	$ -	$ -	$ -	0	$ -	$ -
63	2077	$ -	$ -	$ -	$ -	0	$ -	$ -
64	2078	$ -	$ -	$ -	$ -	0	$ -	$ -
65	2079	$ -	$ -	$ -	$ -	0	$ -	$ -
66	2080	$ -	$ -	$ -	$ -	0	$ -	$ -
67	2081	$ -	$ -	$ -	$ -	0	$ -	$ -
68	2082	$ -	$ -	$ -	$ -	0	$ -	$ -
69	2083	$ -	$ -	$ -	$ -	0	$ -	$ -
70	2084	$ -	$ -	$ -	$ -	0	$ -	$ -
71	2085	$ -	$ -	$ -	$ -	0	$ -	$ -
72	2086	$ -	$ -	$ -	$ -	0	$ -	$ -
73	2087	$ -	$ -	$ -	$ -	0	$ -	$ -

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Short Term ETS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs	
New Cost	$ 1,331,300
Replacement O&M Percentage	0.0%
Routine Maintenance Percentage	1.5%
Avg ($/kWh) Year 1 through 14	$ 0.045
Avg ($/kWh) Year 15 through 100	$ 0.045

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[1]	O&M Labor	Annual Power Usage (kWh)	Electricity Annual Cost	Total Annual Cost
74	2088	$ -	$ -	$ -	$ -	0	$ -	$ -
75	2089	$ -	$ -	$ -	$ -	0	$ -	$ -
76	2090	$ -	$ -	$ -	$ -	0	$ -	$ -
77	2091	$ -	$ -	$ -	$ -	0	$ -	$ -
78	2092	$ -	$ -	$ -	$ -	0	$ -	$ -
79	2093	$ -	$ -	$ -	$ -	0	$ -	$ -
80	2094	$ -	$ -	$ -	$ -	0	$ -	$ -
81	2095	$ -	$ -	$ -	$ -	0	$ -	$ -
82	2096	$ -	$ -	$ -	$ -	0	$ -	$ -
83	2097	$ -	$ -	$ -	$ -	0	$ -	$ -
84	2098	$ -	$ -	$ -	$ -	0	$ -	$ -
85	2099	$ -	$ -	$ -	$ -	0	$ -	$ -
86	2100	$ -	$ -	$ -	$ -	0	$ -	$ -
87	2101	$ -	$ -	$ -	$ -	0	$ -	$ -
88	2102	$ -	$ -	$ -	$ -	0	$ -	$ -
89	2103	$ -	$ -	$ -	$ -	0	$ -	$ -
90	2104	$ -	$ -	$ -	$ -	0	$ -	$ -
91	2105	$ -	$ -	$ -	$ -	0	$ -	$ -
92	2106	$ -	$ -	$ -	$ -	0	$ -	$ -
93	2107	$ -	$ -	$ -	$ -	0	$ -	$ -
94	2108	$ -	$ -	$ -	$ -	0	$ -	$ -
95	2109	$ -	$ -	$ -	$ -	0	$ -	$ -
96	2110	$ -	$ -	$ -	$ -	0	$ -	$ -
97	2111	$ -	$ -	$ -	$ -	0	$ -	$ -
98	2112	$ -	$ -	$ -	$ -	0	$ -	$ -
99	2113	$ -	$ -	$ -	$ -	0	$ -	$ -
100	2114	$ -	$ -	$ -	$ -	0	$ -	$ -
Total		**$ 1,331,300**	**$ -**	**$ 179,726**	**$ 1,157,174**	**381,771,240**	**$ 17,063,019**	**$ 19,731,218**

Notes:
[1] Replacement O&M allowance for the Short-Term ETS is estimated at zero given this is a short-term system and capital replacement is not expected. Routine maintenance is estimated at a percentage of the initial direct capital cost (New Cost in Column H Row 4).
Cost estimate backup details are included in Attachment B to the Tyrone Water Treatment Cost Basis Document.
Costs do not include indirect costs

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Labor Cost Estimate - ETS and Salt Disposal Facility Operations
Project Short Title: Tyrone Mine Closure Closeout Plan

Short-Term ETS			
Day shift - 1.5 operator (7 day/wk shift coverage)[1]			
Operators		1.5	FTE
Operator Rate[2]	$	18.60	/hr
Operator Hours (1 FTE)		2087	hr/yr
Operator Total Cost	$	58,227	
Overtime for operators		15%	
Total overtime hours for operators		470	hr/yr
Operator Overtime Total Cost	$	13,101	
Supervisor		0.5	FTE
Supervisor Rate[3]	$	31.10	/hr
Supervisor Hours (1 FTE)		2,087	hr/yr
Supervisor Total Cost	$	32,453	
Benefits fringe rate per hour[4]	$	5.94	/hr
Total eligible hours per year		4,174	hrs/yr
Benefits Cost	$	24,794	
Total Operator Labor Cost	**$**	**128,575**	

Notes:

[1] Operator numbers are estimated from Golder's experience with operating similar plants.

[2] Wages from 2019 New Mexico Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group I.
https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

[3] Wages from 2019 New Mexico Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group X.
https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

[4] Wages from 2019 New Mexico Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group I-X.
https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

Costs do not include indirect costs

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Long Term ETS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs

Total Pumps and Pipeline Costs if New	**$ 712,270**
Total Sprayer Costs if New	**$ 227,010**
Total Tank and Reservoir Cost if New	**$ 1,175,713**
Replacement O&M	1.8%
Routine Maintenance Percentage	1.5%
Avg ($/kWh) Year 1 through 14	$ 0.045
Avg ($/kWh) Year 15 through 100	$ 0.045

Year Following Closure	Year	Capital	Pumps and Pipeline Replacement O&M[1]	Sprayers Replacement O&M[1]	Tank and Reservoirs Replacement O&M[1]	Pumps and Pipeline Routine Maintenance[2]	Sprayers Routine Maintenance[2]	Tank and Reservoirs Routine Maintenance[2]	O&M Labor[3]	Pumping System Annual Power Usage (kWh)	Mechanical Spray System Annual Power Usage (kWh)	Electricity Annual Cost	Total Annual Cost
1	2015	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
2	2016	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
3	2017	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
4	2018	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
5	2019	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
6	2020	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
7	2021	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
8	2022	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -
9	2023	$ 709,540	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ 709,540
10	2024	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	1,437,896	9,798,498	$ 502,203	$ 571,998
11	2025	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	1,412,387	9,798,498	$ 501,063	$ 570,858
12	2026	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	1,386,931	9,798,498	$ 499,926	$ 569,720
13	2027	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	1,318,926	8,387,514	$ 433,823	$ 503,618
14	2028	$ 547,772	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	1,292,343	8,230,738	$ 425,628	$ 1,043,195
15	2029	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	64,396	1,567,760	$ 73,992	$ 143,787
16	2030	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	63,431	1,567,760	$ 73,948	$ 143,743
17	2031	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	62,466	1,567,760	$ 73,904	$ 143,699
18	2032	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	61,502	1,528,566	$ 72,084	$ 141,879
19	2033	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	60,537	1,528,566	$ 72,040	$ 141,835
20	2034	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	59,572	1,489,372	$ 70,220	$ 140,014
21	2035	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	58,607	1,489,372	$ 70,176	$ 139,971
22	2036	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	57,643	1,469,775	$ 69,244	$ 139,039
23	2037	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	56,678	1,450,178	$ 68,312	$ 138,106
24	2038	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	55,713	1,450,178	$ 68,268	$ 138,063
25	2039	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	54,748	1,430,581	$ 67,336	$ 137,131
26	2040	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	53,783	1,410,984	$ 66,404	$ 136,198
27	2041	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	52,819	1,410,984	$ 66,360	$ 136,155
28	2042	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	51,854	1,391,387	$ 65,428	$ 135,222
29	2043	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	50,889	1,371,790	$ 64,496	$ 134,290
30	2044	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	49,924	1,352,193	$ 63,563	$ 133,358
31	2045	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	48,959	1,352,193	$ 63,520	$ 133,314
32	2046	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,332,596	$ 62,588	$ 132,382
33	2047	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,332,596	$ 62,588	$ 132,382
34	2048	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,332,596	$ 62,588	$ 132,382
35	2049	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,332,596	$ 62,588	$ 132,382
36	2050	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,312,999	$ 61,699	$ 131,494
37	2051	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,312,999	$ 61,699	$ 131,494
38	2052	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,312,999	$ 61,699	$ 131,494
39	2053	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,312,999	$ 61,699	$ 131,494
40	2054	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605
41	2055	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605
42	2056	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605
43	2057	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605
44	2058	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Long Term ETS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs

Total Pumps and Pipeline Costs if New	$	712,270
Total Sprayer Cost if New	$	227,010
Total Tank and Reservoir Cost if New	$	1,175,713
Replacement O&M		1.8%
Routine Maintenance Percentage		1.5%
Avg ($/kWh) Year 1 through 14	$	0.045
Avg ($/kWh) Year 15 through 100	$	0.045

Year Following Closure	Year	Capital	Pumps and Pipeline Replacement O&M[1]	Sprayers Replacement O&M[1]	Tank and Reservoirs Replacement O&M[1]	Pumps and Pipeline Routine Maintenance[2]	Sprayers Routine Maintenance[2]	Tank and Reservoirs Routine Maintenance[2]	O&M Labor[3]	Pumping System Annual Power Usage (kWh)	Mechanical Spray System Annual Power Usage (kWh)	Electricity Annual Cost	Total Annual Cost
45	2059	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,293,402	$ 60,811	$ 130,605
46	2060	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,273,805	$ 59,922	$ 129,717
47	2061	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,273,805	$ 59,922	$ 129,717
48	2062	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,273,805	$ 59,922	$ 129,717
49	2063	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,273,805	$ 59,922	$ 129,717
50	2064	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,273,805	$ 59,922	$ 129,717
51	2065	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
52	2066	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
53	2067	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
54	2068	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
55	2069	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
56	2070	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
57	2071	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,254,208	$ 59,034	$ 128,829
58	2072	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
59	2073	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
60	2074	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
61	2075	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
62	2076	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
63	2077	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
64	2078	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
65	2079	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
66	2080	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,234,611	$ 58,145	$ 127,940
67	2081	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
68	2082	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
69	2083	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
70	2084	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
71	2085	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
72	2086	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
73	2087	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
74	2088	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
75	2089	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
76	2090	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
77	2091	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
78	2092	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
79	2093	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
80	2094	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,215,014	$ 57,257	$ 127,052
81	2095	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
82	2096	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
83	2097	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
84	2098	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
85	2099	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
86	2100	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
87	2101	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
88	2102	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Long Term ETS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs

Total Pumps and Pipeline Costs if New	**$**	**712,270**
Total Sprayer Costs if New	**$**	**227,010**
Total Tank and Reservoir Cost if New	**$**	**1,175,713**
Replacement O&M		1.8%
Routine Maintenance Percentage		1.5%
Avg ($/kWh) Year 1 through 14	$	0.045
Avg ($/kWh) Year 15 through 100	$	0.045

Year Following Closure	Year	Capital	Pumps and Pipeline Replacement O&M[1]	Sprayers Replacement O&M[1]	Tank and Reservoirs Replacement O&M[1]	Pumps and Pipeline Routine Maintenance[2]	Sprayers Routine Maintenance[2]	Tank and Reservoirs Routine Maintenance[2]	O&M Labor[3]	Pumping System Annual Power Usage (kWh)	Mechanical Spray System Annual Power Usage (kWh)	Electricity Annual Cost	Total Annual Cost
89	2103	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
90	2104	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
91	2105	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
92	2106	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
93	2107	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
94	2108	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
95	2109	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
96	2110	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
97	2111	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
98	2112	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
99	2113	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
100	2114	$ -	$ 12,821	$ 4,086	$ 21,163	$ 10,684	$ 3,405	$ 17,636	Included in Total Operating Cost	47,995	1,195,417	$ 56,369	$ 126,163
Total		**$ 1,257,312**	**$ 1,166,698**	**$ 371,842**	**$ 1,925,818**	**$ 972,249**	**$ 309,869**	**$ 1,604,848**	**$ -**	**11,123,637**	**156,364,431**	**$ 7,559,079**	**$ 15,167,715**

Notes:

[1] Replacement O&M costs are estimated at 1.8% of the total capital cost for the complete long-term ETS (pumps, pipelines, tanks, reservoirs, and sprayers). A higher percentage of capital cost is estimated given that existing pumps, pipelines, tanks and reservoirs will be utilized initially up until their associated life expectancies are met and will require replacement sooner than if new equipment was utilized initially. The spray systems from the short-ter ETS will be utilized through Year 19. In Year 20, 4 new spray evaporation units will be purchased. A higher percentage capital cost is estimated to ensure conservatism and to align with existing existing pumps, pipelines, tanks and reservoirs O&M Replacement estimates.

[2] Routine maintenance is estimated at 1.5% of the total capital cost for the complete long-term ETS (pumps, pipelines, tanks, reservoirs, and sprayers). Routine maintenance includes materials needed for preventative maintenance such as mechanical seals, lubricant, valve sleeves, fuses, etc.

[3] O&M Labor for the ETS is included in the TTS Labor.

Cost estimate backup details are included in Attachment B to the Tyrone Water Treatment Cost Basis Document.

Costs do not include indirect costs

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Salt Disposal Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs		
New Cost	$	990,022
Replacement O&M		0.25%
Salt Removal ($/CY)	$	5.633

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[2]	O&M Labor[2]	Annual Salt Production/ Removal (cy/yr)	Total Operating Cost[3]
1	2015	$ -	$ -	$ -	$ -	0	$ -
2	2016	$ -	$ -	$ -	$ -	0	$ -
3	2017	$ -	$ -	$ -	$ -	0	$ -
4	2018	$ -	$ -	$ -	$ -	0	$ -
5	2019	$ -	$ -	$ -	$ -	0	$ -
6	2020	$ -	$ -	$ -	$ -	0	$ -
7	2021	$ -	$ -	$ -	$ -	0	$ -
8	2022	$ -	$ -	$ -	$ -	0	$ -
9	2023	$ 990,022	$ -	$ -	$ -	0	$ 990,022
10	2024	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	93,396	$ 528,543
11	2025	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	78,366	$ 443,884
12	2026	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	63,546	$ 360,410
13	2027	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	46,693	$ 265,483
14	2028	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	32,897	$ 187,774
15	2029	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	13,753	$ 79,942
16	2030	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	13,591	$ 79,031
17	2031	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	13,430	$ 78,123
18	2032	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	13,269	$ 77,216
19	2033	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	13,109	$ 76,312
20	2034	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,949	$ 75,411
21	2035	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,791	$ 74,520
22	2036	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,636	$ 73,649
23	2037	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,484	$ 72,796
24	2038	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,336	$ 71,959
25	2039	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,189	$ 71,134
26	2040	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	12,045	$ 70,322
27	2041	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,903	$ 69,521
28	2042	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,763	$ 68,731
29	2043	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,624	$ 67,950
30	2044	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,487	$ 67,178
31	2045	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,351	$ 66,413
32	2046	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,217	$ 65,657
33	2047	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,190	$ 65,503
34	2048	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,164	$ 65,356
35	2049	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,139	$ 65,215
36	2050	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,114	$ 65,079
37	2051	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,091	$ 64,948
38	2052	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,069	$ 64,822
39	2053	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,047	$ 64,700
40	2054	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,026	$ 64,582
41	2055	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	11,006	$ 64,467
42	2056	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,986	$ 64,357
43	2057	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,967	$ 64,250
44	2058	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,949	$ 64,146
45	2059	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,931	$ 64,046
46	2060	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,914	$ 63,948
47	2061	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,897	$ 63,854
48	2062	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,880	$ 63,761
49	2063	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,865	$ 63,672
50	2064	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,843	$ 63,548
51	2065	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,802	$ 63,317
52	2066	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,788	$ 63,239
53	2067	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,774	$ 63,163
54	2068	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,761	$ 63,089
55	2069	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,748	$ 63,016
56	2070	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,736	$ 62,946
57	2071	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,723	$ 62,877
58	2072	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,712	$ 62,810
59	2073	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,700	$ 62,745
60	2074	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,689	$ 62,681
61	2075	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,678	$ 62,619
62	2076	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,667	$ 62,558
63	2077	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,656	$ 62,499
64	2078	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,646	$ 62,441
65	2079	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,636	$ 62,385
66	2080	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,626	$ 62,329
67	2081	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,617	$ 62,276
68	2082	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,607	$ 62,223
69	2083	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,598	$ 62,171
70	2084	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,589	$ 62,121
71	2085	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,580	$ 62,071
72	2086	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,572	$ 62,023
73	2087	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,563	$ 61,976
74	2088	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,556	$ 61,936

GOLDER

Inputs		
New Cost	**$**	**990,022**
Replacement O&M		**0.25%**
Salt Removal ($/CY)	**$**	**5.633**

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Salt Disposal Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[2]	O&M Labor[2]	Annual Salt Production/ Removal (cy/yr)	Total Operating Cost[3]
75	2089	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,550	$ 61,898
76	2090	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,543	$ 61,860
77	2091	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,536	$ 61,822
78	2092	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,530	$ 61,786
79	2093	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,523	$ 61,750
80	2094	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,517	$ 61,715
81	2095	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,511	$ 61,680
82	2096	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,505	$ 61,646
83	2097	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,499	$ 61,612
84	2098	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,493	$ 61,579
85	2099	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,487	$ 61,547
86	2100	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,482	$ 61,514
87	2101	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,476	$ 61,483
88	2102	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,470	$ 61,452
89	2103	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,465	$ 61,421
90	2104	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,460	$ 61,391
91	2105	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,454	$ 61,362
92	2106	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,449	$ 61,333
93	2107	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,444	$ 61,305
94	2108	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,439	$ 61,277
95	2109	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,434	$ 61,249
96	2110	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,430	$ 61,222
97	2111	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,425	$ 61,195
98	2112	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,420	$ 61,169
99	2113	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,416	$ 61,143
100	2114	$ -	$ 2,475	Included in Total Operating Cost	Included in Total Operating Cost	10,411	$ 61,118
Total		**$ 990,022**	**$ 225,230**	**$ -**	**$ -**	**1,265,297**	**$ 8,342,277**

Notes:

[1] Replacement O&M is estimated only at 0.25% of the total capital cost since the capital cost of the facility is high since it is a lined facility. Costs associated with closure of each of the four individual cells comprising the salt disposal facility (approximately 316,324 cubic yards per cell). Closure includes grading, three foot of earthen cover, and revegetation. Initial capital cost for construction of salt disposal facility (by RS Means) shown in Year 9.

[2] Routine Maintenance and O&M Labor is included in the Total Operating Cost calculation.

[3] Costs based on 2019 RS Means estimate of $5.63 per/cy for excavation, loading, hauling, and placing of salts at the salt disposal facility.

Cost estimate backup details are included in Attachment B to the Tyrone Water Treatment Cost Basis Document.

Costs do not include indirect costs

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Water Conveyance Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs

Total Pump and Pipeline Costs if New	$	1,895,030
Total Tank and Reservoir Cost if New	$	442,427
Replacement O&M Percentage		1.8%
Routine Maintenance Percentage		1.5%
Avg ($/kWh) Year 1 through 14	$	0.045
Avg ($/kWh) Year 15 through 100	$	0.045

Year Following Closure	Year	Capital[1]	Pumps and Pipeline Replacement O&M[2]	Tanks and Reservoir Replacement O&M[2]	Pumps and Pipeline Routine Maintenance[3]	Tanks and Reservoir Routine Maintenance[3]	O&M Labor[4]	Pumping System Annual Power Usage (kWh)	O&M Electrical Annual Cost	Total Annual Cost
1	2019	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
2	2020	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
3	2021	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
4	2022	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
5	2023	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
6	2024	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
7	2025	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
8	2026	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
9[5]	2027	$ 32,000	$ -	$ -	$ -	$ -	N/A	0	$ -	$ 32,000
10[5]	2028	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
11[5]	2029	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
12[5]	2030	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
13[5]	2031	$ -	$ -	$ -	$ -	$ -	N/A	0	$ -	$ -
14[5]	2032	$ 927,861	$ -	$ -	$ -	$ -	N/A	0	$ -	$ 927,861
15	2033	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,934,140	$ 87,682	$ 164,818
16	2034	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,922,454	$ 87,152	$ 164,288
17	2035	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,910,816	$ 86,625	$ 163,761
18	2036	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,899,220	$ 86,099	$ 163,235
19	2037	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,887,687	$ 85,576	$ 162,712
20	2038	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,876,212	$ 85,056	$ 162,192
21	2039	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,865,065	$ 84,551	$ 161,687
22	2040	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,854,615	$ 84,077	$ 161,213
23	2041	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,844,795	$ 83,632	$ 160,768
24	2042	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,835,550	$ 83,213	$ 160,349
25	2043	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,826,789	$ 82,815	$ 159,952
26	2044	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,818,473	$ 82,438	$ 159,575
27	2045	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,810,569	$ 82,080	$ 159,216
28	2046	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,803,054	$ 81,739	$ 158,876
29	2047	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,795,898	$ 81,415	$ 158,551
30	2048	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,789,083	$ 81,106	$ 158,242
31	2049	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,782,570	$ 80,811	$ 157,947
32	2050	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,776,336	$ 80,528	$ 157,664
33	2051	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,770,365	$ 80,258	$ 157,394
34	2052	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,764,628	$ 79,997	$ 157,134
35	2053	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,759,119	$ 79,748	$ 156,884
36	2054	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,753,817	$ 79,507	$ 156,643
37	2055	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,748,702	$ 79,275	$ 156,412
38	2056	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,743,769	$ 79,052	$ 156,188
39	2057	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,739,002	$ 78,836	$ 155,972
40	2058	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,734,394	$ 78,627	$ 155,763
41	2059	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,729,938	$ 78,425	$ 155,561
42	2060	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,725,628	$ 78,229	$ 155,366
43	2061	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,721,453	$ 78,040	$ 155,176
44	2062	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,717,409	$ 77,857	$ 154,993
45	2063	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,713,490	$ 77,679	$ 154,815
46	2064	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,709,685	$ 77,507	$ 154,643
47	2065	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,705,999	$ 77,340	$ 154,476
48	2066	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,702,409	$ 77,177	$ 154,313
49	2067	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,698,923	$ 77,019	$ 154,155
50	2068	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,694,059	$ 76,798	$ 153,934
51	2069	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,684,881	$ 76,382	$ 153,518
52	2070	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,681,763	$ 76,241	$ 153,377
53	2071	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,678,726	$ 76,103	$ 153,239
54	2072	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,675,771	$ 75,969	$ 153,105
55	2073	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,672,889	$ 75,839	$ 152,975
56	2074	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,670,080	$ 75,711	$ 152,847
57	2075	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,667,345	$ 75,587	$ 152,723
58	2076	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,664,673	$ 75,466	$ 152,602
59	2077	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,662,072	$ 75,348	$ 152,484
60	2078	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,659,540	$ 75,233	$ 152,369
61	2079	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,657,057	$ 75,121	$ 152,257
62	2080	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,654,643	$ 75,011	$ 152,147
63	2081	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,652,286	$ 74,905	$ 152,041
64	2082	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,649,975	$ 74,800	$ 151,936
65	2083	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,647,727	$ 74,698	$ 151,834
66	2084	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,645,531	$ 74,598	$ 151,734
67	2085	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,643,382	$ 74,501	$ 151,637
68	2086	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,641,275	$ 74,405	$ 151,541
69	2087	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,639,221	$ 74,312	$ 151,448
70	2088	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,637,215	$ 74,221	$ 151,357
71	2089	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,635,253	$ 74,132	$ 151,268
72	2090	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,633,331	$ 74,045	$ 151,181
73	2091	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,631,452	$ 73,960	$ 151,096
74	2092	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,629,868	$ 73,888	$ 151,024

GOLDER

Inputs

Total Pump and Pipeline Costs if New	$	1,895,030
Total Tank and Reservoir Cost if New	$	442,427
Replacement O&M Percentage		1.8%
Routine Maintenance Percentage		1.5%
Avg ($/kWh) Year 1 through 14	$	0.045
Avg ($/kWh) Year 15 through 100	$	0.045

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Water Conveyance Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Year Following Closure	Year	Capital[1]	Pumps and Pipeline Replacement O&M[2]	Tanks and Reservoir Replacement O&M[2]	Pumps and Pipeline Routine Maintenance[3]	Tanks and Reservoir Routine Maintenance[3]	O&M Labor[4]	Pumping System Annual Power Usage (kWh)	O&M Electrical Annual Cost	Total Annual Cost
75	2093	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,628,324	$ 73,818	$ 150,954
76	2094	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,626,807	$ 73,750	$ 150,886
77	2095	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,625,326	$ 73,682	$ 150,818
78	2096	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,623,873	$ 73,616	$ 150,753
79	2097	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,622,447	$ 73,552	$ 150,688
80	2098	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,621,047	$ 73,488	$ 150,624
81	2099	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,619,665	$ 73,426	$ 150,562
82	2100	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,618,304	$ 73,364	$ 150,500
83	2101	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,616,973	$ 73,304	$ 150,440
84	2102	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,615,670	$ 73,245	$ 150,381
85	2103	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,614,382	$ 73,186	$ 150,322
86	2104	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,613,112	$ 73,129	$ 150,265
87	2105	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,611,871	$ 73,072	$ 150,208
88	2106	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,610,645	$ 73,017	$ 150,153
89	2107	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,609,444	$ 72,962	$ 150,098
90	2108	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,608,262	$ 72,909	$ 150,045
91	2109	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,607,103	$ 72,856	$ 149,992
92	2110	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,605,972	$ 72,805	$ 149,941
93	2111	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,604,862	$ 72,755	$ 149,891
94	2112	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,603,762	$ 72,705	$ 149,841
95	2113	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,602,687	$ 72,656	$ 149,792
96	2114	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,601,626	$ 72,608	$ 149,744
97	2115	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,600,582	$ 72,561	$ 149,697
98	2116	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,599,553	$ 72,514	$ 149,650
99	2117	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,598,544	$ 72,468	$ 149,604
100	2118	$ -	$ 34,111	$ 7,964	$ 28,425	$ 6,636	Inc. in TTS Labor	1,597,552	$ 72,423	$ 149,559
Total		**$ 959,861**	**$ 2,933,506**	**$ 684,877**	**$ 2,444,589**	**$ 570,731**	**$ -**	**145,990,464**	**$ 6,618,316**	**$ 14,211,879**

Notes:

[1] Capital pipeline costs include discharge pipeline from TTS to tributary arroyo to Mangas Wash, energy dissipation structure, and a tank.

[2] Replacement O&M costs are estimated at 1.8% of the total capital cost for the complete water conveyance system. A higher percentage of capital cost is estimated given that existing pumps, pipelines, tanks and reservoirs will be utilized initially up until their associated life expectancies are met and will require replacement sooner than if new equipment was utilized initially.

[3] Routine maintenance is estimated at 1.5% of the total capital cost for the complete water conveyance system. Routine maintenance includes materials needed for preventative maintenance such as mechanical seals, lubricant, valve sleeves, fuses, etc.

[4] Labor for water conveyance is included in labor for the TTS. TTS Labor is provided on the TTS Cash Flow sheet.

[5] The No. 3 PLS Overflow Pond will be closed at the end of Year 9 and a new 20,000 gallon plastic above ground storage tank will be installed in its place to collect low TDS and sulfate concentration waters from the 3A stockpile seepage collection and interceptor systems. There is no replacement O&M or routine maintenance applied to Years 10 through 14.

Cost estimate backup details are included in Attachment B to the Tyrone Water Treatment Cost Basis Document.

Costs do not include indirect costs

GOLDER

Date:	REV 0 July 29, 2019
Project No.:	18106417
Subject:	STS Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title:	Tyrone Mine Closure Closeout Plan

Inputs		
New Cost	$	7,232,445
Replacement O&M Percentage		1.5%
Routine Maintenance Percentage		1.5%
Avg ($/kWh) Year 1 through 14	$	0.045
Avg ($/kWh) Year 15 through 100	$	0.045

					Reagents						
Year	**Capital**	**Labor**	**Replacement O&M**	**Routine Maintenance**	**Lime (CaO)**	**Flocculent**	**Acid (35% HCl)**	**Membrane Chemicals**	**Analytical**	**Power**	**Total Annual Cost**
1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
10	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
11	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,224	$ -	$ 3,224
13	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,612	$ -	$ 1,612
14	$ 7,232,445	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,612	$ -	$ 7,234,057
15	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 1,055,002	$ 189,397	$ 4,783	$ 110,388	$ 30,628	$ 71,345	$ 2,892,360
16	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 1,043,183	$ 187,960	$ 4,733	$ 109,551	$ 30,628	$ 70,804	$ 2,877,675
17	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 1,031,478	$ 186,534	$ 4,683	$ 108,720	$ 30,628	$ 70,266	$ 2,863,125
18	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 1,019,884	$ 185,118	$ 4,634	$ 107,895	$ 30,628	$ 69,733	$ 2,848,708
19	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 1,008,414	$ 183,715	$ 4,585	$ 107,076	$ 30,628	$ 69,204	$ 2,834,438
20	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 997,068	$ 182,323	$ 4,536	$ 106,265	$ 30,628	$ 68,680	$ 2,820,317
21	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 986,096	$ 180,978	$ 4,489	$ 105,481	$ 30,628	$ 68,174	$ 2,806,662
22	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 975,823	$ 179,724	$ 4,445	$ 104,751	$ 30,628	$ 67,701	$ 2,793,890
23	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 966,167	$ 178,551	$ 4,404	$ 104,067	$ 30,628	$ 67,259	$ 2,781,893
24	$ -	$ 1,213,843	$ 108,487	$ 108,487	$ 957,072	$ 177,451	$ 4,366	$ 103,426	$ 30,628	$ 66,845	$ 2,770,604
25	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 948,447	$ 176,412	$ 4,329	$ 102,820	$ 30,628	$ 66,453	$ 2,638,521
26	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 940,248	$ 175,427	$ 4,295	$ 102,246	$ 30,628	$ 66,082	$ 2,628,358
27	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 932,443	$ 174,493	$ 4,262	$ 101,702	$ 30,628	$ 65,731	$ 2,618,692
28	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 925,008	$ 173,607	$ 4,231	$ 101,185	$ 30,628	$ 65,397	$ 2,609,488
29	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 917,913	$ 172,764	$ 4,202	$ 100,694	$ 30,628	$ 65,079	$ 2,600,712
30	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 911,139	$ 171,962	$ 4,174	$ 100,227	$ 30,628	$ 64,777	$ 2,592,339
31	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 904,651	$ 171,197	$ 4,147	$ 99,781	$ 30,628	$ 64,489	$ 2,584,325
32	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 898,428	$ 170,465	$ 4,122	$ 99,354	$ 30,628	$ 64,213	$ 2,576,642
33	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 892,450	$ 169,765	$ 4,097	$ 98,946	$ 18,941	$ 63,950	$ 2,557,581
34	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 886,695	$ 169,093	$ 4,074	$ 98,554	$ 18,941	$ 63,696	$ 2,550,484
35	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 881,152	$ 168,447	$ 4,051	$ 98,178	$ 18,941	$ 63,453	$ 2,543,654
36	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 875,801	$ 167,826	$ 4,029	$ 97,816	$ 18,941	$ 63,219	$ 2,537,064
37	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 870,627	$ 167,227	$ 4,008	$ 97,467	$ 18,941	$ 62,993	$ 2,530,695
38	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 865,622	$ 166,649	$ 3,988	$ 97,130	$ 18,941	$ 62,776	$ 2,524,538
39	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 860,774	$ 166,090	$ 3,969	$ 96,804	$ 18,941	$ 62,565	$ 2,518,576
40	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 856,075	$ 165,551	$ 3,950	$ 96,490	$ 18,941	$ 62,362	$ 2,512,801
41	$ -	$ 1,092,459	$ 108,487	$ 108,487	$ 851,518	$ 165,028	$ 3,932	$ 96,185	$ 18,941	$ 62,165	$ 2,507,202
42	$ -	$ 971,074	$ 108,487	$ 108,487	$ 847,096	$ 164,523	$ 3,914	$ 95,891	$ 18,941	$ 61,975	$ 2,380,387
43	$ -	$ 971,074	$ 108,487	$ 108,487	$ 842,802	$ 164,034	$ 3,897	$ 95,606	$ 18,941	$ 61,791	$ 2,375,118
44	$ -	$ 971,074	$ 108,487	$ 108,487	$ 838,632	$ 163,560	$ 3,880	$ 95,330	$ 18,941	$ 61,612	$ 2,370,003
45	$ -	$ 971,074	$ 108,487	$ 108,487	$ 834,578	$ 163,101	$ 3,864	$ 95,062	$ 18,941	$ 61,439	$ 2,365,034
46	$ -	$ 971,074	$ 108,487	$ 108,487	$ 830,634	$ 162,655	$ 3,849	$ 94,802	$ 18,941	$ 61,271	$ 2,360,200
47	$ -	$ 971,074	$ 108,487	$ 108,487	$ 826,798	$ 162,223	$ 3,834	$ 94,550	$ 18,941	$ 61,109	$ 2,355,503
48	$ -	$ 971,074	$ 108,487	$ 108,487	$ 823,055	$ 161,802	$ 3,819	$ 94,305	$ 18,941	$ 60,950	$ 2,350,920
49	$ -	$ 971,074	$ 108,487	$ 108,487	$ 819,409	$ 161,393	$ 3,805	$ 94,067	$ 18,941	$ 60,796	$ 2,346,458
50	$ -	$ 971,074	$ 108,487	$ 108,487	$ 814,713	$ 160,829	$ 3,785	$ 93,738	$ 18,941	$ 60,583	$ 2,340,636
51	$ -	$ 971,074	$ 108,487	$ 108,487	$ 810,617	$ 159,772	$ 3,748	$ 93,122	$ 18,941	$ 60,185	$ 2,334,433
52	$ -	$ 971,074	$ 108,487	$ 108,487	$ 807,899	$ 159,415	$ 3,735	$ 92,913	$ 18,941	$ 60,051	$ 2,331,002
53	$ -	$ 971,074	$ 108,487	$ 108,487	$ 805,249	$ 159,066	$ 3,723	$ 92,710	$ 18,941	$ 59,919	$ 2,327,657
54	$ -	$ 971,074	$ 108,487	$ 108,487	$ 802,668	$ 158,727	$ 3,711	$ 92,512	$ 18,941	$ 59,791	$ 2,324,399
55	$ -	$ 971,074	$ 108,487	$ 108,487	$ 800,152	$ 158,396	$ 3,700	$ 92,320	$ 18,941	$ 59,667	$ 2,321,223
56	$ -	$ 971,074	$ 108,487	$ 108,487	$ 797,697	$ 158,074	$ 3,689	$ 92,132	$ 18,941	$ 59,545	$ 2,318,125
57	$ -	$ 971,074	$ 108,487	$ 108,487	$ 795,304	$ 157,760	$ 3,678	$ 91,949	$ 18,941	$ 59,427	$ 2,315,107
58	$ -	$ 971,074	$ 108,487	$ 108,487	$ 792,969	$ 157,453	$ 3,667	$ 91,770	$ 18,941	$ 59,312	$ 2,312,160
59	$ -	$ 971,074	$ 108,487	$ 108,487	$ 790,688	$ 157,155	$ 3,656	$ 91,596	$ 18,941	$ 59,199	$ 2,309,284
60	$ -	$ 971,074	$ 108,487	$ 108,487	$ 788,468	$ 156,864	$ 3,646	$ 91,427	$ 18,941	$ 59,090	$ 2,306,484
61	$ -	$ 971,074	$ 108,487	$ 108,487	$ 786,293	$ 156,580	$ 3,636	$ 91,261	$ 18,941	$ 58,983	$ 2,303,742
62	$ -	$ 971,074	$ 108,487	$ 108,487	$ 784,172	$ 156,302	$ 3,627	$ 91,100	$ 18,941	$ 58,878	$ 2,301,068
63	$ -	$ 971,074	$ 108,487	$ 108,487	$ 782,100	$ 156,032	$ 3,617	$ 90,942	$ 18,941	$ 58,776	$ 2,298,456
64	$ -	$ 971,074	$ 108,487	$ 108,487	$ 780,070	$ 155,767	$ 3,608	$ 90,787	$ 18,941	$ 58,677	$ 2,295,898
65	$ -	$ 971,074	$ 108,487	$ 108,487	$ 778,091	$ 155,509	$ 3,599	$ 90,637	$ 18,941	$ 58,579	$ 2,293,404
66	$ -	$ 971,074	$ 108,487	$ 108,487	$ 776,156	$ 155,257	$ 3,590	$ 90,490	$ 18,941	$ 58,484	$ 2,290,966
67	$ -	$ 971,074	$ 108,487	$ 108,487	$ 774,261	$ 155,010	$ 3,581	$ 90,346	$ 18,941	$ 58,392	$ 2,288,579
68	$ -	$ 971,074	$ 108,487	$ 108,487	$ 772,402	$ 154,768	$ 3,573	$ 90,205	$ 18,941	$ 58,300	$ 2,286,238
69	$ -	$ 971,074	$ 108,487	$ 108,487	$ 770,588	$ 154,532	$ 3,565	$ 90,068	$ 18,941	$ 58,212	$ 2,283,953
70	$ -	$ 971,074	$ 108,487	$ 108,487	$ 768,811	$ 154,302	$ 3,557	$ 89,933	$ 18,941	$ 58,125	$ 2,281,717
71	$ -	$ 971,074	$ 108,487	$ 108,487	$ 767,074	$ 154,076	$ 3,549	$ 89,802	$ 18,941	$ 58,040	$ 2,279,529
72	$ -	$ 971,074	$ 108,487	$ 108,487	$ 765,369	$ 153,855	$ 3,541	$ 89,673	$ 18,941	$ 57,957	$ 2,277,384
73	$ -	$ 971,074	$ 108,487	$ 108,487	$ 763,705	$ 153,640	$ 3,534	$ 89,548	$ 18,941	$ 57,876	$ 2,275,291
74	$ -	$ 971,074	$ 108,487	$ 108,487	$ 762,162	$ 153,459	$ 3,527	$ 89,442	$ 18,941	$ 57,807	$ 2,273,387
75	$ -	$ 971,074	$ 108,487	$ 108,487	$ 760,653	$ 153,283	$ 3,521	$ 89,340	$ 18,941	$ 57,741	$ 2,271,526
76	$ -	$ 971,074	$ 108,487	$ 108,487	$ 759,164	$ 153,109	$ 3,515	$ 89,238	$ 18,941	$ 57,675	$ 2,269,690
77	$ -	$ 971,074	$ 108,487	$ 108,487	$ 757,703	$ 152,939	$ 3,509	$ 89,139	$ 18,941	$ 57,611	$ 2,267,891
78	$ -	$ 971,074	$ 108,487	$ 108,487	$ 756,266	$ 152,772	$ 3,503	$ 89,042	$ 18,941	$ 57,549	$ 2,266,121
79	$ -	$ 971,074	$ 108,487	$ 108,487	$ 754,850	$ 152,609	$ 3,498	$ 88,947	$ 18,941	$ 57,487	$ 2,264,379
80	$ -	$ 971,074	$ 108,487	$ 108,487	$ 753,456	$ 152,447	$ 3,492	$ 88,853	$ 18,941	$ 57,426	$ 2,262,662
81	$ -	$ 971,074	$ 108,487	$ 108,487	$ 752,075	$ 152,288	$ 3,486	$ 88,760	$ 18,941	$ 57,366	$ 2,260,964
82	$ -	$ 971,074	$ 108,487	$ 108,487	$ 750,713	$ 152,131	$ 3,481	$ 88,668	$ 18,941	$ 57,307	$ 2,259,290
83	$ -	$ 971,074	$ 108,487	$ 108,487	$ 749,375	$ 151,978	$ 3,475	$ 88,579	$ 18,941	$ 57,249	$ 2,257,644
84	$ -	$ 971,074	$ 108,487	$ 108,487	$ 748,060	$ 151,827	$ 3,470	$ 88,491	$ 18,941	$ 57,193	$ 2,256,030
85	$ -	$ 971,074	$ 108,487	$ 108,487	$ 746,757	$ 151,678	$ 3,465	$ 88,404	$ 18,941	$ 57,136	$ 2,254,430
86	$ -	$ 971,074	$ 108,487	$ 108,487	$ 745,466	$ 151,531	$ 3,460	$ 88,318	$ 18,941	$ 57,081	$ 2,252,845
87	$ -	$ 971,074	$ 108,487	$ 108,487	$ 744,201	$ 151,387	$ 3,455	$ 88,234	$ 18,941	$ 57,027	$ 2,251,292
88	$ -	$ 971,074	$ 108,487	$ 108,487	$ 742,951	$ 151,245	$ 3,450	$ 88,152	$ 18,941	$ 56,973	$ 2,249,760
89	$ -	$ 971,074	$ 108,487	$ 108,487	$ 741,720	$ 151,106	$ 3,445	$ 88,071	$ 18,941	$ 56,921	$ 2,248,251
90	$ -	$ 971,074	$ 108,487	$ 108,487	$ 740,506	$ 150,969	$ 3,440	$ 87,991	$ 18,941	$ 56,869	$ 2,246,764
91	$ -	$ 971,074	$ 108,487	$ 108,487	$ 739,310	$ 150,834	$ 3,435	$ 87,912	$ 18,941	$ 56,818	$ 2,245,299
92	$ -	$ 849,690	$ 108,487	$ 108,487	$ 738,135	$ 150,702	$ 3,431	$ 87,835	$ 18,941	$ 56,769	$ 2,122,476
93	$ -	$ 849,690	$ 108,487	$ 108,487	$ 736,977	$ 150,573	$ 3,426	$ 87,760	$ 18,941	$ 56,720	$ 2,121,061
94	$ -	$ 849,690	$ 108,487	$ 108,487	$ 735,829	$ 150,444	$ 3,422	$ 87,685	$ 18,941	$ 56,672	$ 2,119,657
95	$ -	$ 849,690	$ 108,487	$ 108,487	$ 734,705	$ 150,319	$ 3,418	$ 87,612	$ 18,941	$ 56,624	$ 2,118,281
96	$ -	$ 849,690	$ 108,487	$ 108,487	$ 733,585	$ 150,195	$ 3,413	$ 87,540	$ 18,941	$ 56,578	$ 2,116,914
97	$ -	$ 849,690	$ 108,487	$ 108,487	$ 732,483	$ 150,073	$ 3,409	$ 87,469	$ 18,941	$ 56,532	$ 2,115,569
98	$ -	$ 849,690	$ 108,487	$ 108,487	$ 731,394	$ 149,952	$ 3,405	$ 87,398	$ 18,941	$ 56,486	$ 2,114,240
99	$ -	$ 849,690	$ 108,487	$ 108,487	$ 730,320	$ 149,834	$ 3,401	$ 87,329	$ 18,941	$ 56,442	$ 2,112,930
100	$ -	$ 849,690	$ 108,487	$ 108,487	$ 729,263	$ 149,718	$ 3,396	$ 87,262	$ 18,941	$ 56,398	$ 2,111,641
Total	**$ 7,232,445**	**$ 86,911,164**	**$ 9,329,854**	**$ 9,329,854**	**$ 70,905,775**	**$ 13,875,586**	**$ 327,041**	**$ 8,087,267**	**$ 1,881,204**	**$ 5,226,863**	**$ 213,107,053**

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Sludge Disposal Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Inputs		
New Cost	$	142,305
Replacement O&M		1.5%
Sludge disposal ($/cy)	$	3.03

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[2]	O&M Labor[2]	Annual Sludge Production/ Removal (cy/yr)	Total Operating Cost
1	2019	$ -	$ -	$ -	$ -	0	$ -
2	2020	$ -	$ -	$ -	$ -	0	$ -
3	2021	$ -	$ -	$ -	$ -	0	$ -
4	2022	$ -	$ -	$ -	$ -	0	$ -
5	2023	$ -	$ -	$ -	$ -	0	$ -
6	2024	$ -	$ -	$ -	$ -	0	$ -
7	2025	$ -	$ -	$ -	$ -	0	$ -
8	2026	$ -	$ -	$ -	$ -	0	$ -
9	2027	$ -	$ -	$ -	$ -	0	$ -
10	2028	$ -	$ -	$ -	$ -	0	$ -
11	2029	$ -	$ -	$ -	$ -	0	$ -
12	2030	$ -	$ -	$ -	$ -	0	$ -
13	2031	$ -	$ -	$ -	$ -	0	$ -
14	2032	**$ 142,305**	$ -	$ -	$ -	0	$ 142,305
15	2033	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	24,329	$ 75,916
16	2034	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	24,056	$ 75,089
17	2035	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	23,786	$ 74,271
18	2036	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	23,519	$ 73,460
19	2037	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	23,254	$ 72,658
20	2038	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	22,993	$ 71,864
21	2039	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	22,740	$ 71,097
22	2040	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	22,503	$ 70,378
23	2041	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	22,280	$ 69,703
24	2042	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	22,070	$ 69,067
25	2043	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,871	$ 68,464
26	2044	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,682	$ 67,890
27	2045	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,502	$ 67,345
28	2046	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,331	$ 66,825
29	2047	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,167	$ 66,328
30	2048	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	21,011	$ 65,855
31	2049	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,862	$ 65,401
32	2050	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,718	$ 64,966
33	2051	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,580	$ 64,548
34	2052	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,447	$ 64,145
35	2053	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,320	$ 63,758
36	2054	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,196	$ 63,383
37	2055	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	20,077	$ 63,022
38	2056	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,962	$ 62,672
39	2057	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,850	$ 62,333
40	2058	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,741	$ 62,004
41	2059	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,636	$ 61,685
42	2060	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,534	$ 61,376
43	2061	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,435	$ 61,076
44	2062	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,339	$ 60,784
45	2063	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,246	$ 60,501
46	2064	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,155	$ 60,225
47	2065	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	19,066	$ 59,956
48	2066	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,980	$ 59,695
49	2067	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,896	$ 59,440
50	2068	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,788	$ 59,111
51	2069	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,693	$ 58,825
52	2070	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,630	$ 58,635
53	2071	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,569	$ 58,449
54	2072	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,510	$ 58,269
55	2073	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,452	$ 58,093
56	2074	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,395	$ 57,921
57	2075	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,340	$ 57,754
58	2076	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,286	$ 57,591
59	2077	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,234	$ 57,431
60	2078	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,182	$ 57,276
61	2079	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,132	$ 57,124
62	2080	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,083	$ 56,975
63	2081	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	18,035	$ 56,830
64	2082	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,989	$ 56,689
65	2083	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,943	$ 56,550
66	2084	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,898	$ 56,415
67	2085	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,855	$ 56,282
68	2086	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,812	$ 56,152
69	2087	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,770	$ 56,025
70	2088	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,729	$ 55,901
71	2089	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,689	$ 55,780
72	2090	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,650	$ 55,660
73	2091	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,611	$ 55,544
74	2092	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,576	$ 55,436
75	2093	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,541	$ 55,331
76	2094	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,507	$ 55,226
77	2095	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,473	$ 55,124
78	2096	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,440	$ 55,024
79	2097	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,407	$ 54,925
80	2098	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,375	$ 54,827
81	2099	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,343	$ 54,731

GOLDER

Inputs		
New Cost	**$**	**142,305**
Replacement O&M		**1.5%**
Sludge disposal ($/cy)	**$**	**3.03**

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Sludge Disposal Direct Cost Cash Flow by Year in Current Cost Dollars
Project Short Title: Tyrone Mine Closure Closeout Plan

Year Following Closure	Year	Capital	Replacement O&M[1]	Routine Maintenance[2]	O&M Labor[2]	Annual Sludge Production/ Removal (cy/yr)	Total Operating Cost
82	2100	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,312	$ 54,635
83	2101	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,281	$ 54,542
84	2102	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,250	$ 54,450
85	2103	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,220	$ 54,359
86	2104	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,191	$ 54,269
87	2105	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,161	$ 54,180
88	2106	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,133	$ 54,093
89	2107	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,104	$ 54,007
90	2108	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,076	$ 53,922
91	2109	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,049	$ 53,838
92	2110	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	17,022	$ 53,756
93	2111	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,995	$ 53,675
94	2112	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,968	$ 53,595
95	2113	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,942	$ 53,516
96	2114	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,917	$ 53,438
97	2115	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,891	$ 53,361
98	2116	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,866	$ 53,284
99	2117	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,841	$ 53,209
100	2118	$ -	$ 2,135	Included in Total Operating Cost	Included in Total Operating Cost	16,817	$ 53,135
Total		**$ 142,305**	**$ 183,573**	**$ -**	**$ -**	**1,635,108**	**$ 5,284,651**

Notes:

[1] Capital replacement is estimated at 1.5% of the total capital cost and includes estimated costs associated with closure of each of the four individual cells comprising the sludge disposal facility (approximately 408,777 cubic yards per cell). Closure includes grading, three foot of earthen cover, and revegetation costs. Initial capital cost for construction of sludge disposal facility (by RS Means) shown in Year 14.

[2] Routine Maintenance and Operation and Maintanance Labor is included in the Total Operating Cost calculation. Costs based on 2019 RS Means estimate of $3.03 per/cy for loading, hauling, and placing of sludge at the sludge disposal facility.

Cost estimate backup details are included in Attachment B to the Tyrone Water Treatment Cost Basis Document.
Costs do not include indirect costs

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: STS Capital Cost Estimate Details
Project Short Title: Tyrone Mine Closure Closeout Plan

Item	Description	Qty	UOM	Unit $	Extended
	Equipment Cost				
Membrane System, UF and RO systems [a]	1,600 gpm, UF is 2 50% units and RO is 3 33% units for flexibility	1	each	$ 1,345,700	$ 1,345,700
Reaction Tank [a]	Four 32,000 gallon tanks for flexibility, appx 120 min reaction time, baffles, ladder, platform, mixer mount and mixer	4	each	$ 129,000	$ 516,000
Floc Tank [a]	7,000 gallon tank and mixer	1	each	$ 26,000	$ 26,000
Sludge Densification Tank [a]	2 tanks at 450 gal, with internal baffles, mixer mount and mixer, legs for gravity overflow to reaction tank	2	each	$ 88,400	$ 176,800
Thickener/Clarifier [a]	80' diameter, with feedwell, bridge, ladder, platform	1	each	$ 377,200	$ 377,200
Sludge Pump [a]	29 gpm	2	each	$ 15,000	$ 30,000
Underflow Pump [a]	3 Recycles 152 gpm	2	each	$ 20,000	$ 40,000
Polymer system [a]	10 mg/L - 0.97 gph	1	each	$ 18,525	$ 18,525
Lime Silo and Slaker System [a]	36,780 lb/day - 39 gpm, 10% slurry	1	each	$ 985,000	$ 985,000
pH control system (acid addition) [a]	6.65 mg/L - 1.07 gph, 0.35 concentration	2	each	$ 7,053	$ 14,106
Effluent Neutralization Tank [a]	32,000 gallon tank with mixer	1	each	$ 129,000	$ 129,000
Sludge Holding Tank [a]	13,000 gal	1	each	$ 33,000	$ 33,000
Filter Press System [a]	3 - 100 ft3 including platform and conveyor	3	each	$ 352,667	$ 1,058,001
Filtrate Tank [a]	3,000 gal	1	each	$ 10,000	$ 10,000
Filtrate Pump [a]	9 gpm	2	each	$ 6,700	$ 13,400
Process Water Tank [a]	3,000 gal	1	each	$ 10,000	$ 10,000
Process Water Return Pump [a]	27.97 gpm	2	each	$ 5,396	$ 10,792
Air Compressor [b]	For diaphragm pumps, includes air receiver	2	each	$ 15,000	$ 30,000
Electrical Equipment [b]		1	ls	$ 100,000	$ 100,000
Valves and Piping [b]		1	ls	$ 156,000	$ 156,000
Instrumentation [b]		1	ls	$ 50,000	$ 50,000
Control System [b]		1	ls	$ 50,000	$ 50,000
Freight [b]		1	ls	$ 100,000	$ 100,000
Total Direct Equipment					**$ 5,279,524**
	Installation Cost				
Equipment Placement	Materials/equipment	1	ls	$ 50,000	$ 50,000
[c]	Crew size 6 men				
[c]	Duration 35 days				
	Labor subtotal (Group II Laborers)	1,680	hrs	$23.84	$ 40,051
Tank Erection (Clarifier Tank)	Materials/equipment	1	ls	$ 75,000	$ 75,000
[c]	Crew size 8 men				
[c]	Duration 28 days				
	Ironworker	1,792	hrs	$48.66	$ 87,199
Process Mechanical	Materials/equipment	1	ls	$ 30,000	$ 30,000
[c]	Crew size 6 men				
[c]	Duration 32 days				
	Labor subtotal (Plumber/Pipefitter)	1,536	hrs	$45.45	$ 69,811
Process Electrical	Materials/equipment	1	ls	$ 200,000	$ 200,000
[c]	Crew size 4 men				
[c]	Duration 45 days				
	Labor subtotal [Electrician (Lineman/Tech)]	1,440	hrs	$54.05	$ 77,838
Process Controls	Materials/equipment	1	ls	$ 5,000	$ 5,000
[c]	Crew size 4 men				
[c]	Duration 20 days				
	Labor subtotal [Electrician (Lineman/Tech)]	640	hrs	$54.05	$ 34,595
Per Diem (Facility Electrical, Plumber) [c]	Per Day	252	days	$50.00	$ 12,600
Structural Steel [b]		1	ls	$50,000	$ 50,000
Total Installation Cost					**$ 732,093**
	Facility Cost				
Site Work [b]	2 x pad area 20,800 ft^2	0.5	acre	$100,000	$ 47,750
Foundations [b]	Pad area 10,400 ft^2				
	Total concrete	486	cy	$600	$ 291,615
Building Envelope [b]	Building area 5,000 ft^2	5,000	ft^2	$100	$ 500,000
Building Electrical [b]	Materials/equipment	1	ls	$40,000	$ 40,000
[c]	Crew size 4 men				
[c]	Duration 15 days				
Electrical Lineman (outside)	Labor subtotal	480	hrs	$55.13	$ 26,462
Building Plumbing [b]		1	ls	$75,000	$ 75,000
Building HVAC [b]		1	ls	$115,000	$ 115,000
Freight (building) [d]		1	ls	$25,000	$ 25,000
Commissioning [b]		1	ls	$100,000	$ 100,000
Total Facility Cost					**$ 1,220,828**
	Total Capital Cost				
Total Direct Cost					**$ 7,232,445**

Notes:
a = Cost based on quote from vendor.
b = Cost based on experience with detailed design and construction of similar treatment systems.

c = Hours based on experience with detailed design and construction of similar treatment systems, labor rates based on 2019 New Mexico rates. Per diem based on 2019 New Mexico Subsisistence, Zone and Incentive Pay Rates (per diem applies Plumber/Pipefitter and Electrical Lineman (outside) only.
d = Lump sum costs for freight have been included for the major process equipment and the building. Freight on materials is not included.
Costs do not include indirect costs

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: STS Equipment List
Project Short Title: Tyrone Mine Closure Closeout Plan

Equipment Name	Description	Power, hp	Footprint	Quantity	Cost	Manufacturer/Vendor/ *Quote Tab Number*	Unit Cost	Notes
Membrane System, UF and RO systems	1,600 gpm, UF is 2 50% units and RO is 3 33% units for flexibility	250	784	1	$ 1,345,700	**WesTech Quote 2019 (*Tab 1*)**	$ 1,345,700	
Reaction Tank	Four 32,000 gallon tanks for flexibility, appx 120 min reaction time, baffles, ladder, platform, mixer mount and mixer	NA	1257	4	$ 516,000	**WesTech Quote 2019 (*Tab 1*)**	$ 129,000	Quote is for 1 - 32,000 gallon tanks, need 4 for a total reaction time of 120 min
Floc Tank	7,000 gallon tank and mixer	2	79	1	$ 26,000	**Tank Equipment 2019 (*Tab 2*)**	$ 26,000	
Sludge Densification Tank	2 tanks at 450 gal, with internal baffles, mixer mount and mixer, legs for gravity overflow to reaction tank	1	57	2	$ 176,800	**WesTech Quote 2019 (*Tab 1*)**	$ 88,400	
Thickener/Clarifier	80' diameter, with feedwell, bridge, ladder, platform	2	5542	1	$ 377,200	**WesTech Quote 2019 (*Tab 1*)**	$ 377,200	
Sludge Pump	29 gpm	1.5	16	2	$ 30,000	**Denver Industrial Pumps 2019 (*Tab 3*)**	$ 15,000	
Underflow Pump	3 Recycles 152 gpm	3	16	2	$ 40,000	**Denver Industrial Pumps 2019 (*Tab 3*)**	$ 20,000	
Polymer system	10 mg/L - 0.97 gph	0.3	16	1	$ 18,525	**Velodyne 2019 Quote (*Tab 4*)**	$ 18,525	
Lime Silo and Slaker System	36,780 lb/day - 39 gpm, 10% slurry	10	113	1	$ 985,000	**Louisville Dryer Company Quote 2019 (*Tab 5*)**	$ 985,000	
pH control system (acid addition)	6.65 mg/L - 1.07 gph, 0.35 concentration	0.3	12	2	$ 14,106	**Denver Industrial Pumps 2019 (*Tab 6*)**	$ 7,053	
Effluent Neutralization Tank	32,000 gallon tank with mixer	7.5	154	1	$ 129,000	**WesTech Quote 2019 (*Tab 1*)**	$ 129,000	
Sludge Holding Tank	13,000 gal	NA	113	1	$ 33,000	**Tank Equipment 2019 (*Tab 2*)**	$ 33,000	
Filter Press System	3 - 100 ft3 including platform and conveyor	15	476	3	$ 1,058,001	**WesTech Quote 2019 (*Tab 1*)**	$ 352,667	Need 3 for max, 2 for avg conditions
Filtrate Tank	3,000 gal	NA	50	1	$ 10,000	**Tank Equipment 2019 (*Tab 2*)**	$ 10,000	
Filtrate Pump	9 gpm	0.5	16	2	$ 13,400	**Denver Industrial Pumps 2019 (*Tab 3*)**	$ 6,700	
Process Water Tank	3,000 gal	NA	50	1	$ 10,000	**Tank Equipment 2019 (*Tab 2*)**	$ 10,000	
Process Water Return Pump	27.97 gpm	1	16	2	$ 10,792	**Denver Industrial Pumps 2019 (*Tab 3*)**	$ 5,396	
Air Compressor	For diaphragm pumps, includes air receiver	15	16	2	$ 30,000	Estimation based on previous experience	$ 15,000	
Electrical Equipment		NA	NA	1	$ 100,000	Estimation based on previous experience	$ 300,000	
Valves and Piping		NA	NA	1	$ 156,000	Estimation based on previous experience	$ 160,000	
Instrumentation		NA	NA	1	$ 50,000	Estimation based on previous experience	$ 75,000	
Control System		5	NA	1	$ 50,000	Estimation based on previous experience	$ 200,000	
Freight		NA	NA	1	$ 100,000	Estimation based on previous experience	$ 100,000	
Total Process Equip		**400**	**3,240**	**1**	**$ 5,279,524**			
TTS Total		298.28	8782.159	Total area including the thickner which is located outside of the TTS building.				

Assume building load allowance is covered under safety factor of max hp listed for equipment

NOTE - Quotes are available in referenced lettered tabs (Column F) in a separate PDF.

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Yearly Summary for TTS
Project Short Title: Tyrone Mine Closure Closeout Plan

	TTS Flow Balance										TTS Sulfate Concentration Balance					TTS Sludge																TTS Power Calculations		
Year	MA +Interceptor Flow to HDS, gpm	MA Flow, gpm	HDS Feed (Brine Recycle, MA, Sludge Recycle), gpm	Sludge Recycle, gpm	HDS to RO, gpm	HDS to RO Bypass, gpm	RO Membrane (HDS -Bypass) Feed Flow, gpm	Permeate, gpm	Brine Flow, gpm	Effluent (Perm + RO Bypass) Flow, gpm	MA + Interceptor Sulfate, mg/L	HDS Feed Sulfate, mg/L	HDS Effluent Sulfate AVG, mg/L	Brine Sulfate, mg/L	Effluent Sulfate, mg/L	Sludge Dry Solids, lb/day	Sludge Dry Solids (for calculation), lb/day	Final Sludge @ 50% Moisture, lb/day	Final Sludge @ 50% Moisture, cy/year	Lime (CaO) Consumption, lb/day	Lime (CaO) Consumption, ton/year	Flocculent (Anionic Polymer) Consumption, lb/day	Flocculent (Anionic Polymer) Consumption, ton/year	Acid (35% HCl) Consumption, lb/day	Acid (35%HCl) Consumption, ton/year	Antiscalant, lb/year	Biocide, lb/year	MF High pH Cleaning Chem, lb/year	MF Low pH Cleaning Chem, lb/year	RO High pH Cleaning Chem, lb/year	RO Low pH Cleaning Chem, lb/year	Membrane Power (kwh/yr)	HDS Power (kwh/yr)	Total Power (kwh/year)
15	1189	889	1285	96	925	360	925	722	204	1082	2,811	2,788	1,600	7,273	546	89,983	114,508	179,965	24,329	22,581	4,121	154	28.18	62.4	11.4	12,176	4,059	4228	4228	705	705	1,220,596	353,167	1,573,763
16	1180	880	1275	95	918	357	918	716	202	1073	2,800	2,778	1,600	7,273	546	88,975	113,476	177,949	24,056	22,328	4,075	153	27.97	61.7	11.3	12,083	4,028	4196	4196	699	699	1,211,336	350,488	1,561,824
17	1171	871	1266	94	911	354	911	711	201	1065	2,789	2,768	1,600	7,273	546	87,976	112,453	175,953	23,786	22,078	4,029	152	27.76	61.1	11.2	11,991	3,997	4164	4164	694	694	1,202,145	347,829	1,549,975
18	1163	863	1256	94	904	352	904	705	199	1057	2,778	2,758	1,600	7,273	546	86,987	111,440	173,975	23,519	21,830	3,984	151	27.55	60.5	11.0	11,900	3,967	4133	4133	689	689	1,193,022	345,189	1,538,211
19	1154	854	1247	93	898	349	898	700	197	1049	2,767	2,747	1,600	7,273	546	86,009	110,438	172,018	23,254	21,584	3,939	150	27.34	59.8	10.9	11,810	3,937	4101	4101	684	684	1,183,976	342,572	1,526,547
20	1145	845	1237	92	891	346	891	695	196	1041	2,756	2,737	1,600	7,273	546	85,041	109,446	170,083	22,993	21,341	3,895	149	27.13	59.2	10.8	11,721	3,907	4070	4070	678	678	1,175,007	339,977	1,514,984
21	1137	837	1228	91	884	344	884	690	195	1034	2,745	2,727	1,600	7,273	546	84,106	108,486	168,211	22,740	21,107	3,852	148	26.93	58.6	10.7	11,634	3,878	4040	4040	673	673	1,166,340	337,469	1,503,809
22	1129	829	1220	90	878	341	878	685	193	1026	2,735	2,718	1,600	7,273	546	83,229	107,586	166,459	22,503	20,887	3,812	147	26.74	58.0	10.6	11,554	3,851	4012	4012	669	669	1,158,261	335,132	1,493,392
23	1122	822	1212	90	872	339	872	680	192	1020	2,725	2,708	1,600	7,273	546	82,406	106,739	164,812	22,280	20,680	3,774	146	26.57	57.5	10.5	11,478	3,826	3986	3986	664	664	1,150,699	332,944	1,483,643
24	1115	815	1204	89	867	337	867	676	191	1013	2,716	2,700	1,600	7,273	546	81,630	105,940	163,260	22,070	20,485	3,739	145	26.41	57.0	10.4	11,408	3,803	3962	3962	660	660	1,143,609	330,892	1,474,501
25	1109	809	1197	88	862	335	862	672	190	1008	2,706	2,691	1,600	7,273	546	80,894	105,181	161,789	21,871	20,301	3,705	144	26.25	56.5	10.3	11,341	3,780	3938	3938	656	656	1,136,910	328,954	1,465,864
26	1103	803	1190	88	857	333	857	669	189	1002	2,697	2,683	1,600	7,273	546	80,195	104,458	160,390	21,682	20,125	3,673	143	26.11	56.0	10.2	11,277	3,759	3916	3916	653	653	1,130,565	327,118	1,457,683
27	1097	797	1184	87	853	332	853	665	188	997	2,689	2,675	1,600	7,273	546	79,530	103,770	159,059	21,502	19,958	3,642	142	25.97	55.6	10.1	11,217	3,739	3896	3896	649	649	1,124,548	325,377	1,449,925
28	1092	792	1178	87	848	330	848	662	187	991	2,680	2,667	1,600	7,273	546	78,895	103,112	157,791	21,331	19,799	3,613	142	25.83	55.2	10.1	11,160	3,720	3876	3876	646	646	1,118,834	323,724	1,442,558
29	1086	786	1172	86	844	328	844	658	186	987	2,672	2,659	1,600	7,273	546	78,290	102,484	156,580	21,167	19,647	3,586	141	25.71	54.8	10.0	11,106	3,702	3857	3857	643	643	1,113,402	322,152	1,435,554
30	1081	781	1167	86	840	327	840	655	185	982	2,664	2,652	1,600	7,273	546	77,712	101,884	155,425	21,011	19,502	3,559	140	25.59	54.5	9.9	11,055	3,685	3839	3839	640	640	1,108,235	320,657	1,428,892
31	1077	777	1162	85	836	325	836	652	184	978	2,656	2,645	1,600	7,273	546	77,159	101,308	154,318	20,862	19,363	3,534	140	25.48	54.1	9.9	11,006	3,669	3822	3822	637	637	1,103,303	319,230	1,422,533
32	1072	772	1157	85	833	324	833	650	183	974	2,649	2,638	1,600	7,273	546	76,628	100,755	153,257	20,718	19,230	3,509	139	25.37	53.8	9.8	10,958	3,653	3806	3806	634	634	1,098,588	317,866	1,416,454
33	1068	768	1152	84	829	323	829	647	182	970	2,642	2,631	1,600	7,273	546	76,118	100,222	152,237	20,580	19,102	3,486	138	25.26	53.5	9.8	10,913	3,638	3790	3790	632	632	1,094,075	316,560	1,410,635
34	1064	764	1147	84	826	321	826	644	182	966	2,635	2,625	1,600	7,273	546	75,628	99,709	151,255	20,447	18,979	3,464	138	25.16	53.1	9.7	10,870	3,623	3775	3775	629	629	1,089,742	315,306	1,405,048
35	1060	760	1143	83	823	320	823	642	181	962	2,628	2,618	1,600	7,273	546	75,155	99,214	150,310	20,320	18,860	3,442	137	25.07	52.9	9.6	10,829	3,610	3761	3761	627	627	1,085,582	314,103	1,399,685
36	1056	756	1139	83	820	319	820	640	180	958	2,621	2,612	1,600	7,273	546	74,698	98,735	149,397	20,196	18,746	3,421	137	24.97	52.6	9.6	10,789	3,596	3747	3747	624	624	1,081,578	312,944	1,394,521
37	1052	752	1135	83	817	318	817	637	180	955	2,614	2,606	1,600	7,273	546	74,257	98,272	148,514	20,077	18,635	3,401	136	24.88	52.3	9.5	10,750	3,583	3733	3733	622	622	1,077,716	311,827	1,389,543
38	1049	749	1131	82	814	317	814	635	179	952	2,608	2,600	1,600	7,273	546	73,830	97,823	147,660	19,962	18,528	3,381	136	24.80	52.0	9.5	10,713	3,571	3720	3720	620	620	1,073,992	310,749	1,384,741
39	1045	745	1127	82	812	316	812	633	179	949	2,601	2,594	1,600	7,273	546	73,417	97,387	146,833	19,850	18,424	3,362	135	24.72	51.8	9.4	10,677	3,559	3708	3708	618	618	1,070,393	309,708	1,380,101
40	1042	742	1123	81	809	315	809	631	178	945	2,595	2,588	1,600	7,273	546	73,016	96,965	146,032	19,741	18,324	3,344	135	24.64	51.5	9.4	10,643	3,548	3696	3696	616	616	1,066,915	308,702	1,375,617
41	1039	739	1120	81	806	314	806	629	177	942	2,589	2,583	1,600	7,273	546	72,627	96,554	145,254	19,636	18,226	3,326	135	24.56	51.3	9.4	10,609	3,536	3684	3684	614	614	1,063,550	307,728	1,371,278
42	1036	736	1116	81	804	313	804	627	177	940	2,583	2,577	1,600	7,273	546	72,250	96,155	144,500	19,534	18,131	3,309	134	24.48	51.1	9.3	10,576	3,525	3673	3673	612	612	1,060,294	306,786	1,367,080
43	1033	733	1113	80	801	312	801	625	176	937	2,577	2,572	1,600	7,273	546	71,884	95,767	143,768	19,435	18,039	3,292	134	24.41	50.8	9.3	10,545	3,515	3662	3662	610	610	1,057,142	305,874	1,363,015
44	1030	730	1110	80	799	311	799	623	176	934	2,572	2,566	1,600	7,273	546	71,528	95,389	143,056	19,339	17,950	3,276	133	24.34	50.6	9.2	10,515	3,505	3651	3651	609	609	1,054,088	304,990	1,359,078
45	1027	727	1107	80	797	310	797	622	175	931	2,566	2,561	1,600	7,273	546	71,182	95,021	142,365	19,246	17,863	3,260	133	24.27	50.4	9.2	10,485	3,495	3641	3641	607	607	1,051,129	304,134	1,355,262
46	1024	724	1104	79	795	309	795	620	175	929	2,560	2,556	1,600	7,273	546	70,846	94,663	141,692	19,155	17,779	3,245	133	24.20	50.2	9.2	10,456	3,485	3631	3631	605	605	1,048,256	303,303	1,351,559
47	1022	722	1101	79	793	308	793	618	174	926	2,555	2,551	1,600	7,273	546	70,519	94,314	141,038	19,066	17,697	3,230	132	24.14	50.0	9.1	10,429	3,476	3622	3622	604	604	1,045,471	302,497	1,347,968
48	1019	719	1098	79	791	307	791	617	174	924	2,550	2,546	1,600	7,273	546	70,200	93,973	140,399	18,980	17,617	3,215	132	24.08	49.8	9.1	10,402	3,467	3612	3612	602	602	1,042,759	301,712	1,344,471
49	1017	717	1095	79	789	307	789	615	173	922	2,544	2,541	1,600	7,273	546	69,889	93,641	139,777	18,896	17,539	3,201	132	24.02	49.6	9.1	10,375	3,458	3603	3603	601	601	1,040,124	300,950	1,341,074
50	1013	713	1091	78	786	306	786	613	173	919	2,538	2,536	1,600	7,273	546	69,488	93,218	138,976	18,788	17,438	3,182	131	23.93	49.4	9.0	10,339	3,446	3590	3590	598	598	1,036,484	299,897	1,336,381
51	1006	706	1084	78	781	304	781	609	172	912	2,543	2,540	1,600	7,273	546	69,139	92,858	138,277	18,693	17,351	3,166	130	23.78	48.9	8.9	10,271	3,424	3567	3567	594	594	1,029,677	297,927	1,327,605
52	1004	704	1082	78	779	303	779	608	171	910	2,540	2,537	1,600	7,273	546	68,907	92,618	137,814	18,630	17,292	3,156	130	23.72	48.7	8.9	10,248	3,416	3559	3559	593	593	1,027,371	297,260	1,324,631
53	1002	702	1079	78	777	302	777	606	171	908	2,537	2,534	1,600	7,273	546	68,681	92,383	137,362	18,569	17,236	3,146	130	23.67	48.6	8.9	10,226	3,409	3551	3551	592	592	1,025,124	296,610	1,321,734
54	1000	700	1077	77	776	302	776	605	171	906	2,534	2,531	1,600	7,273	546	68,461	92,154	136,922	18,510	17,180	3,135	129	23.62	48.4	8.8	10,204	3,401	3544	3544	591	591	1,022,937	295,977	1,318,913
55	998	698	1075	77	774	301	774	604	170	905	2,531	2,529	1,600	7,273	546	68,246	91,931	136,492	18,452	17,127	3,126	129	23.57	48.3	8.8	10,183	3,394	3536	3536	589	589	1,020,806	295,360	1,316,166
56	996	696	1073	77	772	300	772	602	170	903	2,528	2,526	1,600	7,273	546	68,037	91,713	136,074	18,395	17,074	3,116	129	23.52	48.1	8.8	10,162	3,387	3529	3529	588	588	1,018,728	294,759	1,313,487
57	994	694	1071	77	771	300	771	601	170	901	2,525	2,523	1,600	7,273	546	67,833	91,500	135,665	18,340	17,023	3,107	129	23.48	48.0	8.8	10,142	3,381	3522	3522	587	587	1,016,706	294,174	1,310,879
58	992	692	1068	77	769	299	769	600	169	899	2,522	2,521	1,600	7,273	546	67,633	91,292	135,267	18,286	16,973	3,098	128	23.43	47.8	8.7	10,122	3,374	3515	3515	586	586	1,014,732	293,603	1,308,335
59	990	690	1066	76	768	299	768	599	169	898	2,520	2,518	1,600	7,273	546	67,439	91,089	134,878	18,234	16,924	3,089	128	23.39	47.7	8.7	10,103	3,368	3508	3508	585	585	1,012,807	293,046	1,305,853
60	988	688	1064	76	766	298	766	598	169	896	2,517	2,516	1,600	7,273	546	67,250	90,891	134,499	18,182	16,876	3,080	128	23.34	47.6	8.7	10,084	3,361	3502	3502	584	584	1,010,934	292,504	1,303,438
61	986	686	1063	76	765	298	765	597	168	894	2,515	2,514	1,600	7,273	546	67,064	90,697	134,128	18,132	16,830	3,071	128	23.30	47.4	8.7	10,066	3,355	3496	3496	583	583	1,009,101	291,974	1,301,075
62	985	685	1061	76	764	297	764	596	168	893	2,512	2,511	1,600	7,273	546	66,883	90,508	133,766	18,083	16,785	3,063	127	23.26	47.3	8.6	10,048	3,349	3489	3489	582	582	1,007,314	291,457	1,298,771
63	983	683	1059	76	762	296	762	595	168	891	2,510	2,509	1,600	7,273	546	66,706	90,322	133,413	18,035	16,740	3,055	127	23.22	47.2	8.6	10,031	3,344	3483	3483	581	581	1,005,570	290,952	1,296,521
64	981	681	1057	76	761	296	761	594	167	890	2,507	2,507	1,600	7,273	546	66,533	90,141	133,067	17,989	16,697	3,047	127	23.18	47.1	8.6	10,014	3,338	3477	3477	580	580	1,003,864	290,458	1,294,322
65	980	680	1055	76	760	295	760	593	167	888	2,505	2,504	1,600	7,273	546	66,365	89,964	132,729	17,943	16,654	3,039	127	23.14	47.0	8.6	9,997	3,332	3472	3472	579	579	1,002,200	289,977	1,292,177
66	978	678	1054	75	759	295	759	592	167	887	2,502	2,502	1,600	7,273	546	66,200	89,790	132,399	17,898	16,613	3,032	127	23.10	46.8	8.5	9,981	3,327	3466	3466	578	578	1,000,576	289,507	1,290,083
67	977	677	1052	75	757	295	757	591	167	885	2,500	2,500	1,600	7,273	546	66,038	89,620	132,076	17,855	16,572	3,024	126	23.07	46.7	8.5	9,965	3,322	3461	3461	577	577	998,986	289,047	1,288,032
68	975	675	1050	75	756	294	756	590	166	884	2,498	2,498	1,600	7,273	546	65,879	89,453	131,759	17,812	16,533	3,017	126	23.03	46.6	8.5	9,949	3,316	3455	3455	576	576	997,427	288,596	1,286,023
69	974	674	1049	75	755	294	755	589	166	883	2,496	2,496	1,600	7,273	546	65,725	89,290	131,449	17,770	16,494	3,010	126	23.00	46.5	8.5	9,934	3,311	3450	3450	575	575	995,907	288,156	1,284,063
70	972	672	1047	75	754	293	754	588	166	881	2,493	2,494	1,600	7,273	546	65,573	89,130	131,146	17,729	16,456	3,003	126	22.96	46.4	8.5	9,919	3,306	3445	3445	574	574	994,420	287,726	1,282,146
71	971	671	1046	75	753	293	753	587	166	880	2,491	2,492	1,600	7,273	546	65,425	88,973	130,850	17,689	16,419	2,996	126	22.93	46.3	8.4	9,905	3,302	3440	3440	573	573	992,968	287,306	1,280,273
72	969	669	1044	75	752	292	752	586	165	879	2,489	2,490	1,600	7,273	546	65,279	88,819	130,559	17,650	16,382	2,990	125	22.90	46.2	8.4	9,891	3,297	3435	3435	572	572	991,544	286,894	1,278,438
73	968	668	1043	74	751	292	751	586	165	877	2,487	2,488	1,600	7,273	546	65,138	88,669	130,275	17,611	16,346	2,983	125	22.86	46.1	8.4	9,877	3,292	3430	3430	572	572	990,158	286,493	1,276,650
74	967	667	1041	74	750	292	750	585	165	876	2,485	2,486	1,600	7,273	546	65,006	88,529	130,012	17,576	16,313	2,977	125	22.84	46.0	8.4	9,865	3,288	3426	3426	571	571	988,991	286,155	1,275,145
75	966	666	1040	74	749	291	749	584	165	875	2,483	2,484	1,600	7,273	546	64,877	88,392	129,754	17,541	16,281	2,971	125	22.81	45.9	8.4	9,854	3,285	3422	3422	570	570	987,854	285,826	1,273,679
76	965	665	1039	74	748	291	748	583	165	874	2,480	2,482	1,600	7,273	546	64,750	88,257	129,500	17,507	16,249	2,965	125	22.78	45.9	8.4	9,843	3,281	3418	3418	570	570	986,734	285,502	1,272,237
77	964	664	1038	74	747	291	747	583	164	873	2,478	2,480	1,600	7,273	546	64,626	88,124	129,251	17,473	16,218	2,960	125	22.76	45.8	8.4	9,832	3,277	3414	3414	569	569	985,639	285,185	1,270,824
78	963	663	1037	74	746	290	746	582	164	872	2,476	2,478	1,600	7,273	546	64,503	87,993	129,006	17,440	16,187	2,954	125	22.73	45.7	8.3	9,821	3,274	3411	3411	568	568	984,564	284,874	1,269,439
79	962	662	1036	74	746	290	746	582	164	872	2,474	2,476	1,600	7,273	546	64,382	87,864	128,765	17,407	16,157	2,949	124	22.71	45.6	8.3	9,811	3,270	3407	3407	568	568	983,508	284,569	1,268,077
80	961	661	1035	74	745	290	745	581	164	871	2,472	2,474	1,600	7,273	546	64,263	87,737	128,527	17,375	16,127	2,943	124	22.69	45.6	8.3	9,800	3,267	3403	3403	567	567	982,470	284,268	1,266,738
81	960	660	1033	74	744	289	744	580	164	870	2,470	2,472	1,600	7,273	546	64,146	87,611	128,291	17,343	16,097	2,938	124	22.66	45.5	8.3	9,790	3,263	3400	3400	567	567	981,443	283,971	1,265,414
82	959	659	1032	73	743	289	743	580	164	869	2,468	2,470	1,600	7,273	546	64,029	87,487	128,059	17,312	16,068	2,932	124	22.64	45.4	8.3	9,780	3,260	3396	3396	566	566	980,433	283,679	1,264,112
83	958	658	1031	73	743	289	743	579	163	868	2,466	2,468	1,600	7,273	546	63,915	87,364	127,831	17,281	16,040	2,927	124	22.62	45.3	8.3	9,770	3,257	3393	3393	565	565	979,442	283,392	1,262,834
84	957	657	1030	73	742	288	742	579	163	867	2,464	2,466	1,600	7,273	546	63,803	87,244	127,606	17,250	16,012	2,922	124	22.59	45.3	8.3	9,760	3,253	3390	3390	565	565	978,472	283,111	1,261,584
85	956	656	1029	73	741	288	741	578	163	866	2,462	2,464	1,600	7,273	546	63,692	87,124	127,384	17,220	15,984	2,917	124	22.57	45.2	8.3	9,751	3,250	3386	3386	564	564	977,513	282,834	1,260,347
86	955	655	1028	73	740	288	740	577	163	865	2,460	2,462	1,600	7,273	546	63,582	87,006	127,164	17,191	15,956	2,912	124	22.55	45.1	8.2	9,741	3,247	3383	3383	564	564	976,563	282,559	1,259,122
87	954	654	1027	73	740	288	740	577	163	865	2,458	2,461	1,600	7,273	546	63,474	86,890	126,948	17,161	15,929	2,907	123	22.53	45.1	8.2	9,732	3,244	3380	3380	563	563	975,635	282,290	1,257,925
88	953	653	1026	73	739	287	739	576	163	864	2,456	2,459	1,600	7,273	546	63,367	86,775	126,735	17,133	15,902	2,902	123	22.51	45.0	8.2	9,723	3,241	3377	3377	563	563	974,721	282,026	1,256,747
89	953	653	1025	73	738	287	738	576	162	863	2,454	2,457	1,600	7,273	546	63,262	86,662	126,525	17,104	15,876	2,897	123	22.49	44.9	8.2	9,714	3,238	3373	3373	562	562	973,823	281,766	1,255,590
90	952	652	1024	73	738	287	738	575	162	862	2,452	2,455	1,600	7,273	546	63,159	86,550	126,318	17,076	15,850	2,893	123	22.47	44.9	8.2	9,705	3,235	3370	3370	562	562	972,940	281,511	1,254,451
91	951	651	1024	73	737	287	737	575	162	861	2,450	2,453	1,600	7,273	546	63,057	86,440	126,114	17,049	15,824	2,888	123	22.45	44.8	8.2	9,696	3,232	3367	3367	561	561	972,072	281,260	1,253,331
92	950	650	1023	72	736	286	736	574	162	861	2,448	2,452	1,600	7,273	546	62,957	86,332	125,913	17,022	15,799	2,883	123	22.43	44.8	8.2	9,688	3,229	3364	3364	561	561	971,222	281,014	1,252,235
93	949	649	1022	72	736	286	736	574	162	860	2,446	2,450	1,600	7,273	546	62,858	86,225	125,716	16,995	15,774	2,879	123	22.41	44.7	8.2	9,680	3,227	3362	3362	560	560	970,387	280,772	1,251,159
94	949	649	1021	72	735	286	735	573	162	859	2,444	2,448	1,600	7,273	546	62,760	86,119	125,520	16,968	15,750	2,874	123	22.39	44.6	8.1	9,671	3,224	3359	3359	560	560	969,561	280,533	1,250,094
95	948	648	1020	72	734	286	734	573	162	858	2,442	2,446	1,600	7,273	546	62,664	86,014	125,328	16,942	15,726	2,870	123	22.37	44.6	8.1	9,663	3,221	3356	3356	559	559	968,753	280,299	1,249,053
96	947	647	1019	72	734	285	734	572	161	858	2,441	2,445	1,600	7,273	546	62,569	85,911	125,137	16,917	15,702	2,866	122	22.35	44.5	8.1	9,655	3,218	3353	3353	559	559	967,952	280,067	1,248,019
97	946	646	1018	72	733	285	733	572	161	857	2,439	2,443	1,600	7,273	546	62,475	85,809	124,949	16,891	15,678	2,861	122	22.33	44.5	8.1	9,648	3,216	3350	3350	558	558	967,165	279,840	1,247,005
98	946	646	1018	72	733	285	733	571	161	856	2,437	2,441	1,600	7,273	546	62,382	85,708	124,763	16,866	15,655	2,857	122	22.31	44.4	8.1	9,640	3,213	3348	3348	558	558	966,390	279,616	1,246,006
99	945	645	1017	72	732	285	732	571	161	856	2,435	2,440	1,600	7,273	546	62,290	85,608	124,580	16,841	15,632	2,853	122	22.30	44.4	8.1	9,632	3,211	3345	3345	558	558	965,627	279,395	1,245,021
100	944	644	1016	72	732	284	732	571	161	855	2,433	2,438	1,600	7,273	546	62,200	85,510	124,400	16,817	15,609	2,849	122	22.28	44.3	8.1	9,625	3,208	3342	3342	557	557	964,879	279,178	1,244,058
Average	**1,016**	**716**	**1,095**	**79**	**788**	**307**	**788**	**615**	**173**	**921**	**2,556**	**2,552**	**1,600**	**7,273**	**546**	**70,322**	**94,088**	**140,643**	**19,013**	**17,647**	**3,221**	**132**	**24**	**50**	**9**	**10,372**	**3,457**	**3,602**	**3,602**	**600**	**600**	**1,039,806**	**300,858**	**1,340,663**
Max	**1,189**	**889**	**1,285**	**96**	**925**	**360**	**925**	**722**	**204**	**1,082**	**2,811**	**2,788**	**1,600**	**7,273**	**546**	**89,983**	**114,508**	**179,965**	**24,329**	**22,581**	**4,121**	**154**	**28**	**62**	**11**	**12,176**	**4,059**	**4,228**	**4,228**	**705**	**705**	**1,220,596**	**353,167**	**1,573,763**
Annual Total			**49,490,202,806**														**2,953,425,928**	**12,095,322**	**1,635,108**	**1,517,675**	**276,976**													

Notes:

Max flow used for sizing capital equipment; annual flows used for OPEX
Flow values directly from Copy of Combined Flow and Water Quality to Treatment_04082019.xlxs

Values for HDS sludge, lime, etc. directly from Updated Chino Mixing v3 1 0leach TS REV07192016 (003).xlsx
Others values were extrapolated and/or calculated

28% Membrane Bypass — *Assuming 1600 mg/L SO4 in HDS Effluent, 20 mg/L SO4 in Perm*
78% RO Recovery
4.55 Brine Concentration Factor
300 Interceptor Flow (gpm)

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Analytical Costs
Project Short Title: Tyrone Mine Closure Closeout Plan

Year	Seep/Interceptor System and NPDES Collection Points			Pit Location			Plant Performance	Number of total Samples	Cost per sample	Total Cost Estimation
	Quarterly	*Semiannual*	*Annual*	*Quarterly*	*Semiannual*	*Annual*	*Monthly*			
1	2	0	0	0	0	0	0	8	$ 403	$ 3,224
2	2	0	0	0	0	0	0	8	$ 403	$ 3,224
3	2	0	0	0	0	0	0	8	$ 403	$ 3,224
4	2	0	0	0	0	0	0	8	$ 403	$ 3,224
5	2	0	0	0	0	0	0	8	$ 403	$ 3,224
6	2	0	0	0	0	0	0	8	$ 403	$ 3,224
7	2	0	0	0	0	0	0	8	$ 403	$ 3,224
8	2	0	0	0	0	0	0	8	$ 403	$ 3,224
9	2	0	0	0	0	0	0	8	$ 403	$ 3,224
10	2	0	0	0	0	0	0	8	$ 403	$ 3,224
11	2	0	0	0	0	0	0	8	$ 403	$ 3,224
12	2	0	0	0	0	0	0	8	$ 403	$ 3,224
13	0	2	0	0	0	0	0	4	$ 403	$ 1,612
14	0	2	0	0	0	0	0	4	$ 403	$ 1,612
15	5	2	0	4	0	0	3	76	$ 403	$ 30,628
16	5	2	0	4	0	0	3	76	$ 403	$ 30,628
17	5	2	0	4	0	0	3	76	$ 403	$ 30,628
18	5	2	0	4	0	0	3	76	$ 403	$ 30,628
19	5	2	0	4	0	0	3	76	$ 403	$ 30,628
20	5	2	0	4	0	0	3	76	$ 403	$ 30,628
21	5	2	0	4	0	0	3	76	$ 403	$ 30,628
22	5	2	0	4	0	0	3	76	$ 403	$ 30,628
23	5	2	0	4	0	0	3	76	$ 403	$ 30,628
24	5	2	0	4	0	0	3	76	$ 403	$ 30,628
25	5	2	0	4	0	0	3	76	$ 403	$ 30,628
26	5	2	0	4	0	0	3	76	$ 403	$ 30,628
27	5	2	0	4	0	0	3	76	$ 403	$ 30,628
28	5	2	0	4	0	0	3	76	$ 403	$ 30,628
29	5	2	0	4	0	0	3	76	$ 403	$ 30,628
30	5	2	0	4	0	0	3	76	$ 403	$ 30,628
31	5	2	0	4	0	0	3	76	$ 403	$ 30,628
32	5	2	0	4	0	0	3	76	$ 403	$ 30,628
33	0	0	7	0	0	4	3	47	$ 403	$ 18,941
34	0	0	7	0	0	4	3	47	$ 403	$ 18,941
35	0	0	7	0	0	4	3	47	$ 403	$ 18,941
36	0	0	7	0	0	4	3	47	$ 403	$ 18,941
37	0	0	7	0	0	4	3	47	$ 403	$ 18,941
38	0	0	7	0	0	4	3	47	$ 403	$ 18,941
39	0	0	7	0	0	4	3	47	$ 403	$ 18,941
40	0	0	7	0	0	4	3	47	$ 403	$ 18,941
41	0	0	7	0	0	4	3	47	$ 403	$ 18,941
42	0	0	7	0	0	4	3	47	$ 403	$ 18,941
43	0	0	7	0	0	4	3	47	$ 403	$ 18,941
44	0	0	7	0	0	4	3	47	$ 403	$ 18,941
45	0	0	7	0	0	4	3	47	$ 403	$ 18,941
46	0	0	7	0	0	4	3	47	$ 403	$ 18,941
47	0	0	7	0	0	4	3	47	$ 403	$ 18,941
48	0	0	7	0	0	4	3	47	$ 403	$ 18,941
49	0	0	7	0	0	4	3	47	$ 403	$ 18,941
50	0	0	7	0	0	4	3	47	$ 403	$ 18,941
51	0	0	7	0	0	4	3	47	$ 403	$ 18,941
52	0	0	7	0	0	4	3	47	$ 403	$ 18,941
53	0	0	7	0	0	4	3	47	$ 403	$ 18,941
54	0	0	7	0	0	4	3	47	$ 403	$ 18,941
55	0	0	7	0	0	4	3	47	$ 403	$ 18,941
56	0	0	7	0	0	4	3	47	$ 403	$ 18,941
57	0	0	7	0	0	4	3	47	$ 403	$ 18,941
58	0	0	7	0	0	4	3	47	$ 403	$ 18,941
59	0	0	7	0	0	4	3	47	$ 403	$ 18,941
60	0	0	7	0	0	4	3	47	$ 403	$ 18,941

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: Analytical Costs
Project Short Title: Tyrone Mine Closure Closeout Plan

Year	Seep/Interceptor System and NPDES Collection Points			Pit Location			Plant Performance	Number of total Samples	Cost per sample	Total Cost Estimation
	Quarterly	*Semiannual*	*Annual*	*Quarterly*	*Semiannual*	*Annual*	*Monthly*			
61	0	0	7	0	0	4	3	47	$ 403	$ 18,941
62	0	0	7	0	0	4	3	47	$ 403	$ 18,941
63	0	0	7	0	0	4	3	47	$ 403	$ 18,941
64	0	0	7	0	0	4	3	47	$ 403	$ 18,941
65	0	0	7	0	0	4	3	47	$ 403	$ 18,941
66	0	0	7	0	0	4	3	47	$ 403	$ 18,941
67	0	0	7	0	0	4	3	47	$ 403	$ 18,941
68	0	0	7	0	0	4	3	47	$ 403	$ 18,941
69	0	0	7	0	0	4	3	47	$ 403	$ 18,941
70	0	0	7	0	0	4	3	47	$ 403	$ 18,941
71	0	0	7	0	0	4	3	47	$ 403	$ 18,941
72	0	0	7	0	0	4	3	47	$ 403	$ 18,941
73	0	0	7	0	0	4	3	47	$ 403	$ 18,941
74	0	0	7	0	0	4	3	47	$ 403	$ 18,941
75	0	0	7	0	0	4	3	47	$ 403	$ 18,941
76	0	0	7	0	0	4	3	47	$ 403	$ 18,941
77	0	0	7	0	0	4	3	47	$ 403	$ 18,941
78	0	0	7	0	0	4	3	47	$ 403	$ 18,941
79	0	0	7	0	0	4	3	47	$ 403	$ 18,941
80	0	0	7	0	0	4	3	47	$ 403	$ 18,941
81	0	0	7	0	0	4	3	47	$ 403	$ 18,941
82	0	0	7	0	0	4	3	47	$ 403	$ 18,941
83	0	0	7	0	0	4	3	47	$ 403	$ 18,941
84	0	0	7	0	0	4	3	47	$ 403	$ 18,941
85	0	0	7	0	0	4	3	47	$ 403	$ 18,941
86	0	0	7	0	0	4	3	47	$ 403	$ 18,941
87	0	0	7	0	0	4	3	47	$ 403	$ 18,941
88	0	0	7	0	0	4	3	47	$ 403	$ 18,941
89	0	0	7	0	0	4	3	47	$ 403	$ 18,941
90	0	0	7	0	0	4	3	47	$ 403	$ 18,941
91	0	0	7	0	0	4	3	47	$ 403	$ 18,941
92	0	0	7	0	0	4	3	47	$ 403	$ 18,941
93	0	0	7	0	0	4	3	47	$ 403	$ 18,941
94	0	0	7	0	0	4	3	47	$ 403	$ 18,941
95	0	0	7	0	0	4	3	47	$ 403	$ 18,941
96	0	0	7	0	0	4	3	47	$ 403	$ 18,941
97	0	0	7	0	0	4	3	47	$ 403	$ 18,941
98	0	0	7	0	0	4	3	47	$ 403	$ 18,941
99	0	0	7	0	0	4	3	47	$ 403	$ 18,941
100	0	0	7	0	0	4	3	47	$ 403	$ 18,941
									TOTAL	**$ 1,881,204**

Notes:

Costs do not include indirect costs

The frequency of sampling and analysis associated with the water management and treatment system is as follows:

Sampling is not required as part of the O&M of the short-term ETS. The only sampling required during the short-term ETS operational period is associated with the NPDES compliance points (two associated with NPDES Permit NMR05GB76).

The high TDS and sulfate water sources will not need to be sampled as part of the O&M for the long-term ETS.

TTS performance monitoring including (2) influent and (1) effluent discharge from water treatment plant: monthly beginning in Year 15 and continuing though Year 100.

NPDES compliance points: quarterly from Year 1 through Year 12, semiannual from Year 13 through Year 32, and annual thereafter (through Year 100).

Collection points for the low TDS and sulfate non-process water streams to the TTS (1X1 Pond, 1A PLS Tank, 1B PLS Tank, Oak Grove Pond, and New No. 3 AST): quarterly from Year 15 through Year 32 (transition period between uncovered and covered flows), and annual thereafter (through Year 100).

Discharge from groundwater interceptor system (4 interceptor wells): quarterly from Year 15 through Year 32 (transition period between uncovered and covered flows), and annual thereafter (through Year 100). The groundwater interceptor system will be sampled at the point that all 4 wells are combined into one pipeline.

Pits (4 sample points-Main Pit, Gettysburg Pit, Copper Mountain Pit, Savanna Pit): quarterly from Year 15 through Year 32 (transition period between uncovered and covered flows), and annual thereafter (through Year 100).

GOLDER

Date: REV 0 July 29, 2019
Project No.: 18106417
Subject: TTS O&M Cost Inputs
Project Short Title: Tyrone Mine Closure Closeout Plan

Reagent Inputs

Lime (CaO) ($/ton)	=	$	256.00	2019 Lhoist Cost (Freight Estimated)
Flocculent ($/lb)	=	$	3.36	2019 NALCO Water
Hydrochloric Acid - 35% ($/lb)	=	$	0.21	2019 Univar Mining - HCl (35%) from bulk delivery (tote price $0.335/lb)
MF High pH Cleaning Chemicals ($/lb)	=	$	3.53	2019 Avista quote - pail price (assume bimonthly cleaning during high flows)
MF Low pH Cleaning Chemicals ($/lb)	=	$	3.53	2019 Avista quote - pail price (assume bimonthly cleaning during high flows)
RO High pH Cleaning Chemicals ($/lb)	=	$	7.52	2019 Avista quote - pail price (assume quarterly cleaning during high flows)
RO Low pH Cleaning Chemicals ($/lb)	=	$	6.44	2019 Avista quote - pail price (assume quarterly cleaning during high flows)
Biocide ($/lb)	=	$	8.15	2019 Avista quote - tote price
Antiscalant ($/lb)	=	$	3.09	2019 Avista quote - tote price

Electricity Input

Electricity ($/kwh)	=	$	0.045	PNM Method of Calculation (Avg ($/kWh) Years 1 through 14) using 2019 PNM Rate Schedule
	=	$	0.045	PNM Method of Calculation (Avg ($/kWh) Years 15 through 100) using 2019 PNM Rate Schedule

Analytical Input

Analytical Cost ($/sample)	=	$	403.00	2019 Hall Environmental Analysis Laboratory (price unchanged from 2018, quote changed to be valid through 2019)

Labor Inputs

NOTE - Type A schedule used for operating labor and Type H schedule used for construction labor

Operator Base Rate	=	$	18.60	2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group I. [1]
Supervisor Rate	=	$	31.10	2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group X. [1]
Maintenance Technician Rate	=	$	19.83	2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group V. [1]
Operator Fringe Rate	=	$	5.94	2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Applies to operator groups I, X, V under Type A. [1]
Laborer (Group II)	=	$	23.84	2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates. [2]
Plumber/Pipefitter	=	$	45.45	2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates. [2]
Electrician (Lineman/Tech Outside)	=	$	55.13	2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates. [2]
Electrician (Wireman/Tech Inside)	=	$	54.05	2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates. Includes 26% increase for work outside Zone 1. [2]
Ironworker	=	$	48.66	2019 NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, apprenticeship contribution rates, and subsistence rate. [2]

Date:	REV 0 July 29, 2019
Project No.:	18106417
Subject:	TTS O&M Cost Inputs
Project Short Title:	Tyrone Mine Closure Closeout Plan

Maintenance

Replacement O&M	=		1.5%	of Direct Capital Cost
Routine Maintenance	=		1.5%	of Direct Capital Cost
Per Diem Subsistence, Zone and Incentive	=	$	50.00	per day for Plumber/Pipefitter, Electrical Lineman/Tech (outside). 2019 NM Department of Labor Type H (Heavy Engineering), 2019 Subsistence, Zone, and Incentive Pay Rates
				2019 Subsistence, Zone and Incentive Pay Rates, per diem only required for Electrician (Outside classification) and Plumber/Pipefitters for the construction labor classes used for TTS construction. Operating labor is assumed to be local

Notes:

(1) - https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

(2) - https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf

GOLDER

Date:	REV 0 July 29, 2019
Project No.:	18106417
Subject:	Example Calculations
Project Short Title:	Tyrone Mine Closure Closeou

Flow and Sulfate Inputs

Max Year	=	6	
Membrane Max Flow rate	**=**	**1,300**	**gpm**
Membrane Avg Flow rate	=	*800*	*gpm*
HDS Equipment Max Flow rate	**=**	**1,600**	**gpm**
HDS Equipment Avg Flow rate	=	*1,100*	*gpm*
HDS Sulfate Max	**=**	**2,788**	**mg/L**
HDS Sulfate Avg	=	*2,552*	*mg/L*
Sludge Recycle Avg Flow rate	**=**	**79**	**gpm**
Sludge Max (50% Solids)	**=**	**179,965**	**lb/day**
Sludge Avg (50% Solids)	=	*140,643*	*lb/day*
Effluent Neutralization Max (if necessary)	**=**	**1,100**	**gpm**
Effluent Neutralization Avg Flow rate(if necessary)	=	*1,000*	*gpm*

Equipment sizing based on maximum flows, operating costs based on average flows.

Van Riper Study (2002) Inputs

Lime Consumption Factor	=	0.5249	mg/L CaO/mg/L SO4	5,270 mg/L CaO needed to treat high metals AMD water with sulfate concentration of 10,040 mg/L
Sulfuric Acid Consumption Factor	=	0.000028	lb/gal	0.028 pounds per 1,000 gallons (50 mg acid per liter of water treated)
Sludge Factor	=	2.0916	mg/L Sludge/mg/L SO4	21,000 mg/L Sludge for 10,040 mg/L SO4

Van Riper treatability study results used to detemine lime usage and sludge production according to the factors listed above and the sulfate concentration.

HDS Chemical Precipitation

Reaction Tank

Tank size

Need 4 reaction tanks - to provide minimum of 90 min retention time at max flow and minimum of 120 min retention time at avg flow

$$= \frac{1{,}600 \text{ gal}}{1 \text{ min}} \times 24 \text{ min}$$

$$= \mathbf{38{,}400 \text{ gal}}$$

$$= \frac{38400 \text{ gal}}{1 \text{ min}} \times 1.1 \text{ Freeboard}$$

$$= \mathbf{43{,}000 \text{ gal}}$$

each tank, total of 4 tanks for approximately 90 min reaction time

$$= 43{,}000 \text{ gal} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}}$$

$$= \mathbf{5{,}748 \text{ ft}^3}$$

Tank Height = 20 ft

Diameter

$$= \left| \frac{5{,}748 \text{ ft}^3}{20 \text{ ft}} \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{20 \text{ ft}}$$

Mixing Requirement

$$= \frac{0.001139 \text{ N-s}}{\text{m}^2} \times 5{,}748 \text{ ft}^3 \times \frac{1 \text{ m}^3}{35 \text{ ft}^3} \times \frac{\text{W}}{1{,}000 \text{ kW}} \times \frac{300}{1 \text{ sec}}^2$$

$$= \mathbf{17 \text{ kW}}$$

GOLDER

Date: REV 0 July 29, 2019
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Subject: Example Calculations
Project Short Title: Tyrone Mine Closure Closeou

Floc Tank

Tank size

$$= \frac{1{,}600\ \text{gal}}{1\ \text{min}} \times 3.5\ \text{min}$$

$$= \mathbf{5{,}600\ gal}$$

$$= \frac{5{,}600\ \text{gal}}{1\ \text{min}} \times 1.1\ \text{Freeboard}$$

$$= \mathbf{7{,}000\ gal}$$

$$= 7{,}000\ \text{gal} \times \frac{1\ \text{ft}^3}{7.48\ \text{gal}}$$

$$= \mathbf{936\ ft^3}$$

Tank Height $= 12\ \text{ft}$

Diameter

$$= \left| \frac{936\ \text{ft}^3}{12\ \text{ft}} \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{10\ ft}$$

Mixing Requirement

$$= \frac{0.001139\ \text{N-s}}{\text{m}^2} \times 936\ \text{ft}^3 \times \frac{1\ \text{m}^3}{35\ \text{ft}^3} \times \frac{\text{W}}{1{,}000\ \text{kW}} \times \left(\frac{300}{1\ \text{sec}}\right)^2$$

$$= \mathbf{3\ kW}$$

Clarifier

Tank size (based on Clarification)
Use conservative loading rate of 0.3 gpm/ft^2 considering sludge is primarily calcium sulfate and iron hydroxide and densified.

$$= \frac{1{,}600\ \text{gal}}{1\ \text{min}} \times \frac{1\ \text{ft}^2}{0.3\ \text{gpm}}$$

$$= \mathbf{5{,}424\ ft^2}$$

Diameter (based on Clarification)

$$= \left| 5{,}424\ \text{ft}^2 \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{84\ ft}$$

Depth (based on Clarification) $= \mathbf{15\ ft}$

Overflow

Solids underflow

$$= \frac{405{,}511\ \text{lb}}{\text{day}} \times \frac{1\ \text{kg}}{2.2\ \text{lb}} \times \frac{1\ \text{day}}{1{,}440\ \text{min}} \times \frac{1\ \text{m}^3}{1{,}190\ \text{kg}} \times \frac{264\ \text{gal}}{1\ \text{m}^3}$$

$$= \mathbf{29\ gpm}$$

Solids recycle (max)
(assumption)

$$= 3\ \text{Recycles} \times \frac{179{,}965\ \text{lb}}{\text{d}} \times \frac{1}{25\%\ \text{solids}} \times \frac{1\ \text{gal}}{8.34\ \text{lb}} \times \frac{1}{1.19\ \text{SG}} \times \frac{1\ \text{day}}{1{,}440\ \text{min}}$$

$$= \mathbf{152\ gal/min}$$

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Effluent Neutralization System

Effluent Neutralization Tank

Tank size

$$= \frac{1{,}100 \text{ gal}}{1 \text{ min}} \times 18 \text{ min}$$

$$= \mathbf{19{,}800\ gal}$$

$$= \frac{19{,}800 \text{ gal}}{1 \text{ min}} \times 1.1 \text{ Freeboard}$$

$$= \mathbf{22{,}000\ gal}$$

$$= 22{,}000 \text{ gal} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}}$$

$$= \mathbf{2{,}941\ ft^3}$$

Tank Height

$$= 20 \text{ ft}$$

Diameter

$$= \left| \frac{2{,}941 \text{ ft}^3}{20 \text{ ft}} \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{14\ ft}$$

Mixing Requirement

$$= \frac{0.001139 \text{ N-s}}{\text{m}^2} \times 2{,}941 \text{ ft}^3 \times \frac{1 \text{ m}^3}{35 \text{ ft}^3} \times \frac{\text{W}}{1{,}000 \text{ kW}} \times \frac{300}{1 \text{ sec}}^{2}$$

$$= \mathbf{9\ kW}$$

Discharge System

Discharge Tank

Tank size

$$= \frac{1{,}100 \text{ gal}}{1 \text{ min}} \times 30 \text{ min}$$

$$= \mathbf{33{,}000\ gal}$$

$$= \frac{33000 \text{ gal}}{1 \text{ min}} \times 1.1 \text{ Freeboard}$$

$$= \mathbf{37{,}000\ gal}$$

$$= 37{,}000 \text{ gal} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}}$$

$$= \mathbf{4{,}946\ ft^3}$$

Tank Height

$$= 20 \text{ ft}$$

Diameter

$$= \left| \frac{4{,}946 \text{ ft}^3}{20 \text{ ft}} \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{18\ ft}$$

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Solids Management
Sludge Storage Tank

Sludge Production	=	21,000 mg Sludge	x	1 L								
per Hazen Research, Inc., May 3, 2002		1 L		10,040 mg SO_4								
Van Riper Factor (Sulfate x Factor = sludge)	=	**2.0916 mg/L**										
Influent Concentration	=	2,788 mg SO_4	x	2.0916 mg/L Sludge								
		1 L		1 mg/L SO_4								
	=	**5,832 mg/L**										
Influent Dry Solids	=	5,832 mg	x	1,448 gal	x	3.785 L	x	1,440 min	x	1 lb		
		1 L		1 min		1 gal		1 d		454,000 mg		
	=	**101,378 lb/day**										
Influent Wet Cake	=	101,378 lb	x	1 Wet Cake								
		1 day		50% Dry Solids								
		202,756 lb/day										
Influent Wet Solids	=	101,378 lb/day	x	1 Wet Solids								
(Clarifier Underflow)		1 day		25% Wet Cake								
		405,511 lb/day										
Water Content	=	405,511 lb	-	202,756 lb								
(filtrate from dewatering)		1 day		1 day								
		202,756 lb/day										
	=	202,756 lb	x	1 kg	x	1 m^3	x	1 day	x	264 gal		
		1 day		2.2 lb		1,000 kg		1,440 min		1 m^3		
		17 gpm										
Volume of Cake - Max	=	202,756 lb	x	1 ft^3	x	365 days						
		1 day		100 lb		1 yr						
		740,058 ft^3/yr										
Filter Press Size - Max	=	740,058 ft^3	x	1 yr	x	1 days	x	1 cycle				
		1 yr		365 days		6 cycle		3 filter presses online			*2 shifts, 3 presses*	6 op
		100 ft^3/cycle/filter press										
Volume of Cake - Average	=	140,643 lb	x	1 ft^3	x	365 days						
		1 day		100 lb		1 yr						
		513,348 ft^3/yr										
Filter Press Size - Avg	=	513,348 ft^3	x	1 yr	x	1 days	x	1 cycle			*1 shift 3 presses*	
		1 yr		365 days		3 cycle		3 filter presses online				
		200 ft^3/cycle/filter press										

Sludge storage tank $= \frac{29\ \text{gal}}{1\ \text{min}} \times 270\ \text{min} \times 1.1\ \text{Freeboard}$

$= \mathbf{9{,}000\ gal}$

$= 9{,}000\ \text{gal} \times \frac{1\ \text{ft}^3}{7.48\ \text{gal}}$

$= \mathbf{1{,}203\ ft^3}$

Tank Height = 12 ft

Diameter $= \left[\frac{1{,}203\ \text{ft}^3}{12\ \text{ft}} \times \frac{4}{\pi}\right]^{1/2}$

$= \mathbf{12\ ft}$

Filtrate Tank

Filtrate = 9 gpm

Tank size $= \frac{9\ \text{gal}}{1\ \text{min}} \times 240\ \text{min}$

$= \mathbf{3{,}000\ gal}$

$= 3{,}000\ \text{gal} \times \frac{1\ \text{ft}^3}{7.48\ \text{gal}}$

$= \mathbf{401\ ft^3}$

Tank Height = 10 ft

Diameter $= \left[\frac{401\ \text{ft}^3}{10\ \text{ft}} \times \frac{4}{\pi}\right]^{1/2}$

$= \mathbf{8\ ft}$

Chemical Addition Systems

Lime Chemical Addition System

Lime Consumption $= \frac{5{,}270\ \text{mg CaO}}{1\ \text{L}} \times \frac{1\ \text{L}}{10{,}040\ \text{mg } SO_4}$

per Hazen Research, Inc., May 3, 2002

$= \mathbf{0.5249\ mg/L\ CaO\ /\ mg/L\ SO_4}$

Lime, CaO $= \frac{2{,}788\ \text{mg } SO_4}{1\ \text{L}} \times \frac{0.5249\ \text{mg/L CaO}}{1\ \text{mg/L } SO_4}$

$= \mathbf{1{,}464\ mg/L\ CaO}$

Lime Consumption $= \frac{1{,}464\ \text{mg CaO}}{1\ \text{L}} \times \frac{3.785\ \text{L}}{1\ \text{gal}} \times \frac{1\ \text{lb}}{454{,}000\ \text{mg}} \times \frac{1{,}448\ \text{gal}}{1\ \text{min}} \times \frac{1{,}440\ \text{min}}{1\ \text{day}}$

$= \mathbf{25{,}441\ \ lb\ CaO/day}$

Volume, 10% $Ca(OH)_2$ slurry $= \frac{25{,}441\ \text{lb}}{1\ \text{day}} \times \frac{1\ \text{kg}}{2.2\ \text{lb}} \times \frac{1\ \text{L}}{1\ \text{kg}} \times \frac{1\ \text{day}}{1440\ \text{min}} \times \frac{1\ \text{Concentration}}{10\%\ \text{Factor}} \times \frac{1}{1.07\ \text{SG}} \times \frac{1\ \text{gal}}{3.785\ \text{L}} \times \frac{75\ \text{mg } CaOH_2}{56\ \text{mg CaO}}$

From FMI's Calcs

$= \mathbf{27\ \ gpm}$

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Lime Consumption, as CaO	=	25,441	lb CaO	x	1	day	x	1	min																		
		1	day		1,440	min		1,600	gal																		
	=	**0.01**	**lb CaO/gal**																								
Chemical Usage, as CaO	=	25,441	lbs CaO	x	365	day	x	1	ton																		
		1	day		1	yr		2,000	lbs																		
	=	**4,643**	**ton CaO/yr**																								
Densification Tank (lime slurry + recycled sludge)	=	179 gpm																									
Tank size	=	179 gal		x	5 min																						
		1 min																									
	=	**900 gal**																									
	=	900 gal		x	1 ft^3																						
					7.48 gal																						
	=	**120 ft^3**																									
Tank Height	=	6 ft																									

Diameter $= \left(\dfrac{120\ ft^3}{6\ ft} \times \dfrac{4}{\pi} \right)^{1/2}$

$=$ **6 ft**

Flocculent Chemical Addition System

Mass	=	10	mg	x	3.785	L	x	1,600	gal	x	1	lb
Estimated from experience		1	L		1	gal			min		453,600	mg
(typically moderately anionic polymer)	=	**0.13**	**lb/min**									
Usage	=	0.13	lb	x			x	1440	min	x	365	d
		1	min		1,600	gpm		1	d		1	yr
	=	**44**	**lb/yr-gpm**									

Volume	=	0.13	lb	x	1	kg	x	1	L	x	60	min	x	1	Concentration	x	1		x	1	gal
		1	min		2.2	lb		1	kg		1	hr		100%	Factor		1	SG		3.785	L
	=	**0.97**	**gph**																		

HCl Acid Chemical Addition

NOTE: 2018 UPDATE INCLUDES USING HCL INSTEAD OF SULFURIC - THE FOLLOWING CONVERSION FACTOR IS INCORPORATED INTO THE SUMMARY SHEET TO CONVERT 93% SULFURIC USAGE TO 35% HCL USAGE

	=	1	lb 93% H2SO4	x	93	lb H2SO4	x	1	mol H2SO4	x	2	mols H+	x	1	mol HCl	x	36.5	lb HCl	x	100	lb 35%
		1	gal		100	lb 93%		98	lb H2SO4		1	mol H2SO4		1	mol H+		1	mol HCl		35	lb HCl
factor lb SO4(93%)/gal to lb HCl (35%)/gal		1.98	lb 35%HCL/gal																		

HCl (35%) Acid Consumption	=	0.028	lbs H2SO4 (93%)	x	1.98	lbs HCl (35%)			
Used Van Riper Consulting, 2002 for H2SO4		1,000	gal		1	lbs H2SO4 (93%)			
then converted to 35% HCl	=	**0.0001**	**lbs/gal**						
Mass	=	0.0001	lbs	x	453,600	mg	x	1	gal
		1	gal		1	lb		3.785	L
	=	**6.65**	**mg/L**						

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Usage	=	6.65	mg	x	1,100	gal	x	3.785	L	x	1	lb
		1	L		1	min		1	gal		453,600	mg
	=	**0.0610**	**lb/min**									

Volume	=	0.06	lb	x	1	kg	x	1	L	x	60	min	x	1	Concentration	x	1		x	1	gal
		1	min		2.2	lb		1	kg		1	hr		35%	Factor		1.18	SG		3.785	L
	=	**1.07**	**gph**																		

Chemical Usage	=	0.0001	lbs	x	1,100	gal	x	1,440	min	x	365	day
		1	gal		1	min		1	day		1	yr
	=	**32,053**	**lbs/yr**									

MF Cleaning Chemicals

High pH Cleaner Mass	=	2	cleanings	x	12	month	x	6	pail	x	45	lb
Estimated from experience		1	month		1	yr			cleaning			pail
and advice from Avista	=	**5,940**	**lb/yr**									

High pH Cleaner Usage Rate	=	5,940	lb MF Cleaning Chem	x		
		1	year		1,300	gpm
	=	**4.57**	**lb/yr-gpm**			

Low pH Cleaner Mass	=	2	cleanings	x	12	month	x	6	pail	x	45	lb
Estimated from experience		1	month		1	yr			cleaning			pail
and advice from Avista	=	**5,940**	**lb/yr**									

Low pH Cleaner Usage Rate	=	5,940	lb MF Cleaning Chem	x		
		1	year		1,300	gpm
	=	**4.57**	**lb/yr-gpm**			

RO Cleaning Chemicals

High pH Cleaner Mass	=	1	cleanings	x	12	month	x	6	pail	x	45	lb
Estimated from experience		3	month		1	yr			cleaning			pail
and avista advice	=	**990**	**lb/yr**									

High pH Cleaner Usage Rate	=	990	lb MF Cleaning Chem	x		
		1	year		1,300	gpm
	=	**0.762**	**lb/yr-gpm**			

Low pH Cleaner Mass	=	1	cleanings	x	12	month	x	6	pail	x	45	lb
Estimated from experience		3	month		1	yr			cleaning			pail
	=	**990**	**lb/yr**									

Low pH Cleaner Usage Rate	=	990	lb MF Cleaning Chem	x		
		1	year		1,300	gpm
	=	**0.762**	**lb/yr-gpm**			

Antiscalant

Mass	=	3	mg	x	3.785	L	x	1,300	gal	x	1	lb	x	1,440	min	x	365	d
Estimated from experience		1	L		1	gal			min		453,600	mg			d		1	yr
	=	**17,105**	**lb/yr**															

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Usage

$$= \frac{17{,}105 \text{ lb MF Cleaning Chem}}{1 \text{ year}} \times \frac{}{1{,}300 \text{ gpm}}$$

$$= \mathbf{13.16 \text{ lb/yr-gpm}}$$

Biocide

Mass
Estimated from experience

$$= \frac{1 \text{ mg}}{1 \text{ L}} \times \frac{3.785 \text{ L}}{1 \text{ gal}} \times \frac{1{,}300 \text{ gal}}{\text{min}} \times \frac{1 \text{ lb}}{453{,}600 \text{ mg}} \times \frac{1{,}440 \text{ min}}{\text{d}} \times \frac{365 \text{ d}}{1 \text{ yr}}$$

$$= \mathbf{5{,}702 \text{ lb/yr}}$$

Usage

$$= \frac{5{,}702 \text{ lb}}{1 \text{ yr}} \times \frac{}{1{,}300 \text{ gpm}}$$

$$= \mathbf{4.39 \text{ lb/yr-gpm}}$$

Process Water (Does not include slaking water)

Water required = Polymer make-down + Lime make-down

$$= \frac{0.97 \text{ gal}}{\text{min}} + \frac{27 \text{ gal}}{\text{min}}$$

Water required = **28.0 gpm**

Tank size

$$= \frac{28.0 \text{ gal}}{1 \text{ min}} \times 75 \text{ min}$$

$$= \mathbf{3{,}000 \text{ gal}}$$

$$= 3{,}000 \text{ gal} \times \frac{1 \text{ ft}^3}{7.48 \text{ gal}}$$

$$= \mathbf{401 \text{ ft}^3}$$

Tank Height = 10 ft

Diameter

$$= \left| \frac{401 \text{ ft}^3}{10 \text{ ft}} \times \frac{4}{\pi} \right|^{1/2}$$

$$= \mathbf{8 \text{ ft}}$$

Power Consumption

Membrane System
Plus 5% for building load

$$= 263 \text{ hp} \times \frac{0.746 \text{ kw}}{1 \text{ hp}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ day}}{1 \text{ year}}$$

$$= 1{,}714{,}737 \text{ kw-hr/year}$$

$$= \frac{1{,}714{,}737 \text{ kw-hr}}{\text{year}} \times \frac{}{1{,}300 \text{ gpm}}$$

$$\mathbf{1{,}319 \text{ kw-hr/gpm-yr}}$$

HDS System
Plus 5% for building load

$$= 67 \text{ hp} \times \frac{0.746 \text{ kw}}{1 \text{ hp}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ day}}{1 \text{ year}}$$

$$= 439{,}659 \text{ kw-hr/year}$$

$$= \frac{439{,}659 \text{ kw-hr}}{\text{year}} \times \frac{}{1{,}600 \text{ gpm}}$$

$$\mathbf{275 \text{ kw-hr/gpm-yr}}$$

GOLDER

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Subject: Labor Cost Estimate - TTS and SDF Operations
Project Short Title: Tyrone Mine Closure Closeout Plan

Year 15 Solids			
Day shift - 1 supervisor, 2 maintenance - 40 hrs a week (also used for ETS, SDF, Salt Disposal Facility) Operators at 6 Per shift as follows - 2 filter press, 1 lime silo, 1 membrane, 1 HDS, 1 pumps/pipelines (conveyance and discharge) and ETS. 2 shifts each 8 hr days, 7 days week, Covered by 2 crews that work full-time 8 hr shifts 5 days per week (one crew on days and one on evenings). Assumes 2 crews on weekends both working part-time hours to cover the 2 8-hour shifts per day on weekends.		Note that the sludge falls by 10% from year 15 to year 25 so at year 25% a 10% deduction is taken on the total labor cost. At Year 43 the sludge decreases another 10% so another 10% decrease in annual labor cost is included at year 43 and again at year 92.	
Operators[2]	16.8	Operators	16.8
Operator Rate[2]	$ 18.60 /hr	Operator Rate	$ 18.60 /hr
Reg Operator Hours [2]	2,087 hr/op	Operator Hours	2,087 hr/op
Operator Total Cost	$ 652,146	Operator Total Cost	$ 652,146
Supervisors	1	Supervisors	1
Supervisor Rate[3]	$ 31.10 /hr	Supervisor Rate	$ 31.10 /hr
Supervisor Hours (5 day/wk)	2,087 hr/op	Supervisor Hours	2,087 hr/op
Supervisor Total Cost	$ 64,906	Operator Total Cost	$ 64,906
Maintenance Techs	2	Maintenance Techs	2
Maintenance Tech Rates[4]	$ 19.83 /hr	Maintenance Tech Rates	$ 19.83 /hr
Maintenance Tech Hours (5 day/wk)	2,080 hr/op	Maintenance Tech Hours	2,080 hr/op
Maintenance Tech Total Cost	$ 82,493	Maintenance Tech Total Cost	$ 82,493
Sub-Total Labor Cost	**$ 799,544**	**Sub-Total Labor Cost**	**$ 799,544**
Overtime for supervisor[5]	10%	Overtime for supervisor[5]	10%
Overtime hours for supervisor	209	Overtime hours for supervisor	209
Supervisor Overtime Total Cost	$ 9,736	Supervisor Overtime Total Cost	$ 9,736
Overtime for maintenance[5]	10%	Overtime for maintenance[5]	10%
Overtime hours for maintenance	416	Overtime hours for maintenance	416
Maintenance Overtime Total Cost	$ 12,374	Maintenance Overtime Total Cost	$ 12,374
Overtime for operators[5]	15%	Overtime for operators[5]	15%
Overtime hours for operators[5]	5,259	Overtime hours for operators[5]	5,259
Operator Overtime Total Cost	$ 146,733	Operator Overtime Total Cost	$ 146,733
Overtime Cost	**$ 168,843**	**Overtime Cost**	**$ 168,843**
Benefits fringe rate per hour[6]	$ 5.94 /hr	Benefits fringe rate per hour[6]	$ 5.94 /hr
Number of employees	19.8 ops	Number of employees	19.8 ops
Hours per year	2,087 hrs/op	Hours per year	2,087 hrs/op
Benefits Cost	$ 245,456	Benefits Cost	$ 245,456
Benefits Cost	**$ 245,456**	**Benefits Cost**	**$ 245,456**
Total Labor Cost	**$ 1,213,843**	**Total Labor Cost**	**$ 1,213,843**
Sludge (lb/day)	*179,965*	*Sludge (lb/day)*	*140,643*
Labor Cost/lb sludge ($/d)	*$ 7*	*Labor Cost/lb sludge ($/d)*	*$ 9*

Notes:

1 Operator numbers are estimated from Golder's experience with operating similar plants.

2 Number of operators reflects covering 16 hours per day and 7 days per week with 2 shifts of 6 operators working 8 hours per day (day shift and evening shift) and 2 shifts of 6 operators working part-time on the weekends for 16 hours total (8 hours per day times two days) and covering the day shift and evening shift. This results in an equivalent number of full-time operators of 16.8 to cover 16 hours per day and 7 days per week. Rate per operators is from 2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group I. Hours per operator is regular hours to cover 6 operator positions for 16 hours per day (12 operators per day) 7 days per week (56 hrs/week x 7 days/week per operator position) . It is assumed that a shift of 40 hour per week operators and a shift of weekend 16 hour per week operators can be hired to staff the plant for a 8 hour per day shift and an 8 hour swing shift per day. This staffing plan assumes part-time operators are available. https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

3 Rate per operator is from 2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group X. https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf.

4 2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. Operator Group V. https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

5 Overtime for supervisor/maintenance at 10% of regular time hours is for call-outs when off-shift (nights and weekends). Overtime for operators includes average of 15% for nightime callouts (midnight to 8 am), unexpected projects, covering sick time, holiday work, etc). Overtime rate for operators assumes "worst-case" situation and that the part-time weekend operators are not available to cover and the full-time operators must cover at the Overtime rate.

6 2019 NM Type "A" Street, Highway, Utility & Light Engineering Prevailing Wages. All Operator groups. https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_A_2019_final.pdf

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