TAILING FACILITY COVER DEMONSTRATION PILOT PROJECT – FINAL REMEDIAL DESIGN

Chevron Questa Mine Superfund Site
Questa, New Mexico

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Tables

Figures

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Acronyms and Abbreviations

AOC	Administrative Settlement Agreement and Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ARCADIS	ARCADIS U.S., Inc.
BMP	Best Management Practices
°C	degrees Celsius
CAES	computer-aided earthmoving system
cm	centimeters
CMI	Chevron Mining Inc.
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
CQC	Construction Quality Control
CQCP	Construction Quality Control Plan
CY	cubic yards
DNA	Deoxyribonucleic Acid
DR	decision rule
DU	decision unit
DQO	data quality objective
EMNRD	New Mexico Energy, Minerals, and Natural Resources Department
°F	degrees Fahrenheit
FDR	frequency domain reflectometer
FI	focused investigation
Golder	Golder Associates Inc.
GPS	global positioning system
HASP	Health and Safety Plan
HDS	heat dissipation sensors
ICS	incremental composite sampling
Kg	kilogram
lbs/ac	pounds per acre
m	meter
mg/kg	milligrams per kilogram
mm	millimeters
MMD	New Mexico Mining and Minerals Division
NMAC	New Mexico Administrative Code
O&M	Operation and Maintenance
OSE	Office of the State Engineer
OSHA	Occupational Safety and Health Administration
PET	potential evapotranspiration
Pilot Project	Tailing Facility Cover Demonstration Pilot Project – Final Design
PMLU	post-mining land use
PLS	pure live seed
PRG	preliminary remedial goal
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RD	Remedial Design
ROD	Record of Decision
site	Chevron Questa Mine Superfund Site located in Questa, New Mexico
SOW	Statement of Work
SWCC	soil water characteristic curve
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
VSP	Visual Sample Plan
WRCC	Western Regional Climate Center

Executive Summary

Chevron Mining Inc. (CMI) has prepared a Final Remedial Design Report (report) for the Tailing Facility Cover Demonstration Pilot Project (Pilot Project) at the Chevron Questa Mine Superfund Site located in Questa, New Mexico. This report has been prepared in accordance with the Statement of Work (SOW) for the First Partial Remedial Design/Remedial Action (RD/RA) Consent Decree at the Chevron Questa Mine Superfund Site, Questa, New Mexico, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID No.: NMD002899094, entered May 1, 2017 (PCD; U.S. Environmental Protection Agency [USEPA] 2017). This report complements and follows on the Final Design for the Dam 1 (Section 36) Tailing Facility Grading (Demonstration Project). The grading plan was designed to provide positive drainage of surface water runoff without affecting the integrity of the dams and considering long-term draindown and consolidation of the tailing.

This report is intended to address the applicable requirements of Sections 5.2.1 and 9.1 of the SOW, which requires CMI to conduct a Pilot Project on approximately 270 acres of the Dam 1 tailing impoundment at the Chevron Questa Mine Tailing Facility. Pre-Final and Final Remedial Designs are required prior to implementation of the Pilot Project. This Final Remedial Design report includes design criteria and design basis reports, drawings and specifications, Construction Quality Assurance Plan (CQAP)/Construction Quality Control Plan (CQCP), O&M Plan and O&M Manual, performance monitoring plan, schedule, and accessory information according to Section 9.1 of the SOW.

The purpose of the Pilot Project is (1) to determine whether a two-foot thick cover can be successfully designed, constructed and maintained such that it is adequately protective of soil and groundwater, can be successfully revegetated, and can be maintained over time, and (2) to support an inquiry into whether the CERCLA remedy, as it pertains to cover thickness at the tailing facility, should be modified accordingly. The Pilot Project success criteria are defined in Section 5.2.1 of the SOW, whereby the USEPA will make a determination that the Pilot Project has succeeded if it concludes, after five growing seasons, that the cover is showing progress toward achieving a self-sustaining ecosystem through the satisfaction of all the following criteria:

> **Surface Soil**: Concentrations of molybdenum in soil (sampled to 3 inches below ground surface) averaged within each of the three decision units (of approximately 100 acres each) are maintained at or below the Tailing Facility soil remediation goal of 41 mg/kg molybdenum;
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> **Groundwater**: Based on predictions using the calibrated evaporative flux model and the long-term precipitation record (Cerro Station), there is a 90% probability that, in any given year, net percolation averaged across the entire cover demonstration project would be limited to less than 5% of mean annual precipitation.

Vegetation: Total canopy cover is ≥40% of the total canopy cover present at the selected reference area(s) and the presence of 3 species of native perennial grasses, 2 species of native perennial forbs, and 2 species of native shrubs.

Cover Integrity: The cover does not show significant deterioration from erosion, slip-offs, or other impacts that cannot be repaired through normal operation and maintenance (O&M). CMI shall, no later than the end of the fifth growing season, provide documentation to USEPA that demonstrates that the cover achieves positive drainage (i.e., that required grades have been maintained and that any observed ponding has been or can be addressed through normal O&M).

The overall reclamation process will involve grading, channel construction, cover placement, and revegetation. Grading of the facility will involve local redistribution of the interim cover and tailing to achieve the design grades. The design anticipates a balanced cut-fill for the facility including the channel excavations. Approximately 700,000 to 800,000 cubic yards of tailing and interim cover will be redistributed to achieve the design subgrade, including the tailing from the channel cuts. The borrow area north of the Tailing Facility, will provide the approximate 1,200,000 cubic yards of material needed to construct the cover, channel fill, and berms as currently designed. The thick and extensive alluvial deposits ensure that a substantial surplus of borrow resources exists if an additional volume of borrow material is required to accommodate unforeseen field conditions. The borrow materials will be excavated and hauled to the tailing facility using scrapers or trucks, with final grading achieved with global positioning system (GPS) motor graders and/or dozers equipped with computer-aided earthmoving systems (CAES). The grading and cover placement will need to be sequenced and integrated with the channel and pond construction. The grading, cover placement, and channel construction will be achieved using heavy construction earth moving equipment. Revegetation will be accomplished using industry standard methods including scarification, seeding, and mulching. The construction process is expected to start in the winter/spring of 2019 and extend into the spring of 2020. Soil water monitoring instrument installation, final detailing, and surveying will follow the major construction and revegetation activities.

This report includes a performance monitoring plan, which was developed to evaluate the success of the Pilot Project. The monitoring will involve soil sampling in 3 decision units to assess soil molybdenum concentrations relative to the preliminary remediation goal (PRG) of 41 mg/kg. Continuous soil water monitoring will be conducted in each of the 3 decision units to support the development of a calibrated soil-atmosphere model, which will be used in conjunction with climate data from Cerro, New Mexico to estimate the long-term annual net percolation. Vegetation monitoring will be conducted to allow comparison of the reclamation to a reference area and the Pilot Project vegetation success criteria. Cover integrity will be monitored through quarterly joint inspections with the agencies to evaluate erosion and ponding. The monitoring plan extends over 5 growing seasons and includes provisions for annual reports and a Final Pilot Project Completion Report, which is due 6 years after the Final Construction Inspection.

This Final Remedial Design report includes an operation and maintenance (O&M) Plan and O&M Manual, which is required prior to implementation of the Pilot Project. The O&M Plan is intended to apply to Dam 1 following the completion of the grading, cover placement, and seeding, rather than during the construction phase of the project.

Separate schedules for the construction and monitoring phases of the Pilot Project are presented in this report. CMI developed an estimate of the construction schedule based on site-specific experience, anticipated strategies considering the potential for dust hazards, and standard equipment production rates. The construction duration aspects of the schedule are considered approximate pending consultation with the selected earthworks contractor.

1. Introduction

On behalf of Chevron Mining Inc. (CMI), Golder Associates Inc. (Golder) has prepared a Final Remedial Design Report for the Tailing Facility Cover Demonstration Pilot Project (Pilot Project) at the Chevron Questa Mine (mine) Superfund Site located in Questa, New Mexico (site) (Figure 1-1). This work is being conducted in partial fulfillment of the obligations set forth in the U.S. Environmental Protection Agency (USEPA) Comprehensive Environmental Response, Compensation, and Liability Act Docket No. 06-13-12. This report has been prepared in accordance with the Statement of Work (SOW) for the First Partial Remedial Design/Remedial Action (RD/RA) Consent Decree at the Chevron Questa Mine Superfund Site, Questa, New Mexico, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID No.: NMD002899094, entered May 1, 2017 (PCD; U.S. Environmental Protection Agency [USEPA] 2017).

More specifically, this report is intended to address the applicable requirements of Sections 5.2.1 and 9.1 of the SOW, which require CMI to conduct a Tailing Facility Cover Demonstration Pilot Project (Pilot Project) on approximately 270 acres of the Dam 1 tailing impoundment at the Chevron Questa Mine Tailing Facility (Figure 1-1). Pre-Final and Final Remedial Designs are required prior to implementation of the Pilot Project. The Pre-Final and Final Remedial Designs will include design criteria and design basis reports, drawings and specifications, Construction Quality Assurance Plan (CQAP)/Construction Quality Control Plan (CQCP), Operation and Maintenance (O&M) Plan and O&M Manual, performance monitoring plan, schedule, and accessory information according to Section 9.1 of the SOW. The development of this report follows on the USEPA approval of the final design for the Dam 1 (Section 36) Tailing Facility Grading (Demonstration Project).

1.1 Project Overview

CMI is required to design, construct, and maintain the Pilot Project in such a manner so as to achieve the Pilot Project success criteria. The purpose of the Pilot Project is (1) to determine whether a two-foot thick cover can be successfully designed, constructed and maintained such that it is adequately protective of soil and groundwater, can be successfully revegetated, and can be maintained over time, and (2) to support an inquiry into whether the CERCLA remedy, as it pertains to cover thickness at the tailing facility, should be modified accordingly. This project serves as a pilot demonstration project because it is the first area of the Tailing Facility to be addressed and to test the effectiveness of the two-foot cover thickness during an initial five-year period.

1.2 Performance Objectives

The Pilot Project success criteria are defined in Section 5.2.1 of the SOW, whereby the USEPA will make a determination that the Pilot Project has succeeded if it concludes, after five growing seasons, that the cover is showing progress toward a self-sustaining ecosystem through the satisfaction of all the following criteria:

Surface Soil: Concentrations of molybdenum in soil (sampled to 3 inches below ground surface) averaged within each of the three decision units (of approximately 100 acres each) are maintained at or below the Tailing Facility soil remediation goal of 41 milligrams per kilogram (mg/kg) molybdenum;

Groundwater: Based on predictions using the calibrated evaporative flux model and the long-term precipitation record (Cerro Station), there is a 90% probability that, in any given year, net percolation averaged across the entire cover demonstration project would be limited to less than 5% of mean annual precipitation.

Vegetation:

(1) Canopy Cover: Total canopy cover is ≥40% of the total canopy cover present at the selected reference area(s).

(2) Diversity:

a. Presence of 3 species of native perennial grasses
b. Presence of 2 species of native perennial forbs
c. Presence of 2 species of native shrubs

(3) Contingency: If circumstances unrelated to cover depth (for example, adverse climatic conditions) result or may result in non-achievement of the foregoing vegetation criteria by the end of the fifth growing season, such non-achievement of these criteria will not preclude success of the Pilot Project if CMI performs an evaluation and demonstrates, to USEPA's satisfaction, that the pilot project area is likely to achieve the ARARs in 19.10.5.507 New Mexico Administrative Code (NMAC) and 19.8.20.2060-63, 65, 66 NMAC for vegetation success in the long term.

Cover Integrity: The cover does not show significant deterioration from erosion, slip-offs, or other impacts that cannot be repaired through normal operation and maintenance (O&M). CMI shall, no later than the end of the fifth growing season, provide documentation to USEPA that demonstrates that the cover achieves positive drainage (i.e., that required grades have been maintained and that any observed ponding has been or can be addressed through normal O&M).

1.3 Report Organization

This Final Remedial Design Report includes the following sections:

- **Section 1 – Introduction:** This section includes the project narrative, overview, and performance objectives, report organization, and other plans relevant to this Final Remedial Design.

- **Section 2 – Site Overview and Background:** This section includes a summary of previous studies and plans conducted at the Tailing Facility that relate to cover design issues.

- **Section 3 – Cover and Revegetation Design Criteria and Basis Report:** This section summarizes the combined Final Design Criteria and Basis of Design, which is included as Appendix A and describes the technical parameters supporting the designs for grading, cover placement and revegetation of Dam 1.

- **Section 4 – Pre-Final Drawings and Specifications:** This section summarizes the cover and grading plan, which are included as Appendix B.

- **Section 5 – Construction Quality Assurance Plan:** This section summarizes the CQAP/CQCP, which is included as Appendix C.

- **Section 6 – Pilot Project Performance Monitoring Plan:** This section presents the Performance Monitoring Plan for the Pilot Project including the experimental design and methods. This section also includes a discussion of data quality assessment and reporting and the data quality objectives (DQOs) for the Pilot Project.

- **Section 7 – Operation and Maintenance Plan and Manual:** This section addresses the operation and maintenance plan for Dam 1 following the completion of construction.

- **Section 8 – Project Schedule:** This section includes information on timing of major activities and deliverables.

- **Section 9 – Contractors and Subcontractors:** This section includes a discussion of contractors and subcontractors that will be used for project activities.

- **Section 10 – Health and Safety:** This section includes a discussion of health and safety practices that will be followed.

- **Section 11 – Greener Cleanup Provisions:** This section discusses actions to reduce the environmental footprint of the remedial action.

- **Section 12 – References:** This section provides a list of references cited or used for this report.

1.4 Other Plans and Procedures

Work activities described for the Pilot Project will be supplemented by other plans, including:

- Site Health and Safety Plan (HASP) for Remedial Designs/Remedial Actions (RD/RA)
- Draft Overall Site Plan for RD/RA (ARCADIS 2017b)
- Site Management Plan (Pollution Control and Mitigation Plan and Waste Management Plan)
- Data Management Plan

These plans are provided under separate cover as required by the PCD (USEPA 2016) and are referenced herein as appropriate.

2. Site Overview and Background

The Questa Mine is a historic open pit and underground molybdenum mine near the Village of Questa in Taos County, NM. The mine area encompasses approximately 3 square miles about 3.5 miles east of the Village of Questa. The mine also includes tailing disposal impoundments (the Tailing Facility) covering approximately 2 square miles west of the Village of Questa. A 9-mile long tailing pipeline runs from the mill to the Tailing Facility, predominantly along Highway 38 and the Red River, and is currently being removed under site closure plans.

The Tailing Facility consists of three tailing impoundments (Figure 2-1) including the Section 35, Section 36, and Historic Tailing. The Section 35 impoundment includes Dam 4 to the south, Dam 3A to the north, Dam 5A to the northeast and a discontinuous dike located along the north and east sides of the decant pond. The Section 36 impoundment includes Dams 1, 1A, and 1C to the south; Dams 1B and 2A to the east; and a separator dike between Sections 35 and 36 to the west and is, hence, sometimes referred to as the Dam 1 complex. The Historic Tailing impoundment is the oldest of the three tailing impoundments and is located immediately north of Dam 3A (part of Section 35 impoundment) and west of Section 36 impoundment. The Tailing Facility was investigated as part of the Chevron Mining Inc. Remedial Investigation and Feasibility Study (URS 2009a, 2009b). Additional characterization was conducted in association with the Final Design Report for Dam 1 Tailing Facility Grading (Golder 2018).

The Tailing Facility occurs at an elevation of about 7,600 feet above mean sea level. The climate is semi-arid, with warm summers and cool winters. Mean annual precipitation is about 12.7 inches and mean annual temperature is near 44°F (Western Regional Climate Center [WRCC] 2018). Average annual snowfall is 59.7 inches, ranging from about 7 to 127 inches (WRCC 2018). Snowfall was recorded in September through May, with the highest average monthly totals in December, January, February, and March. These months account for about 70% of annual snowfall. On average, the snowpack is relatively thin and transient with the average monthly snow depth ranging from about 1 to 4 inches.

The Tailing Facility lies within the Great Basin Desert Scrub vegetation type according to Dick-Peddie (1993). Dominant native vegetation in undisturbed areas adjacent to the Tailing Facility include big sagebrush (*Artemisia tridentata*), rubber rabbitbush (*Ericameria nauseosa*) and broom snakeweed (*Gutierrezia sarothrae*) with interspersed warm- and cool-season grasses including blue grama (*Bouteloua gracilis*) and western wheatgrass (*Pascopyrum smithii*). Pinon-Juniper woodlands occur on the shallow, upland soils west of the Tailing Facility in the Guadalupe Mountains.

The primary performance objectives for the cover include support of adapted native vegetation and reduction in net percolation. The ability of the cover to support vegetation is essential for achieving a self-sustaining ecosystem, which is required under the Record of Decision (ROD). From a functional perspective, vegetation promotes erosional stability and reduces net percolation. It is recognized that complete preclusion of meteoric waters from the tailings is not possible with evapotranspiration cover systems and alternative controls may be required to augment the cover.

2.1 ROD Cover and Vegetation Requirements

The ROD requires the Tailing Facility to be covered and revegetated for source containment. A store and release/evapotranspiration cover system was determined to be an appropriate cover system for the climate conditions near Questa and the type of borrow materials that are locally available. A minimum 36-inch thick cover was required pending the results of on-going studies, as stipulated in Permit TA001RE-96-1 and Permit DP-933. The cover was intended to reduce infiltration and percolation of water through the tailing material to ground water that would cause an exceedance of ground water quality standards. The reduction of infiltration and percolation was also intended to minimize oxidation and acid generation of the tailing. Furthermore, the cover was intended to provide conditions that would allow for the re-establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas, and thereby conform to the MMD-approved post-mining land use of wildlife habitat.

The ROD anticipated that the cover material would be sourced from alluvial deposits north of the Tailing Facility and placed using scrapers. In the mid-1990's, similar materials and methods were used to construct the interim cover on the surface of Dam 1. In the early 2000's, the vegetation on the interim cover was considered well-established with respect to vegetation density, species constancy and uniformity. Because the interim cover materials were not screened and the vegetation performance was adequate, no screening of materials for the final cover was required.

The ROD requires the final cover to be revegetated with grasses and forbs and possibly woody shrubs. Revegetation designs are intended to optimize the effectiveness of the cover to reduce infiltration and percolation through the underlying tailing to protect ground water, promote evapotranspiration from the cover system, and provide cover stability and protection from wind and water erosion. The revegetation designs were also intended to consider selecting plants with lower propensities to take up molybdenum at levels that present risks to large herbivorous wildlife (e.g., deer and elk).

2.2 Tailing Facility Vegetation and Wildlife Studies

The Tailing Facility Vegetation and Wildlife Studies Report evaluated soil, vegetation, and wildlife interactions under conditions associated with the interim cover (Intrinsik, 2018). The purposes of these studies were to: 1) to evaluate the diet composition and foraging habits of elk and mule deer at the Tailing Facility; 2) to evaluate the current impact of gophers and other burrowing rodents on cover integrity at the Tailing Facility; and 3) to develop bioaccumulation models for plants growing on the interim covers of the Tailing Facility. Three studies were included in the report including: 1) Elk and Deer Molecular Scatology Study based on Plant Deoxyribonucleic Acid (DNA) Analysis; 2) Gopher Study; and 3) Collocated Plant and Soil Study. The results of these studies provide information that was supports the cover design and monitoring plans for the Tailing Facility.

Diet composition and foraging habits of elk and mule deer at the Tailing Facility were assessed by comparing DNA analysis of scat samples collected over four seasons to plant DNA databases. The diet data strongly indicated that substantial portions of both elk and deer diets were obtained off the Tailing Facility. Collectively these data suggest that while elk and deer may seek refuge at the Tailing Facility and/or use the property as a thoroughfare, the majority of their diets appear to be obtained offsite.

The impact of gophers and other burrowing animals on the integrity of the interim cover at the Tailing Facility was evaluated by quantifying gopher mounds within the cover area Decision Units (DUs) and measuring mound characteristics. Where the interim covers were thin enough, gophers brought tailing to the surface. Gopher activity on the existing interim cover, which has been in place for over 20 years, was limited to <5% of the areas of DUs 1 and 2. The depths of gopher burrows at the Tailing Facility and Solar Facility rarely exceeded 50 centimeters (cm) (19.7 inches). In spite of the thin interim covers, incremental composite sampling (ICS) soil data indicate that excavation by gophers had not resulted in surface molybdenum concentrations above the 41 mg/kg preliminary remedial goal (PRG). Based on the extensive gopher-related data from DUs 1 and 2 and the Solar Facility, there is no indication that gophers will excavate through a 24-inch thick cover and bring significant quantities of tailing to the surface, which could result in molybdenum surface soil concentrations greater than the 41 mg/kg PRG.

The collocated plant and soil study concluded that plants growing in the interim cover and tailings take up molybdenum with significant differences among species. Based on the results of the diet and collocation studies, six species (rubber rabbitbrush, blue grama, bottlebrush squirreltail, big sagebrush, western wheatgrass, and common sunflower) should be considered for inclusion in the revegetation seed mix. Crested wheatgrass was not recommended because it is an introduced and highly competitive species. Alfalfa and yellow sweetclover, should be excluded due to their forage preference, high molybdenum bioaccumulation rates and low copper to molybdenum (Cu:Mo) ratios.

2.3 Dam 1 Tailing Facility Grading

CMI prepared the Final Design Report for Dam 1 Tailing Facility Grading (Golder 2018), which was approved by the USEPA on May 25, 2018. The grading plan was designed to provide positive drainage of surface water runoff without affecting the integrity of the dams and considering long-term draindown and consolidation of the tailing. Cover requirements and potential borrow source volumes and availability were estimated as part of the grading plan. In addition, design criteria were developed for the Dam 1 Tailing Facility Grading, whereby the top surface grade shall meet the design criteria of a minimum 0.5 percent, maximum 2 percent, and post-settlement top surface gradient with localized areas of up to 5 percent.

The Finished Subgrade surface gradient will be directed away from the crest and a berm will be placed to prevent flows from overtopping and eroding the Dam 1 Tailing Facility outslope. The existing access road across the Section 36 top surface will be maintained, and top surface channels and swales will be constructed to convey surface water through either Torgeson Gorge or Lacome Gorge to interim surface water management facilities located on the Section 35 and Historic Tailing impoundments. Top surface and downslope channels will be constructed on the Dam 1 bench area to convey surface water to the existing East Diversion Channel. Cover will be placed on the Finished Subgrade, and Channel Fill and revetment (as required) will be placed within the top surface and downslope channels and swales. The tailing regrade is generally anticipated to be performed as a balanced top surface excavation and local fill placement to achieve the Finished Subgrade design.

2.4 Borrow Materials

A borrow material investigation was conducted as part of the Tailing Facility Grading Plan (Golder 2018). The intent of the investigation was to characterize the native soils and alluvium and determine their suitability for use as a cover. The investigation included a review of previous studies and the collection of additional data. The results of the investigation indicated that native soils and alluvial borrow materials have relatively few limitations for growth of plant species and are suitable for use as cover material. This finding was consistent with previous studies and the ROD, which specified the use of local alluvium for cover on the tailing facility. A potential borrow area was identified northwest of Dam 1, which is capable of yielding approximately 1,200,000 cubic yards (CY) or more of native material to meet cover, Channel Fill, and Crest Berm Fill requirements for the Dam 1 Tailing Facility Grading. The borrow requirements and resources were revised and updated during the Pre-Final Design for the Tailings Facility Cover Demonstration Pilot Project (Section 3.3).

3. Cover and Revegetation Design Criteria and Basis Report

This section is intended to describe the technical parameters supporting the closure design and reclamation of Dam 1. The evaluation of 2-foot thick covers composed of local alluvium is predicated on the performance of similar cover in reducing net percolation and providing the conditions necessary to support a self-sustaining ecosystem. Studies of water relations conducted at Questa (Golder 2015a) indicate that hydraulic performance is improved with thinner covers (≈ 1-foot thick), but the potential for molybdenum uptake by plants is negatively affected (Intrinsik 2018). Somewhat thinner covers (e.g., < 20 inches thick) tend to increase the likelihood of burrowing animals bringing tailing to the surface, which further increases the potential for molybdenum uptake by plants and ingestion by wildlife. Thus, the cover design is intended to balance risks associated with groundwater protection and the promotion of wildlife habitat.

A combined design criteria and design basis report is included in Appendix A. Section 3.1 provides a description of the project and the objectives. The tailing grading process is described in Section 3.2. The cover placement and construction process is described in Section 3.3 and the revegetation methods are discussed in Section 3.4. Reclamation of the borrow area is discussed in Section 3.5.

3.1 Project Description and Objectives

The Pilot Project represents the first area on the Tailing Facility to be regraded to achieve positive drainage with an engineered cover system. The cover system will be a minimum of 2 feet thick and have a gradient greater than 0.5%. The purpose of the Pilot Project is (1) to determine whether a two-foot thick cover can be successfully designed, constructed and maintained such that it is adequately protective of soil and groundwater, can be successfully revegetated, and can be maintained over time, and (2) to support an inquiry into whether the CERCLA remedy, as it pertains to cover thickness at the tailing facility, should be modified accordingly. The cover is intended to support a self-sustaining ecosystem appropriate for a wildlife post-mining land use (PMLU), protect the tailing impoundments from wind and water erosion, and reduce the volume of water entering the tailing that could eventually reach groundwater.

The Pilot Project is intended to build on and complement the Tailing Facility Grading Plan (Golder 2018). In addition, this work will assist in the development of construction methods and design elements for the future remediation of the Tailing Facility.

3.2 Tailing Facility Grading

The grading plan for Dam 1 was finalized and approved on May 25, 2018. Grading of Dam 1 will involve local redistribution of the interim cover and tailing to achieve the design grades. The design anticipates a balanced cut-fill for the facility including the channel excavations. Approximately 700,000 to 800,000 CY of tailing and interim cover will be redistributed to achieve the design subgrade, including the tailing from the channel cuts (Golder 2018).

The grading will be achieved using moderate to large, heavy construction earth moving equipment. The type of equipment will be determined in consultation with the earthworks contractor after their selection. CMI anticipates the grading will be accomplished using equipment that may include scapers, dozers, trucks, loaders, excavators, and motor graders. The dozers, scapers, and motor graders can be fitted with global positioning system (GPS) to control the grade during construction. Grade control will be maintained using a computer-aided earthmoving system (CAES) and confirmed by traditional survey methods post construction.

The regrading process is expected to result in burial and mixing of the interim cover with tailing. At the completion of the regrading, the final surfaces in several areas will be composed of unadulterated or straight tailing, as opposed to areas with mixed tailing and interim cover. As the grading progresses, but prior to cover placement, the straight tailing areas will be surveyed and delineated to identify the extent of the focused investigation (FI) areas that will be monitored separately and in addition to the facility as a whole (Section 5).

3.3 Cover Placement

The thick alluvial deposits adjacent to the Tailing Facility were considered suitable cover borrow sources for use without the need for screening (USEPA 2010). The borrow investigations conducted as part of the Tailing Facility Grading Plan confirmed the suitability of the materials (Golder 2018). The Pilot Project covers will be constructed using construction-scale equipment. To account for potential settlement and construction precision limitations, the cover was designed with a thickness of 27 inches, which exceeds the 24-inch (2-foot) design criteria by about 12.5 percent.

The borrow area north of the Tailing Facility will provide the approximate 1,200,000 CY of material needed to construct the cover as currently designed (Table 3-1). It should be noted that because of the thickness and lateral extent of the alluvial deposits a substantial surplus of suitable borrow materials is available if required. The borrow materials will be excavated and hauled to the tailing facility using scrapers or trucks. If scrapers are used, they will traverse defined haul routes to the tailing facility and place the cover in discrete lifts until near final grade and thickness are achieved. Final grading will be achieved with a motor grader equipped CAES. If trucks are used, the cover will be hauled and strategically end dumped and spread with dozers equipped CAES. The equipment fleet that will ultimately be used is being determined through consultation with potential construction contractors.

Table 3-1. Estimated Quantities of Cover, Channel, and Berm Fill for the Pilot Project

Item No.	Description	Unit	Quantities		
			Section 36 Top Surface	Dam 1 Bench Area	Total
1	Cover Fill	CY	911,700	112,700	1,024,400
2	Channel Fill	CY	89,800	15,100	104,900
3	Crest Berm Fill	CY	40,000	14,000	54,000
	Total	CY	1,041,500	141,800	**1,183,300**

Notes:
CY = cubic yard
1. Quantities are neat line (i.e., cut and fill material shrinkage or bulking was not considered in calculating the cover quantities.
2. AutoCAD Civil 3D was used to calculate quantities.

3.4 Revegetation

Revegetation will be accomplished using industry standard methods. The revegetation activities will include the following practices; scarification, seeding, and mulching. The practices and potential modifications are described below.

3.4.1 Scarification

Scarification is performed to break up compaction, roughen the soil surface, and provide microsites for seed emplacement. The degree and method of scarification required will be determined after cover placement depending on the soil surface conditions. Dedicated haul routes where truck and/or scraper traffic was concentrated may require deeper or more extensive ripping to break up compaction. The need for ripping as opposed to scarification will be determined by the Engineer. Scarification is typically performed on the contour to avoid the development of concentrated flow paths parallel to the slope that could promote erosion.

3.4.2 Seeding

The seed mix was prepared to include adapted native species and in consideration of the propensity of the plants for molybdenum uptake (Dreesen 1993, Dreesen and Hensen 1996, and Intrinsik 2018). The seed will be drilled and broadcast simultaneously using a rangeland drill with depth control bands, packer wheels, agitators and augers, and picker wheels. The light and fluffy seeds will be allowed to fall freely behind the drill and subsequently covered using chain drags pulled behind the drill. Seeding will be performed in the spring but no later than June 30. Seed will be applied at the rates specified in Table 3-2. The seed mix is considered provisional pending confirmation that the materials and quantities are available. If adjustments to the species selected or rates are required because of availability limitations, the USEPA will be consulted.

3.4.1 Mulching

Mulch will be applied to stabilize the cover surface from erosion by wind and water. Depending on the sequence and timing of the grading and cover placement, the mulch will be applied either before or after seeding. For areas where the construction is completed in advance of the facility seeding date, mulch may be applied prior to seeding to reduce the potential for dust generation. The need to mulch in these instances will depend on the nature of the cover materials that are placed and their inherent susceptibility to wind erosion. The nature of the mulched cover surface will be assessed prior to seeding to determine if alternative seeding practices are required to promote seed soil contact.

Certified weed-free mulch will be applied at a rate of about 2 tons/acre. To promote persistence, long-stem mulch is recommended to facilitate persistence and anchoring during the crimping process. The mulch will be crimped with vertically oriented coulters.

Table 3-2: Proposed Seed Mix for the Tailing Facility Cover Demonstration Pilot Project

Scientific Name	Common Name	Application Rate (lbs/ac)	seeds/sq ft	Seasonality
Grasses				
Bouteloua curtipendula	Sideoats grama	1.25	5.5	W
Bouteloua gracilis	Blue grama	0.25	4.2	W
Pleuraphis jamesii	Galleta	0.8	2.9	W
Achnatherum hymenoides	Indian ricegrass	1.8	5.8	C
Elymus lanceolatus	Streambank wheatgrass	1.5	5.4	C
Leymus cinereus	Basin wildrye	1.8	5.4	C
Pascopyrum smithii	Western wheatgrass	1.2	3.0	C
Forbs				
Achillea millefolium	Common yarrow	0.15	9.5	NA
Heliomeris multiflora	Showy goldeneye	0.2	4.8	NA
Linum lewisii	Blue flax	0.4	2.7	NA
Machaeranthera bigelovii	Bigelow's tansyaster	0.2	7.1	NA
Penstemon barbatus	Beardlip penstemon	0.6	7.6	NA
Ratibida columnaris	Prairie coneflower	0.3	8.5	NA
Shrubs				
Artemisia ludoviciana	White sagebrush	0.05	5.2	NA
Atriplex canascens	Fourwing saltbush	3.5	4.2	NA
Cercocarpus montanus	Mountain mahogany	1	1.4	NA
Ericameria nauseosa	Rubber rabbitbrush	0.6	5.5	NA
Fallugia paradoxa	Apache plume	0.3	2.9	NA
Purshia tridentata	Antelope bitterbrush	2	0.7	NA
	Total	17.9	92.2	

Notes: Application rate in pounds per acre (lbs/ac) and seeds per square foot (sq ft) assume Pure Live Seed (PLS)
W = warm season grass, C = cool season grass

3.5 Borrow Area Reclamation

The borrow area(s) will be stabilized and/or reclaimed using methods similar to the Tailing Facility. The borrow area reclamation plan will consider the potential for future expansion associated with the reclamation of the remainder of the Tailing Facility. Portions of the borrow area that are likely to be accessed for future use may be stabilized using alternative or interim methods. The agencies will be consulted if interim stabilization areas are identified. Borrow area slopes that are considered final will be graded to 3:1 or flatter and run-on controls will be established. The borrow area(s) will be revegetated using the methods described in Section 3.4 with the intent of meeting the vegetation success criteria for the Tailing Facility.

4. Final Drawings and Specifications

The Final Remedial designs for the Pilot Project were prepared using the Final Tailing Facility Grading Plan as a base for achieving positive drainage. The Final Remedial Design for the Pilot Project integrates the additional cover lifts and refinements needed to the grading plan to accommodate the cover and maintain the design criteria for grading. The design drawings are included in Appendix B.

The Final Remedial Design drawing package includes details relevant to cover construction and should be used in concert with the Final Tailing Grading Plan for the details associated with the channel and revetment construction.

5. Construction Quality Assurance Plan

A CQAP/CQCP was prepared following the technical guidance document “Construction Quality Assurance for Hazardous Waste Land Disposal Facilities” (USEPA 1986) to ensure the Pilot Project is constructed according to the design and satisfies the requirements of the SOW. The CQAP is designed to help assure that the construction techniques, procedures, quality control and quality assurance are coordinated to meet the design intent and requirements of the Pilot Project. A primary objective of the CQAP is to document the construction quality assurance (CQA) procedures that will be used to independently verify and test that the contractor performs the construction activities required to meet the requirements and objectives of the Pilot Project (e.g., material handling, grading, cover placement, and revegetation). An additional objective of the CQAP is to identify and resolve problems or design deficiencies that may arise during the construction phase. The CQCP included herein describes general construction quality control (CQC) functions and procedures that will be performed by CMI (or the Contractor) to verify that the Pilot Project construction has satisfied all plans, specifications, and related requirements, including quality objectives. The CQAP/CQAP is included in Appendix C.

6. Pilot Project Performance Monitoring Plan

The SOW requires the development and implementation of a Performance Monitoring Plan. The plan shall be designed to collect information that will be used to evaluate the success of the Pilot Project in accordance with the criteria described in Section 5.2.1 of the SOW. The performance monitoring plan is intended to provide information necessary to assess the effectiveness of the 2-foot thick cover with respect to surface soil molybdenum content (Section 6.1), groundwater (Section 6.2), vegetation (Section 6.3), and cover integrity (Section 6.4) as detailed in Section 1.2 of this Final Remedial Design Report. Data quality assessment and reporting provisions are discussed in Section 6.5. The data quality objectives (DQO's) are defined and presented in Section 6.6.

6.1 Surface soil

The average concentration of molybdenum in surface soils (0 to 3 inches below ground surface) will be evaluated within each of three decision units (approximately 100 acres each) on the Tailing Facility. The proposed configuration of the DUs is shown on Figure 6-1. The sampling approach for surface soils will follow the general methods presented in the Tailing Facility Vegetation and Wildlife Studies Report (Intrinsik 2018).

6.1.1 Incremental Composite Soil Sampling

Average total molybdenum concentrations for each of the DUs will be estimated using the ICS method. Composite samples from randomized locations will be collected and submitted to the laboratory for total molybdenum and copper analysis. The soil samples will be analyzed on the < 2 mm fraction of the soils using USEPA SW-846 Methods 3050 and 6020. Data will be used to compare to the preliminary remediation goals and to compare molybdenum concentrations in the surface samples of the soil cover across the Dam No. 1 reclamation area.

For the ICS sampling, the Dam No. 1 reclamation area will be split into approximately three equal-size DUs which include the FI areas. A fourth DU will be comprised of the combined FI areas. Figure 6-1 shows the proposed layout of DUs on Dam 1. For each DU, a sample grid of approximately 200 intersections will be constructed using Visual Sample Plan ([VSP], Matzke et. al 2014). Three random sets of 30 intersections will be chosen as sampling locations for each DU. Each set of 30 grid samples will be composited per the ICS methodology to obtain three samples for each DU. To the extent practicable, the number of samples for the fourth DU will be area-weighted for each of the FI areas.

Sampling points will be located using a handheld GPS unit. At each sampling point, a ¼-cup (60 cm^3) of soil will be collected for each discrete grab sample assigned at that location. Thus, at each random sample point, one to three samples may be collected depending on the overlap of the random points for each sample set. Prior to sampling the cover, surface plant litter will be brushed off the soil surface to avoid confounding the soil analysis. Samples will be collected from the upper 3 inches (0 to 7.5 cm) and added to one plastic bucket depending on the assigned composite set for the sample. Once all the samples are collected for a set, the soil will be thoroughly mixed and homogenized in a clean bucket. The resulting composite sample (approximately ½-gallon) will be submitted to the analytical laboratory for analysis. In total, 12 composite samples will be analyzed for total molybdenum and copper.

6.1.2 Surface Soil Sampling Schedule

Sampling of surface soils using the ICS methodology will be performed following cover placement and seeding operations to establish a baseline for the Tailing Facility. The final sampling event will be performed in the last monitoring year of the Pilot Project (Year 6), to determine if average molybdenum concentrations are maintained at or below the Tailing Facility soil remediation goal of 41 mg/kg. Comparison of the baseline and final sampling data will give an indication of whether the molybdenum concentrations have increased over time. Results from the baseline monitoring event will be included in the first Annual Monitoring Report, which is due one year after the Final Construction Inspection for the Pilot Project. The results of the final sampling event will be included in the Final Project Completion Report, which is due 6 years after the Final Construction Inspection for the Pilot Project.

6.2 Groundwater

Near-surface soil water monitoring instruments will be installed to evaluate potential impacts from the Tailing Facility to groundwater. The monitoring plots will include instrumentation that measure matric potential and soil water content. Prior to or during installation of the instruments, samples of representative alluvial cover and tailing will be collected. Select samples will be tested in the laboratory for the suite of analytes listed below in Table 6-1. Following five growing seasons of data collection from the soil monitoring instruments, a soil-atmosphere model will be calibrated to the measured matric potential and soil water content data. The calibrated model will then be used with a long-term climate set to evaluate hydraulic performance of the cover.

6.2.1 Soil Water Monitoring Instrumentation

The monitoring plot program will include the installation of soil water monitoring instruments to further characterize cover and tailings water dynamics in situ and demonstrate cover performance. The monitoring plots will also provide data to evaluate the performance of the cover design to reduce net percolation over the long-term using soil-atmosphere modeling.

Monitoring plots will measure hydrogeologic conditions in the upper zone of the tailing impoundment. Three monitoring plots will be installed, one in each of three DUs in the 270 acres of the Dam 1 area. Figure 6-1 presents the proposed monitoring plot locations. Each monitoring plot will contain three instrument nests, with each nest at discrete locations installed radially around a central data logger in each plot. The instruments will be installed approximately 50 to 80 horizontal feet from the data loggers. A total of nine instrument nests will be installed. Each instrument nest will include heat dissipation sensors (HDS) to measure temperature and matric potential and frequency domain reflectometry (FDR) sensors to measure water content. Figure 6-2 (Instrument Layout) provides the typical location of instrument nests within a monitoring plot and the installation of sensors within an instrument nest. As shown in Figure 6-2 (Instrument Layout), six HDS will be installed in each instrument nest while five FDR will be installed. Sensor placement depths shall be approximately 25, 50, 100, 150, 200 and 225 cm below the cover surface for the HDS. The FDR will be placed at of approximately 25, 50, 100, 150, and 225 cm. Due to the relatively large size of the FDR sensor (6.7 inches long), two sensors cannot be installed over a short depth interval, and soil moisture is not needed to measure gradients.

Sensors will be installed in the side-walls of pits excavated in the covers and down auger holes in the tailing (Figure 6-2). This downhole sensor installation approach avoids extensive disruption of the tailing matrix, disturbance of large areas, and the need to segregate large volumes of tailing from the cover. In addition, this method prevents the need for personnel to access deep excavations, which would require sloping or shoring. Two auger holes will be required for each instrument nest, one for the HDS and one for the FDR. The auger holes will be closely spaced (e.g., 12 to 18 inches apart). Tailing and cover material will be backfilled carefully surrounding the sensors and tamped from the surface. Further details are provided below.

6.2.1.1 Cover and Tailing Logging and Sample Collection

Tailing in the FI areas will be sampled prior to cover placement in the approximate location of the proposed monitoring plots (Figure 6-1). Three approximately 3-inch diameter auger holes will be advanced with a hand auger to 140 cm below the tailing surface at the approximate location of each instrument nest. The tailing will be logged in general accordance with the Unified Soil Classification System (USCS), the ASTM Standard D2488 (ASTM 2009) and USDA Soil Survey methods (Soil Survey Staff 1993). Sampling intervals will be determined by the textural variations encountered in the tailing with depth. A 5 to 10 kilogram (kg) sample of tailing will be collected for physical characterization (Table 6-1) and samples will be placed directly in gallon-sized plastic bags. The number of samples at each FI area will be determined by the variability encountered in tailing characteristics. For instance, if the tailing is texturally similar among the auger holes, fewer samples would be collected than if the materials are substantially different.

Cover samples will be collected from hand dug shallow test pits in conjunction with instrument installation. Samples will be selected to represent the variability of cover material encountered at each FI area. Samples collected for moisture content will be stored in gallon-sized plastic bags after removing larger rock fragments (>75 mm). Cover samples collected for the remaining analyses will be placed in a 5-gallon plastic bucket.

Laboratory measurements will include particle size analysis, moisture content, saturated hydraulic conductivity, and soil water characteristic curves (SWCCs). Table 6-1 provides the laboratory analytical methods that will be employed for the physical characterization of the cover and tailings material.

Table 6-1: Methods for Physical Characterization

Analysis/Parameter	Source-Method
Particle size distribution	ASTM D422
Moisture content	ASTM D2216
Particle density/Specific gravity	ASTM D854
Saturated hydraulic conductivity	ASTM D5856M
Soil water characteristic curve	ASTM D6836

6.2.2 Instrumentation

Campbell Scientific data loggers will be installed at each monitoring plot. The data loggers will be wired to a power system consisting of a solar panel and battery capable of running the instrumentation with limited long-term maintenance requirements. The data will be downloaded from the data loggers manually each quarter. To protect the data logger electronic equipment, desiccant bags will be placed inside each weather-proof enclosure. Readings from the HDS and FDR sensors will be collected at four-hour intervals.

6.2.2.1 Heat Dissipation Sensors

Campbell Scientific 229 HDS will be installed at varying depths below the cover surface (e.g., 25, 50, 100, 150, 200, and 225 cm) at each instrument nest to directly measure soil temperature and indirectly measure soil water matric potential. The 229 HDS is designed to measure matric potentials in the -10 to -2,500 kPa range with a resolution of about 1 kPa at matric potentials greater than -100 kPa (Campbell Scientific 2006). The HDS calibration process and installation methods are discussed below.

The HDS will be calibrated in the laboratory according to the standard methods developed by Scanlon et al. (2002) including compensation for ambient temperature variations (Flint et al. 2002). The calibrations will include five to ten-point HDS measurements at varying suctions for each sensor. Individual water characteristic curves can be developed for each sensor (van Genuchten 1980). Previous experience with these sensors has shown that additional adjustment of calibration values (e.g., ΔT_{dry} and ΔT_{wet}) may be required to accommodate actual field measured values. Adjustment of the calibration coefficients may be performed as needed in the future and any adjustments made will be identified and reported in the annual monitoring reports associated with the Pilot Project.

The HDS will be installed using a downhole emplacement and profile reconstruction method. Prior to the sensor installation, an approximately 18-inch long by 12-inch wide section of the cover will be excavated by hand to the underlying tailing contact. Once the tailing contact is reached, a 3-inch diameter borehole will be augured by hand to an approximate total depth of 225 cm at each location. The excavated cover and tailing will be segregated on a plastic liner on the surface at each location or in a 5- gallon bucket and covered to limit moisture loss of the excavated materials. The instruments will then be lowered into the borehole to the target depths in a step wise manner; after each sensor is placed, the remaining void will be backfilled with cover or tailing depending on the corresponding depth and the material will then be compacted. The backfill material will be screened to particle sizes less than ¼-inch prior to placement to eliminate the potential for bridging around the instruments. The screened cover and tailing used as backfill will be tamped using a capped PVC pipe to ensure good contact with the instruments and compaction of the backfill to near the density of the surrounding cover and tailing.

The instrument cables from the individual HDS will be bundled into protective Schedule 40 PVC conduit along with the other sensor cables and buried in shallow trenches that extend from each sensor nest location to the data logger.

6.2.2.2 Frequency Domain Reflectometer Sensors

Dynamax ThetaProbe ML3 soil moisture sensors will be installed at varying depths below the cover surface (i.e., 25, 50, 100, 150, and 225 cm) at each nest to provide an indirect measure of volumetric water content. The accuracy of the ML3 ThetaProbe is reported to be about ± 1 percent absolute volumetric water content in the range between 0 and 50 percent volumetric water content. The expected accuracy decreases as the ambient soil temperature increases above 40°C and as salinity increases. The FDR calibration and installation methods are discussed below.

FDR sensor calibrations will be performed using bulk tailing samples and alluvial cover material. The bulk samples will be placed in 5-gallon containers at the approximate in-situ bulk density of the materials. Work published by Whalley (1993) and White et al. (1994) show an almost linear correlation between the square root of the soil dielectric constant (related to the DC voltage measured with the FDR sensors) and soil volumetric moisture content. The material-specific calibrations will be conducted in accordance with the manufacturer's specifications (Delta-T Devices Ltd. 2013). Specifically, the calibrations will be conducted by measuring the soil dielectric constant (from the FDR sensors) at varying moisture contents (determined from core samples analyzed in a laboratory after each successive increase in moisture content). Calibration equations for each material type will be developed that relate the DC voltage from the FDR sensors with in-situ soil volumetric moisture content. Further adjustment of the calibration coefficients to accommodate actual field measured values may be performed as needed in the future and any adjustments made will be reported in the annual monitoring reports associated with the Pilot Project.

The FDR sensors will be installed using the downhole emplacement and profile reconstruction method described previously. The instrument cables from the individual FDR sensors will be bundled into protective Schedule 40 PVC conduit along with the cables from other sensors and buried in shallow trenches that extend from each sensor nest location to their respective data logger.

6.2.3 Soil-Atmosphere Modeling

The purpose of the soil-atmosphere modeling is to evaluate long-term hydraulic performance of the cover. Following five growing seasons of data collection from the monitoring plots, the calculated matric potential data will be used to calibrate soil-atmosphere models. Both the hydraulic material properties of the tailing and cover and the vegetation properties will be adjusted to best fit the calculated and measured conditions in the monitoring plots. The calibrated models will then be used with a long-term climate set to evaluate hydraulic performance of the cover in the long-term. Consequently, the conditions measured in the monitoring plots will form a basis to evaluate cover performance in the long-term from conditions that may not occur in five years such as natural variation in climate or vegetation progression.

6.2.3.1 Approach

One dimensional soil-atmosphere modeling will be completed to simulate the dynamic processes of infiltration, drainage (or net infiltration), moisture redistribution, evaporation, transpiration, and runoff. The software to be used will be chosen prior to initiating the effort based on the capabilities of soil-atmosphere software at that time, given advances in software of this type are ongoing. Based on the goals of the project, the software considered will be those based on Richards' equation such as HYDRUS-1D or UNSAT-H.

All models constructed will evaluate near-surface water balance components to below the depth at which evaporation and transpiration are effective (e.g., 8 to 10 feet below ground surface). The models will not be used to predict draindown or seepage from the Tailing Facility. Two phases of soil-atmosphere modeling will be completed. The first phase will include calibration to the monitoring plot data. The second phase will use the calibrated models from the first phase with a long-term climate set to evaluate hydraulic cover performance in the long-term. Each phase is described below.

6.2.3.2 Calibration Phase

Models will be constructed to represent the data from the monitoring plots. The top boundary condition will be the atmosphere, which includes precipitation and evapotranspiration when applicable. For the calibration phase, climate measured at the Tailing Facility will be used for the time period that soil monitoring data are available. The bottom boundary condition will be defined as free-draining, which applies a unit hydraulic gradient. Initial conditions will be defined using data collected from the monitoring plots during installation. Model parameters will vary through time to represent vegetation conditions and status of the cover and tailing following installation of instrumentation. The calibration phase will include adjustment of hydraulic material properties and vegetation properties to best fit the soil monitoring data.

<u>Hydraulic Properties</u>: The required material properties for soil-atmosphere models typically include saturated hydraulic conductivity and soil water characteristic functions. Initial hydraulic properties will be defined based on the laboratory testing described in Section 6.2.1.1 and data available from previous studies for the cover material and tailing, where applicable.

Vegetation Properties: Vegetation inputs typically required for soil-atmosphere models include critical suction limits, root distribution with depth, total root depth, and leaf are index distribution for the reclamation plant community. Vegetation parameters will be developed from literature values (Romig et al. 2006, Peace et al. 2004) and extrapolation of the conditions that exist during the monitoring period and those projected to exist over the long-term.

Climate Set: Climate data needed to support soil-atmosphere modeling include temperature, precipitation, and potential evapotranspiration (PET). PET can be calculated using daily temperature, relative humidity, wind speed, and net radiation. For the calibration phase, climate measured at the tailing facility will be used for the time period soil monitoring data are available given site-specific measurements will best represent conditions for the test plots. The climate station at the Tailing Facility measures precipitation, temperature, relative humidity, wind speed, and net radiation to facilitate calculation of PET. The potential impact of snowfall and snowpack on the equivalent precipitation for the Tailing Facility will be assessed. If justified, the climate data will be pre-processed using the restricted degree-day approach (Kustas et al. 1994) or similar methods. In this case, the precipitation input will be equivalent precipitation to account for rain and calculated snowmelt. Alternately, some soil-atmosphere models account for accumulation of snowpack and the resulting equivalent precipitation, which may be used in lieu of pre-processing the climate data.

6.2.3.3 Predictive Phase

Models will be constructed using the best estimates of hydraulic properties for the cover and tailing and vegetation properties developed in the calibration phase. The models will be used to predict net percolation, which is defined as the portion of precipitation that infiltrates into the soil surface and is not returned to the atmosphere through evaporation or transpiration. The top boundary condition will be the atmosphere. For the predictive phase, the long-term climate data set will be used. The bottom boundary condition will be defined as free-draining. Initial conditions will be defined by equilibrating the profile to average climatic conditions. A sensitivity and uncertainty analysis will be completed to assess the effect of parameter uncertainty on predicted net percolation. The net infiltration results from the long-term model will be used to assess the average and annual net percolation and probability of exceeding the success criteria established for the Pilot Project.

Climate Set: A detailed and comprehensive synthetic climate data set (100 years) will be developed with precipitation and temperature data from the nearby National Weather Service station at Cerro, NM (NCDC COOP Station # 291630). Data are currently available from 1910 to 2018 with more than 96% completeness for precipitation, which is adequate to assess long-term climate. The weather data from Cerro will be supplemented with data measured at the Tailing Facility to develop a long-term data set to calculate PET. Climate monitoring at the Tailing Facility was initiated in August 2000. Once the long-term climate set is developed, specific periods will be identified that represent wet, dry, average, and extreme precipitation conditions and events. Other periods may be identified that represent temperature extremes to assess the potential effects of changes in climate. These periods will be used to evaluate model sensitivity to climatic inputs and to bracket hydraulic cover performance based on historical climate variability.

Sensitivity and Uncertainty Analysis: The sensitivity and uncertainty analysis will include a reasonable and probable range of parameters to assess their effects on the predicted near surface water balance components (e.g., runoff and net percolation). A sensitivity analysis will be conducted first to identify parameters that significantly affect predicted net percolation and will include the major factors that typically affect water balance simulations. These factors may include, but are not limited to, variations in hydraulic material properties, vegetation properties, model domain configurations, and climatic parameters (e.g., daily versus hourly precipitation, temperature, and effective precipitation from snow melt). The results from the sensitivity analysis will inform the uncertainty assessment. The uncertainty analysis will focus on sensitive parameters and will be completed to bound predicted net percolation.

6.2.4 Groundwater Monitoring and Reporting Schedule

Monitoring of the soil water monitoring instruments is a continuous process with data collected throughout the day at the specified intervals. The data will be compiled quarterly and on an annual basis and reported in the Annual Monitoring Reports in graphical and tabular formats as appropriate for the specific data. The matric potential and water content data will be presented in cumulative time series graphs for the duration of data collection. Trends in the matric potential and water content data in relation to the climate data will be noted in the Annual Monitoring Reports. The site-specific model calibration, extrapolation to the long-term climate, and evaluation of compliance with success criteria will be conducted in the final year of the Pilot Project. The results of the calibration and modeling will be included in the Final Project Completion Report.

6.3 Vegetation Success Monitoring

Vegetation monitoring will be conducted to evaluate the cover's effectiveness in establishing sufficient vegetation throughout the Pilot Project time frame. Monitoring will be conducted in the reference area and on the covered and revegetated surface of Dam 1.

6.3.1 Reference Area

Section 5.2.1 of the SOW requires CMI to establish and monitor a reference area for canopy cover by species, diversity, and shrub density to establish technical standards for review and approval by USEPA. This process shall be based on EMNRD's "*Closeout Plan Guidelines for Existing Mines – Attachment 2, Revegetation Standards and Sampling Methods*" (MARP 1996) and the "*Coal Mine Reclamation Program Vegetation Standards*" (MMD 1999). The technical standards approved by USEPA will be used by USEPA to determine the success of the vegetation in the time period beyond termination of the Pilot Project.

The selected reference area for the Tailing Facility is approximately 0.6 miles north of the facilities within the permit boundary (Figure 6-3). The site was selected as the best representative native reference area in consultation with MMD and USEPA during a field tour in September 2016.

The reference area is approximately 2.7 acres on a nearly level to slightly sloping alluvial fan remnant. Soils are deep and well drained, formed in mixed alluvium. The site lies within the Great Basin Desert Scrub vegetation type according to Dick-Peddie (1993). Dominant native shrubs include big sagebrush (*Artemisia tridentata*), rubber rabbitbrush (*Ericameria nauseosa*) and broom snakeweed (*Gutierrezia sarothrae*) with a mixed understory of cool- and warm-season grasses including western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), threeawns (*Aristida* spp.) and alkali sacaton (*Sporobolus airoides*).

The selected reference area is in good range condition though it appears to have been disturbed in the past 25 to 30 years. The nature of the disturbance is undetermined, but it was likely subjected to range improvements (e.g., chaining) or agricultural crop production based on air photo interpretation. The reference area was grazed by livestock in the past, but it is not currently grazed and is under CMI's control. Vegetation data from the reference area will be compared to data collected from the reclamation to evaluate the success of the Pilot Project and used to support the development of technical standards for vegetation success to be applied after termination of the Pilot Project.

6.3.2 Vegetation Monitoring Methods

Vegetation monitoring will be conducted annually to evaluate the progress of the reclaimed plant community. All monitoring will be conducted in the late summer-early fall (e.g., August and September), before the first hard frost. Monitoring will consist of both qualitative inspections and quantitative vegetation surveys.

Qualitative inspections will be performed in Years 0, 1, 2, and 4 to evaluate vegetation establishment and performance and forecast reclamation success. The inspections will appraise total canopy cover, plant community condition, plant species encountered, and evidence of excessive erosion or other issues related to cover integrity. In addition, the vegetation inspections will assess the need for implementing any husbandry practices or corrective actions should any issues be identified (see Section 5.0).

Formal quantitative vegetation surveys of the reclaimed and reference areas will be conducted in Years 3 and 5. A systematic random sampling scheme using a transect/quadrat system will be employed to select sample sites within the reclaimed and reference areas. A 10-meter (m) center square grid will be imposed over each vegetation monitoring unit to delineate vegetation sample plots and random coordinates will be used to select plots for vegetation sampling. Transects will originate from the southeastern corner of the selected vegetation plot. Each transect will be 20 m in a dog leg pattern (Figure 6-4). Four 0.5-m^2 quadrats will be located at predetermined intervals along the transect for quantitative vegetation measurements.

For each quadrat, ocular estimates of total canopy, species canopy cover, basal cover, surface litter, surface rock fragments and bare soil will be made. Not all plant species on the reclaimed area are expected to occur in the sampling quadrats. Thus, prior to formal sampling, each site will be traversed on foot to inventory plants growing within the plots and across the test plot and reference area. This process is intended to provide a comprehensive plant list for the reclaimed and reference areas to better assess species composition.

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil will be determined within each quadrat. Canopy cover estimates will include the foliage and foliage interspaces of all individual plants rooted in the quadrat. Canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy (Daubenmire 1968). The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil will not exceed 100 percent.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates will also be made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100 percent.

All canopy and basal cover estimates will be made in 0.1 percent increments. Sectional, painted frames and percent area cards will be used to increase the accuracy and consistency of the cover estimates. To further increase consistency the number of investigators will be limited, and comparison plots will be performed. Plant frequency will also be determined on a species-basis by counting the number of individual plants rooted in each quadrat. A photograph of each quadrat will be taken to preserve a record of the conditions.

From a statistical perspective, each quadrat is considered an independent sample. A total of 40 samples will be collected in the Dam 1 reclamation area, FI areas, and reference area. For the FI areas, sampling would be proportionally distributed based on the aerial extent of each unit. An additional 40 samples will be collected from the remainder of the reclaimed tailing areas.

Shrub density, or the number of woody plants per square meter, will be determined using the frequency count data from the quadrats (Bonham 1989). Shrub density will be calculated from the quadrat data by dividing the total number of individual plants counted by the number of quadrats measured. In addition, shrub density will be determined using the belt transect method. For the belt transect method, shrub density will be determined by counting the shrubs rooted in a 2-m wide, 20-m long belt transect situated along the perimeter of the dog-legged transect (Figure 6-4). The belt transect data is intended to complement the quadrat data. Shrubs will be counted on a species basis.

6.3.2.1 Data Analyses

Data analysis and statistical testing to evaluate vegetation performance will be conducted in accordance with MMD guidance (MMD 1999, MARP 1996). The transect data will be entered into spreadsheets to determine percent cover and relative cover on a species basis. Descriptive statistics will then be calculated for the reclaimed and reference areas and the normality of each data set will be assessed using the Shapiro-Wilk test at the 10% significance level (alpha = 0.10). In cases where the data were not normally distributed, a mathematical transformation (e.g., logarithmic function) will be applied to see if it normalizes the data.

The number of samples necessary to meet sample adequacy will be calculated for canopy cover and shrub density assuming the data are normally distributed using Snedecor and Cochran (1967).

$$N_{min} = \frac{t^2 s^2}{(\bar{x}D)^2}$$

Where N_{min} equals the minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\bar{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean. In addition, the 90% confidence interval of the sample mean and the level of confidence that the sample mean is within 10 percent of the true mean are reported. For canopy cover data that are not normally distributed, sample adequacy may be calculated using Hofmann and Ries (1990).

MMD (1999) recognizes the practical limitations of achieving statistical adequacy and has provided minimum sample sizes for various quantitative methods. With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The minimum of 40 samples is based on an estimate of the minimum number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) have also demonstrated that this number remains robust for most cover and density measures with increased numbers of samples only slightly improving precision. Vegetation monitoring may not achieve statistical adequacy at either the reclaimed or reference areas. However, sample adequacy and statistical confidence will be reported as part of any quantitative monitoring effort.

The success of the Pilot Project will be evaluated after five growing seasons. The end of the fifth growing season is defined as six years following completion of seeding of the cover. A comparative analysis of data collected from the reclaimed and reference areas will be used to demonstrate revegetation success and progress toward a self-sustaining ecosystem. Statistical hypothesis testing will be performed to compare total canopy cover in reclaimed areas and reference areas and the reference area-based performance standard ($\geq$ 40%) will be used to determine revegetation success. Both parametric and non-parametric test methods may be used depending on the data distributions.

The parametric t-test is used to evaluate reclamation success for normally distributed data. Prior to running the hypothesis test, population variances will be assessed using the Levene's test for homogeneity of variances. In cases where the populations have similar variances, the Student's t-test will be used. Populations with unequal variances will be evaluated using the Welch's t-test that includes the Satterthwaite correction to determine the appropriate degrees of freedom. For non-normal data, statistical comparison of medians will use the non-parametric Mann-Whitney test or similar rank sum test procedure.

All hypothesis tests will be performed with a 90% level of confidence. Hypothesis testing to demonstrate vegetation progress may use a reverse-null approach because it does not require statistical adequacy, which is often difficult or impractical to achieve in native and reclaimed plant communities (MMD 1999).

6.4 Cover Integrity

The SOW requires that “the cover does not show significant deterioration from erosion, slip-offs, or other impacts that cannot be repaired through normal operation and maintenance (O&M).” CMI is required at the end of the fifth growing season to provide documentation to USEPA that demonstrates that the cover achieves positive drainage and that any observed ponding has been or can be addressed through normal O&M.

CMI will conduct joint inspections with the agencies of the Dam 1 reclamation area and ancillary facilities for signs of ponding and erosion, and general vegetation performance. Quarterly inspections will be conducted for the duration of the Pilot Project starting after the Final Construction Inspection. Inspections will consist of a foot survey of the reclamation area with an emphasis on the covered tailing surface and stormwater conveyance structures. Inspections will primarily focus on steeper internal slopes, ditches, drainage channels, and low gradient areas that may accumulate water. Inspections will be conducted in accordance with nationally recognized standards of the U.S. Natural Resources Conservation Service or equivalent best management practice.

The inspections will focus on features that could potentially affect cover integrity:

- Erosion features will be assessed as to their origin, relative size, and the potential to expose tailing. Those features that have the imminent potential to effect cover integrity and expose tailing and that require O&M will be rated as significant. In most instances a corrective action plan will be developed prior to repairing significant erosion features. Erosion features that are small or less active will be recorded. These features will be monitored to track their evolution if they are expected to stabilize and heal as plant cover increases.

- Evidence of localized subsidence and ponding (standing water, sediment deposition and desiccation cracks, pronounced and deep cracks in the cover, dead and/or stressed plants affected by intermittent flooding) will be documented. An area where subsidence has resulted in ponding will be assessed as to its size and frequency and duration of ponding if possible.

- Distinct areas within the reclamation area where plant establishment is inadequate will be evaluated. Poor plant establishment is defined as having less than an average of 1 seeded species per square foot. Each area will be described as to possible reasons for poor establishment, evidence of volunteer species being recruited from adjacent undisturbed areas, surface soil conditions, herbivory, wildlife use, etc. Recommendations for reseeding a particular site will depend on the cause of the vegetation failure, its apparent trajectory, and aerial extent.

All features will be assigned a unique identifier and their location recorded with a hand-held GPS unit. A monitoring station will be established to track the impacts and changes over time and a photograph point will be marked with a wooden stake. Photographs will be taken at each monitoring station to document and track conditions of the individual features over time. The perimeter of areas experiencing ponding or failure to establish vegetation will be delineated with the GPS unit. Ponded areas will be tracked for at least one year to determine whether the area continues to subside or has stabilized. Areas with insufficient plant establishment where reseeding or inter-seeding is recommended will be seeded prior to the third growing season.

6.5 Data Quality Assessment and Reporting

Data quality will be assessed to confirm there is adequate information about surface soils, groundwater monitoring, vegetation, and cover integrity. Criteria to be used include compliance with the metrics defined by the Pilot Project success criteria. Analytical methods used for previous data collection, testing, and modeling will be compared to methods used for new data collection, where appropriate, to confirm data reliability.

The data quality assessment will include semi-quantitative and quantitative data and statistical evaluation of the data where appropriate. The overall success of the Pilot Project will be analyzed and compared against criteria as outlined in the DQOs (Section 6.6).

The statistical summary of the data and comparison with industry standard guidance will provide an assessment of the Pilot Project. The effectiveness of the methods and techniques used in the Pilot Project will provide a basis for advancement of the work to remedial design/remedial action scale for the additional impoundments at the Tailing Facility.

The results and conclusions concerning the Pilot Project will be reported in the Pilot Project Completion Report. The report will summarize the methods, analytical results, and evaluation and interpretation of the data. The report will provide a description of the methods and techniques used for grading, cover placement, and revegetation. In addition, the report will provide a summary of all monitoring results; evaluation of long term cover stability; evaluation of erosion; evaluation of cover performance; operations and maintenance requirements; evaluation of vegetation design performance; and summary of lessons learned.

6.6 Data Quality Objectives

DQOs for the Pilot Project have been developed in accordance with USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* document (USEPA 2006). The DQO process consists of a series of steps that are intended to clarify environmental investigation goals, define data needs, specify decision rule (DR) criteria and tolerable decision errors, and establish sampling approaches that support the decision-making process. It is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a contaminant). The DQO Process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. For the purposes of the data collection described in the Pilot Project Performance Monitoring Plan, the intended use of the data is for the purposes of decision making and estimation. The DQO process is summarized below and in tabular form in Appendix D.

6.6.1 Problem Statement

Step 1 of the DQO process is used to describe the problem to be studied, identify team members and key decision makers, provide a conceptual model of the area to be investigated, and identify available resources, constraints, and deadlines associated with planning, data collection, and data assessment. The information documented in Step 1 helps ensure that the focus of the study and data collection activities will be precise and clearly understood.

The Pilot Project generally follows the ROD cover and revegetation requirements (Section 2.1), with the exception of cover thickness and the minimum gradient of the reclaimed surface. The study is intended to evaluate the ability of a 2-foot thick cover to achieve the Pilot Project success criteria related to surface soils, groundwater, vegetation, and cover integrity as defined in the SOW. This study will be performed under the direction of Golder on behalf of CMI, with support from Redente Ecological Consultants LLC. Barring unforeseen conditions, CMI believes that the resources required to complete the Pilot Project monitoring will be available.

The monitoring will be conducted on the Dam 1 tailing impoundment after completion of the grading, cover placement and revegetation.

6.6.2 Identify the Goals of the Study

Step 2 in the DQO process is to identify the principal study questions, consider alternative outcomes or actions that can occur upon answering those questions, and state what needs to be estimated and the key assumptions of the investigation. The primary study questions associated with the Tailing Facility Cover Demonstration Pilot Project monitoring are:

1) Surface Soils
   - Will application of 2-foot thick cover composed of local alluvium maintain average molybdenum concentration at or below the Tailing Facility soil remediation goal of 41 mg/kg molybdenum after 5 growing seasons?
2) Groundwater Protection
   - Based on evaluation with a calibrated water balance model, is there a 90% probability that the application of a 2-foot thick cover composed of local alluvium and revegetation will result in long-term net percolation of less than or equal to 5% of mean annual precipitation at the Cerro weather station?

3) Vegetation

- Assuming no climatic problems affect vegetation establishment, can the reclaimed 2-foot cover composed of local alluvium:
    - Achieve canopy cover equal to or greater than 40% of the reference area canopy cover after five growing seasons?
    - Support a minimum of 3 grass, 2 forb, and 2 shrub species after five growing seasons?

4) Cover Integrity

- With normal O&M, is deterioration of the cover system from wind and/or water erosion insignificant?
- Can positive drainage and grades be maintained with normal O&M?

The decision and estimation components and key assumptions for the 4 main areas of investigations are detailed below:

Surface Soils: The principal decision component for the surface soils are molybdenum concentration data collected to characterize the cover five growing seasons after placement.

Groundwater: The principal estimate components for groundwater protection are data collected to measure soil water and the prediction of net percolation from a calibrated evaporative flux model using the long-term Cerro climate record.

Vegetation: The principal decision components for vegetation are data collected on plant canopy cover and presence of grass, forb, and shrub species.

Cover Integrity: The principal estimate components for cover integrity are observations of settling and/or ponding and erosion.

6.6.3 Identify Information Inputs

Step 3 in the DQO process is to identify the types and sources of information that need to be obtained to resolve decisions or produce estimates, establish appropriate analysis approaches and performance or acceptance criteria; and establish appropriate sampling and analysis methodology to properly measure environmental characteristics for addressing the problem.

Two major programs at the Tailing Facility assessed cover performance including the Storage Cover Lysimeter Study (Golder 2015a) and the Alternative Cover Depth Project (Golder 2015b). The methods and techniques used in these previous studies to measure matric potentials and water content were used to develop the soil-water monitoring protocols and modeling procedures to answer questions related to groundwater.

Sampling and analysis of the cover materials and tailing will be conducted in accordance with approved methods as outlined in the Overall Site Plan (ARCADIS 2017b) and QAPP (ARCADIS 2017c). The ICS method described in the Tailing Facility Vegetation and Wildlife Studies Report (Intrinsik 2018) will be used to sample surface soil for molybdenum.

Vegetation data will be collected using methods that are applied at other mines in New Mexico to assess vegetation conditions.

6.6.4 Define the Boundaries of the Study

Step 4 in the DQO process is to specify the target population of interest and relevant spatial boundaries to which decisions will apply and determine when and where the data should be collected. This step also defines what constitutes a sampling unit, the temporal boundaries, or other constraints on sample units, as well as the smallest sampling unit on which decisions will be made.

The primary target population is the soil cover and underlying tailing in reclaimed areas on the Dam 1 top surface. The FI areas are subsets of the target population that will be monitored and compared to the facility as a whole. The native reference area is also a target population that will be used to assess vegetation performance after the fifth growing season. The Pilot Project will be conducted on the nearly-level top surface of Dam 1, which is approximately 270 acres. The Pilot Project will extend for 5 growing seasons or 6 years following completion of construction.

The sampling units for this study vary depending on the question(s) to be answered. The sampling unit for evaluating compliance with the Mo concentrations is the surface 3-inch thick layer of the cover. Data will be collected from 3 decision units and the FI areas. The sampling units for groundwater and net percolation will be the vadose zone monitoring nests in the FI areas, which are located in the DU's. The sampling units for evaluating vegetation performance will be the native reference area, FI areas, and the entire reclaimed area on Dam 1. For cover integrity, the sampling unit is the entire reclaimed top surface of Dam 1, including the water control structures.

6.6.5 Develop the Analytic Approach

Step 5 in the DQO process is to specify appropriate population parameters for making decisions and/or estimates. This step also defines action levels and/or estimation procedures. The key study parameters for the Pilot Project are Mo concentration, total canopy cover and species presence, the estimate of net percolation based on a calibrated water balance model, and evidence or the lack thereof for erosion or subsidence.

Surface Soils: The key study parameter for the surface soils is average total Mo concentration in the decision units. The PRG of 41 mg/kg total molybdenum in the surface soil is the action level. At a minimum, this parameter will be described by mean, standard deviation, 90% CI, and compared against the action level.

Groundwater: The key study parameter for the groundwater performance are the estimates of annual net percolation from a calibrated evaporative flux model using the long-term Cerro climate record. At a minimum, this parameter will be described by mean, standard deviation, and graphical methods.

Vegetation Success: The key study parameters for the vegetation performance are total canopy cover and the presence of various life-forms. Data will include plant frequency and total canopy cover. At a minimum, these parameters will be described by mean, standard deviation, 90% CI, and graphical methods as appropriate.

Cover Integrity: The key study parameters for cover integrity are evidence of erosion and subsidence. These parameters will be judged whether they are deteriorating the cover and affecting its function and the level of maintenance that may be required.

6.6.6 Specify Performance or Acceptance Criteria

Step 6 of the DQO process involves identifying the performance criteria for decision making elements and the acceptable limits on estimation uncertainty for estimation problems. The primary acceptance criteria associated with the four main areas of investigation being evaluated as part of the Pilot Project include the following:

Surface Soils:

Acceptance criteria for surface soil elements is an average molybdenum concentration at or below the Tailing Facility soil remediation goal of 41 mg/kg molybdenum after 5 growing seasons.

Groundwater:

The groundwater assessment defined in the SOW requires the use models to simulate complex soil-water and atmospheric dynamics. The measurement of site-specific climate and soil water date will reduce the uncertainty inherent in this type of modeling. Sensitivity analyses of key input parameters will allow further characterization of the uncertainty of the estimates for net percolation. Predicted annual net percolation is less than 5% of mean annual precipitation using the long-term Cerro weather record.

Vegetation:

The acceptance criteria for Pilot Project vegetation success is average total canopy cover of the reclamation ≥ 40% of the reference area canopy cover and the presence of a minimum of 3 grass, 2 forb, and 2 shrub species.

Long-term success vegetation criteria will ultimately be determined based on, yet undefined, vegetation cover, shrub density and diversity parameters. The long-term success criteria will be developed as part of the scope of Pilot Project but will apply to the vegetation after termination of the Pilot Project.

Cover Integrity:

The question of cover integrity in the Pilot Project is inherently qualitative in nature and statistical analysis is impossible as there are no replicated treatments, which further restricts rigorous statistical analysis. The issue of statistical rigor notwithstanding, acceptance criteria are proposed for the more qualitative aspects of this project. The success criteria include 1) Insignificant deterioration of the cover system from wind and/or water erosion with normal O&M and 2) Positive drainage and grades are maintained with normal O&M. Acceptance criteria will be evaluated qualitatively based on the frequency of and severity of erosion and frequency and magnitude of effort required for any corrective actions.

6.6.7 Develop the Detailed Plan for Obtaining Data

Step 7 of the DQO process involves defining the plan for obtaining the data needed to determine the success of the Pilot Project. The sampling program is presented in Section 6.1 (Surface Soils), 6.2 (Groundwater), 6.3 (Vegetation), and 6.4 (Cover Integrity).

7. Operation and Maintenance Plan and Manual

Pre-final and Final Designs are required to include an O&M Plan and O&M Manual prepared prior to implementation of the Pilot Project. This O&M Plan was completed in accordance with information provided in the *Operation and Maintenance in the Superfund Program* guidance document (USEPA 2001). This document is intended to provide an O&M Plan and Manual for the Dam 1 tailing impoundment. The O&M Plan and Manual apply to Dam 1 following the completion of the grading, cover placement, and seeding, rather than during the construction phase of the project.

7.1 Operation Plan for the Tailing Facility

General operations of the tailing impoundments are described in the O&M Manual for Questa Tailing Facilities (Appendix E). The O&M Manual was developed in accordance with Office of the State Engineer (OSE) requirements set forth in NMAC 19.25.12.17. The manual outlines the roles and responsibilities of CMI managers and technical personnel for day-to-day operations of the facility including site safety and security, tailing deposition, water management, and safe operation of the tailing facility. Components of the O&M Manual include routine maintenance activities (e.g., pipeline repair, vegetation removal from embankment surfaces and diversion channels, road grading, dust control, etc.) and surveillance monitoring activities (e.g., piezometers, displacement, seepage collection, surface discharge, etc.). The manual also includes contingencies for inspections and non-routine maintenance following an extreme event such as a period of high precipitation or a seismic event. While some of these operational procedures only apply to an operating tailing facility, much of the day-to-day activities will continue once Dam 1 is reclaimed.

7.2 Post-Closure Operation Plan for Dam 1

Operation of reclaimed surface facilities generally involves limiting access to authorized users, monitoring, and maintenance. The post-mining land use for the Questa Tailing Facilities is wildlife habitat. Consequently, the cover area will be managed with the intent to still allow wildlife access while the vegetation is establishing. Such wildlife access is not expected to be detrimental to the reclaimed land while it is maturing. Operation of the facility, however, will involve restricting unauthorized public access and livestock use of the area. To control access, the site will be monitored for signs of livestock use, and No Trespassing signs will be posted in strategic locations. The site will be checked periodically for unauthorized access.

7.3 Cover Integrity Monitoring

The cover integrity will be preserved by ensuring it does not show significant deterioration from erosion, slip-offs, or other impacts that cannot be repaired through normal O&M. CMI shall, no later than the end of the fifth growing season, provide documentation to USEPA that demonstrates that the cover achieves positive drainage (i.e., that required grades have been maintained and that any observed ponding has been or can be addressed through normal O&M).

In accordance with the Pilot Project monitoring plan, CMI will visibly inspect the reclaimed tailing pond and ancillary facilities for signs of ponding, excessive erosion, and/or seeding failure. For the first year after seeding, inspections will be conducted monthly and in response to storm events of 1-inch or greater in a 24-hour period. Quarterly inspections will be conducted for the duration of the Pilot Project. Inspections will consist of a foot survey of the reclamation with an emphasis on the covered tailing surface and stormwater conveyance structures. Inspections will primarily focus on steeper or long internal slopes, ditches, drainage channels, and low gradient areas that may accumulate water. Inspections will be conducted in accordance with nationally recognized standards of the U.S. Natural Resources Conservation Service or equivalent best management practices.

The inspections will focus on features that could potentially affect cover integrity:

- Erosion features will be assessed as to their origin, relative size and watershed, and the potential to expose tailings. Erosional features will be rated as significant if they have the potential to reduce cover performance, expose tailing, and require O&M to stabilize them. In most instances a corrective action plan may be developed to repair significant erosion features. Erosion features that are smaller or less active will also be recorded, but if they are expected to stabilize and heal as plant cover increases, they will only be monitored to track their evolution. Both significant and small erosion features will be documented and the corrective action or monitoring results recorded.

- Evidence of subsidence and ponding (standing water, sediment deposition and desiccation cracks, pronounced and deep cracks in the cover, dead and/or stressed plants affected by intermittent flooding) will be documented. An area where subsidence has resulted in ponding will be assessed with respect to size, and frequency and duration of ponding, if possible.

Armored drainage structures will also be inspected quarterly for performance and necessary maintenance. The inspections and repair activities will be documented in quarterly inspection reports.

Vegetation growth will be monitored annually. Distinct areas within the reclamation where plant establishment is not attained will be evaluated. Poor plant establishment is defined as a contiguous area of at least 1 acre in size having less than an average of 1 plant per square foot within the first few years. Information will be collected for such areas that includes possible reasons for poor vegetation establishment, evidence of volunteer species being recruited from adjacent undisturbed areas, surface soil conditions, herbivory, wildlife use, etc. Recommendations for reseeding a particular site will depend on the cause of the poor vegetation performance or failure, its apparent trajectory, and aerial extent. Monitoring will include identification of state-listed noxious weeds.

7.4 Maintenance Plan

Maintenance of reclaimed facilities generally involves addressing issues related to vegetation, erosion, drainage, and functioning of water control structures. The SOW requires that 1) the cover does not show significant deterioration from erosion, slip-offs, or other impacts that cannot be repaired through normal O&M, and 2) the cover achieves positive drainage and that any observed ponding has been or can be addressed through normal O&M.

Vegetation: Once vegetation is established the primary maintenance requirement is avoiding disturbances associated with vehicle traffic and over use by grazing animals. Areas identified as having inadequate vegetation or an unfavorable balance in species composition will be interseeded or reseeded as needed to support the postmining land use.

Maintenance may also include the control of noxious weeds, if they become established. The methods of control depend on the particular species and their life history. Treatment and control may include herbicides, grubbing, burial, burning, or other methods. Once the plants and residual weed seed sources are removed, the site typically requires reseeding.

Erosion: Erosion is a natural process and is expected to proceed over time, with the highest rates in the early phases of the vegetation establishment. Maintenance of erosion features must consider the causative factors and the trajectory of the feature towards continued degradation. Corrections of erosion features may include, but are not limited to, grade adjustments, construction of berms or diversions to divert water away from the erosion feature, installation of grade control and check structures, or shaping the erosion feature into a channel and armoring.

Areas with excessive sheet erosion may require supplemental seeding, water bars that drain to a central armored channel, contour furrowing and reseeding, surface stabilization with rock armor, or the use of other recognized best technologies currently available.

Ponding: Ponding features will require assessment on the reason for its formation, which could be because of subsidence, or uneven initial grading or placement of cover. Most ponded areas can be mitigated by the addition of cover to reestablish grade and reseeding. Depending on the reason for the ponding, treatments may include creating a channel from the ponded area so it drains. Small depressions (< 0.1 acre) with ephemeral ponding will be evaluated for a period of years (e.g., 2 to 4) to confirm that the consolidation process has progressed to completion prior to mitigation with additional cover.

Water Control Structures: Drainage channels may require maintenance when their ability to safely pass a design storm event is compromised, or the cover integrity could be or is being adversely impacted. Typical problems include excessive displacement of rock armoring resulting in an unstable channel, headcuts, debris and sedimentation affecting flow through the channel, or flooding that exceeds the channel design storm resulting in bank erosion. Corrections include assessment of the root cause of channel rock movement or loss, engineering assessments, installation of additional rock material, installation of check dams or check structures, or constructing secondary channels or diversions to reduce flow to channels with chronic damage. Inspections will be conducted quarterly. Inspections and repair work will be documented as specified in Section 6.4.

7.5 O&M Reporting

Documentation and reporting of maintenance activities is essential to evaluating the performance of the Pilot Project with respect to the cover integrity success criteria. CMI will provide inspection reports and maintenance logs associated with the reclaimed tailing facility to the USEPA. This information will be included in quarterly monitoring reports submitted to the USEPA and state agencies as required under Section 9.1.6 of the SOW. Ultimately, the maintenance records will be evaluated and summarized in the Final Pilot Project Completion Report.

8. Project Schedule

The SOW conceptualized the Pilot Project implementation in separate construction and monitoring phases, which follow approval of the Pre-final and Final designs. The anticipated schedules for the Tailing Facility Cover Demonstration Pilot Project are listed in Tables 8-1 (Construction) and 8-2 (Monitoring). The schedule in Table 8-1 was developed in accordance with Sections 9.1.1, 9.1.3, and 9.1.5 of the SOW. In addition, CMI has estimated the duration of construction that will be required to safely and successfully complete the construction. The construction duration aspects of the schedule are considered approximate pending consultation with the selected earthworks contractor.

8.1 Project Planning and Design Schedule

The first stage of planning and design for the Pilot Project was the development of the Pre-Final Design. In accordance with Section 9.1.1 Pre-Final Design for the Pilot Project was submitted within 60 days after approval "Tailing Facility Dam 1 Grading Final Design Report," submitted under Section 6.12.5 of the Early Design AOC. In accordance with this requirement, this Pre-final Design was submitted to the USEPA on July 25, 2018.

The USEPA, MMD, and New Mexico Environment Department (NMED) provided written review comments on the Pre-Final Design Report on September 4, 2018 and held a review meeting with Chevron on October 25, 2018. The Final Remedial Design for the Pilot Project that addresses all comments on the Pre-Final Remedial Design will be submitted to the USEPA within 30 days after receipt of the comments (November 16, 2018). Assuming a 30 day review period, CMI anticipates USEPA Written Approval of the Pilot Project Final Design within 30 days or by December 16, 2018.

Upon receipt of USEPA Written Approval of the Pilot Project Final Design, CMI will schedule a Pre-construction meeting for March 13, 2019. This schedule accounts for holiday delays and contractor procurement constraints in addition to the 15 days specified in the SOW. CMI will issue a Notice of the Start of Field Activities at the Pre-construction meeting on March 13, 2019 in accordance with Section 9.15 of the SOW and accounting for the year-end holiday period. CMI intends to start construction on the Pilot Project on April 1, 2019. CMI has entered into discussions with qualified earthworks contractors but has not finalized the selection of a contractor(s). Communications with contractors are predicated on the permitting schedule described above and assume mobilization to the site in early March 2019.

8.2 Pilot Project Construction Schedule

The proposed schedule for completion of the construction, seeding, instrument installation, and final surveying of the Pilot Project is based on an assumed start date for construction of April 1, 2019. The assumed start date is contingent upon timely review by the USEPA and finalization of the Final Design, availability of the required equipment fleet on this date, and favorable ground conditions at the site. CMI has developed an estimate of the construction schedule based on site-specific experience, anticipated strategies to considering the potential for dust hazards, and standard equipment production rates. The schedule will be finalized once a construction firm is under contract.

The initial phases of construction will involve mobilization and site preparation. A number of operations are required for site-preparation including establishment of staging areas, survey controls, utility clearances, stormwater BMP's, development of traffic plans, signage, any necessary grubbing, and haul road siting and construction. The next major phase of construction involves grading of the tailing surface to achieve the design grades and cover placement. The grading and cover construction process is expected to be sequenced to minimize the amount of area of tailing that is exposed and susceptible to wind erosion, prior to cover placement. Confirmatory surveys of the subgrade will be conducted prior to hauling and application of cover. Deviations from the design grade will require corrective grading prior to cover placement. This sequenced and quality focused approach to construction is expected to require more time than would be required for bulk grading and hauling of the cover materials. The size of the construction units or areas that are graded and covered will determine the level of equipment congestion that can be tolerated and still maintain a safe working zone. Similar congestion constraints may exist in the borrow area and haul routes depending on the borrow area mining plan, type of equipment, and final traffic plan. The grading and cover placement will need to be sequenced and integrated with the channel and lined-pond construction, which is expected to further complicate the scheduling and rates of construction.

The current designs require redistribution of approximately 700,000 to 800,000 CY (neat yards) of tailing and interim cover on the tailing facility to achieve the design grade including the channel excavations. Approximately 1,200,000 CY of alluvium are required for cover, channel fill, and berm construction. The volumes of materials to be moved warrant the use of heavy construction, but not mining scale equipment. CMI anticipates the contractor fleet will be balanced to provide adequate production rates but avoid redundancy and the potential for idle time to maintain efficiency. Thus, the equipment are assumed to be involved interchangeably in both the grading and cover placement aspects of the projects in a sequenced manner. The current schedule assumes the contractor will utilize a single 10-hour shift per day and a 5-day work week. No provisions for extraordinary or prolonged inclement weather or unfavorable ground conditions were included in grading and hauling estimates. However, extending the work week from 5 days to 6 days will allow the construction to proceed on schedule if unforeseen delays are encountered.

Table 8-1. Final Design Permitting and Construction Schedule

SOW Section	Deliverable	Due Date
9.1.1	Pre-Final Design for the Pilot Project for USEPA Review	July 25, 2018
	EPA Comments on Pre-Final Design for the Pilot Project	September 6, 2018
9.1.2	Final Design for the Pilot Project for USEPA Review	November 16, 2018
	EPA Written Notification of Approval of Pilot Project Final Design	December 16, 2018
9.1.3	Updated Overall Site Plan	February 6, 2019
9.1.5	Pre-construction Meeting	March 13, 2019
	Notice of Start of Field Activities	March 13, 2019 [(a)]
	Start of Construction	April 1, 2019
	Initial Earthwork Construction Inspection (Approximate)	May 10, 2020
	Final Earthworks Construction Inspection (Approximate)	June 2, 2020
	Seeding Completed	June 30, 2020
	Instrument Installation	July 30, 2020
	Pre-Final Construction Inspection	August 30, 2020[(a)]
	Pre-Final Construction Inspection Report for USEPA Review	September 30, 2020
	Corrective Measures to Address Deficiencies	October 30, 2020
	Final Construction Inspection	October 30, 2020
	Notification of Construction Completion to USEPA	November 13, 2020
	Draft Final Pilot Project Construction Completion Report	December 2, 2020
	EPA Comments on Draft Final Construction Completion Report	December 31, 2020
	Final Pilot Project Construction Completion Report	February 1, 2021

Notes: [(a)] - The assumed start date of field activities is contingent upon the required equipment fleet being available and favorable ground conditions at the site at the start of construction. The projected completion date for the Pilot Project construction is based on favorable ground conditions present throughout the construction period.

The channels will be completed incrementally after cover placement and in coordination with the completion of the sediment ponds. Because the channel construction process typically results in disruption of the cover grading in the areas peripheral to the channels, final grading will be performed as the channels are completed. CMI anticipates agency inspection of the earthworks in early- to mid-May 2020 prior to seeding. Any deficiencies noted by the agency during this earthworks inspection would documented in an inspection report and rectified prior to seeding.

The revegetation operations will be conducted as the next major phase of construction. The seeding is specified for completion prior to June 30 to take of advantage of the summer rains, which typically begin in early July. CMI requests agency inspection of the reclamation following the completion of seeding operations near the end of June 2020. This inspection will allow verification of the actions taken following the earthworks review and evaluation of the seeding and mulching operations. Any deficiencies identified during the post-seeding inspection will be rectified prior to the formal Pre-Final Construction Inspection.

The last construction activity for the Pilot Project is the installation of monitoring equipment including final surveying. The soil water monitoring instruments will be installed after the seeding operation, with completion scheduled for end of July 2020. Completion and in-fill surveys of the facility and detailing of the reclamation will be completed in August 2020.

The target date for completion of the grading, cover placement, water control feature construction, instrument installation, and confirmation surveys for the Pilot Project is August 30, 2020, which would mark the date of the formal Pre-final Inspection with the agencies. Within 30 days of the Pre-final inspection, CMI will submit the Pre-final Inspection report to USEPA. Corrective actions to address any deficiencies identified during the Pre-final inspection will be implemented within 30 days of submission of the Pre-final inspection report (October 30, 2020). The Final Construction Inspection would correspond with completion of the corrective actions on October 30, 2020. Assuming no additional work is required, CMI will submit the Notification of Completion of construction to USEPA by November 13, 2020. The projected completion date for the construction is based on favorable ground conditions present throughout the construction period and confirmation from the selected contractor.

8.3 Monitoring and Reporting Schedule

The projected schedule for the monitoring phase of the project is shown in Table 8-2. The baseline soil sampling is expected to be completed in early November 2020 with qualitative vegetation inspections conducted in the September 2021. In accordance with Section 9.1.6 of the SOW, annual monitoring reports are required one year after the Final Construction Inspection. The first Annual Monitoring report is anticipated to be submitted to the USEPA on October 30, 2021. Subsequent annual reports will be each year thereafter in October.

The Final Pilot Project Completion report is due six years after the Final Construction Inspection. CMI will prepare and submit to the USEPA a Pilot Project Completion Report 6 years after the Final Construction Inspection. The Final Pilot Project Completion Report will provide a description of the methods and techniques used for grading, cover placement, and revegetation. In addition, the report will provide a summary of all monitoring results; evaluation of long term cover stability; evaluation of erosion; evaluation of cover performance; operations and maintenance requirements; evaluation of vegetation design performance; and summary of lessons learned. The draft Final Pilot Project Completion Report will be submitted to the USEPA on or before October 30, 2026. The schedule assumes a 30 day review and comment period by the USEPA (November 30, 2026). CMI will submit a revised Final Pilot Project Completion Report that address all comments received by the USEPA for approval within 30 days after receipt of the comments by December 30, 2026.

Table 8-2. Final Pilot Project Monitoring Schedule

SOW Section	Monitoring Event[1] or Deliverable	Due Date
9.1.5	Final Construction Inspection	October 30, 2020
	Baseline Surface Soil Sampling	November 3, 2020
	Qualitative Vegetation Inspection	September 15, 2021
	Draft Annual Monitoring Report (Year 1) for Review	October 30, 2021
	EPA Comments on Annual Monitoring Report (Year 1)	November 30, 2021
	Final Annual Monitoring Report (Year 1) to USEPA	December 30, 2021
	Qualitative Vegetation Inspection	September 15, 2022
	Draft Annual Monitoring Report (Year 2) for Review	October 30, 2022
	EPA Comments on Annual Monitoring Report (Year 2)	November 30, 2022
	Final Annual Monitoring Report (Year 2) to USEPA	December 30, 2022
	Qualitative Vegetation Inspection	September 15, 2023
	Draft Annual Monitoring Report (Year 3) for Review	October 30, 2023
	EPA Comments on Annual Monitoring Report (Year 3)	November 30, 2023
9.1.6	Final Annual Monitoring Report (Year 3) to USEPA	December 30, 2023
	Quantitative Vegetation Monitoring	September 15, 2024
	Draft Annual Monitoring Report (Year 4) for Review	October 30, 2024
	EPA Comments on Annual Monitoring Report (Year 4)	November 30, 2024
	Final Annual Monitoring Report (Year 4) to USEPA	December 30, 2024
	Qualitative Vegetation Inspection	September 15, 2025
	Draft Annual Monitoring Report (Year 5) for Review	October 30, 2025
	EPA Comments on Annual Monitoring Report (Year 5)	November 30, 2025
	Final Annual Monitoring Report (Year 5) to USEPA	December 30, 2025
	Surface Soil Sampling	June 30, 2026
	Quantitative Vegetation Monitoring	September 15, 2026
	Draft Final Pilot Project Completion Report to USEPA	October 30, 2026
	EPA Comments on Pilot Project Completion Report	November 30, 20260
	Final Pilot Project Completion Report to USEPA	December 30, 2026

Notes: 1 – Monitoring includes continuous vadose zone data acquisition as part of the groundwater monitoring requirement and quarterly erosion/subsidence inspections with USEPA and state agencies for the cover integrity monitoring requirement (dates to be determined)

9. Contractors and Subcontractors

The Tailing Facility Cover Demonstration Pilot Project will be performed under the direction of CMI. Golder will be the Contractor in Charge and will supervise the study. Key members of the project team are listed below.

The Contractor who will supervise the Engineering and Design for CMI is Golder Associates, Inc. Contact information is as follows:

Golder Associates, Inc.
Contact: Dave Kidd, PE
Phone: 602.888.8818
Email: DKidd@Golder.com

The Contractor that will perform the earthworks for CMI is undetermined. This will be updated once the contractor is selected. The Contractor that will supervise the Pilot Project monitoring for CMI is Golder Associates Inc. Contact information is as follows:

Golder Associates Inc.
Contact: Lewis Munk, Ph.D.
Phone: 505.821.3043
Email: lmunk@golder.com

The Laboratory Contractor that will be performing soil analyses is Energy Labs. Contact information is as follows:

Energy Labs
Contact: Shari Endy
Phone: 406.869.6253
Email: sendy@energylab.com

The Laboratory Contractor that will be performing the geotechnical and hydraulic analysis on the tailing and cover materials is Golder Associates, Inc. Contact information is as follows:

Golder Associates, Inc.
Contact: Matt Barrett
Phone: 303-980-0540
Email: Matt_Barrett@golder.com

10. Health and Safety

All activities that take place on CMI property, including the tailing grading, loading and hauling of cover and channel construction will be completed under the Occupational Safety and Health Administration (OSHA) authorities, and under OSHA authority for highway transport. The project will be executed under the Site HASP for the RD/RA (ARCADIS 2017a). In addition, a project-specific HASP will be prepared for the Pilot Project. CMI contractors and consultants will follow these HASPs as appropriate. Work tasks, potential hazards and mitigation measures, personal protective equipment, hazard communications, and other health and safety information will be provided in the project-specific HASP. A Site Safety Officer will oversee grading, loading and placement of cover, and revegetation activities at the tailing facility.

11. Greener Cleanup Provisions

The USEPA Principles for Greener Cleanups serve as the foundation for the Agency's Greener Cleanup Policy (USEPA 2009). Among other things, these principles establish a policy goal to evaluate cleanup actions comprehensively for the purpose of ensuring protection of human health and the environment and reducing the environmental footprint of cleanup activities, to the maximum extent possible.

To evaluate the approaches listed above, USEPA describes five elements to consider:

- Minimize total energy use and maximize use of renewable energy
- Minimize air pollutants and greenhouse gas emissions
- Minimize water use and impacts to water resources
- Reduce, Reuse, and Recycle Materials and Waste
- Protect Land and Ecosystems

The regrading design conformance to these approaches and criteria for greener cleanups is discussed below.

Minimize total energy use and maximize use of renewable energy

The regrading design achieves a balanced cut and fill which reduces the volume of material to move. The design redistributes the existing interim cover, reducing the need to import additional material. Optimizing the cover thickness from 3-foot to 2-foot thick minimizes the volume of material that needs to be placed. In addition, the use of an evapotranspiration cover requires fewer trips and less compactive effort than that required for a compacted low permeability soil cover. CMI will work to optimize haul routes and equipment fleet to maximize efficiency. By minimizing the volume of material to hauled and placed and, the equipment (haul trucks, loader, etc.) is minimized, thus minimizing the fuel consumed and the amount of energy used.

Minimize air pollutants and greenhouse gas emissions

The cover design components discussed in the previous paragraph, optimize the volume of material to haul and place, which will reduce the amount of fuel burned and the quantity of greenhouse gasses and air pollutants produced. Minimizing the handling of cover material will minimize the particulate matter produced during cover placement.

Minimize water use and impacts to water resources

Minimizing the volume of cover material required to haul and place will reduce the volume of water required for dust control over the life of the project.

Protect Land and Ecosystems

Borrow area designs and transportation routes will consider limiting amount of direct disturbance and soil compaction to native areas. Revegetation of disturbed areas will use a mix of grasses, forbs, and shrubs that are native to the surrounding ecosystem to preserve or improve biodiversity and related ecosystem services.

12. References

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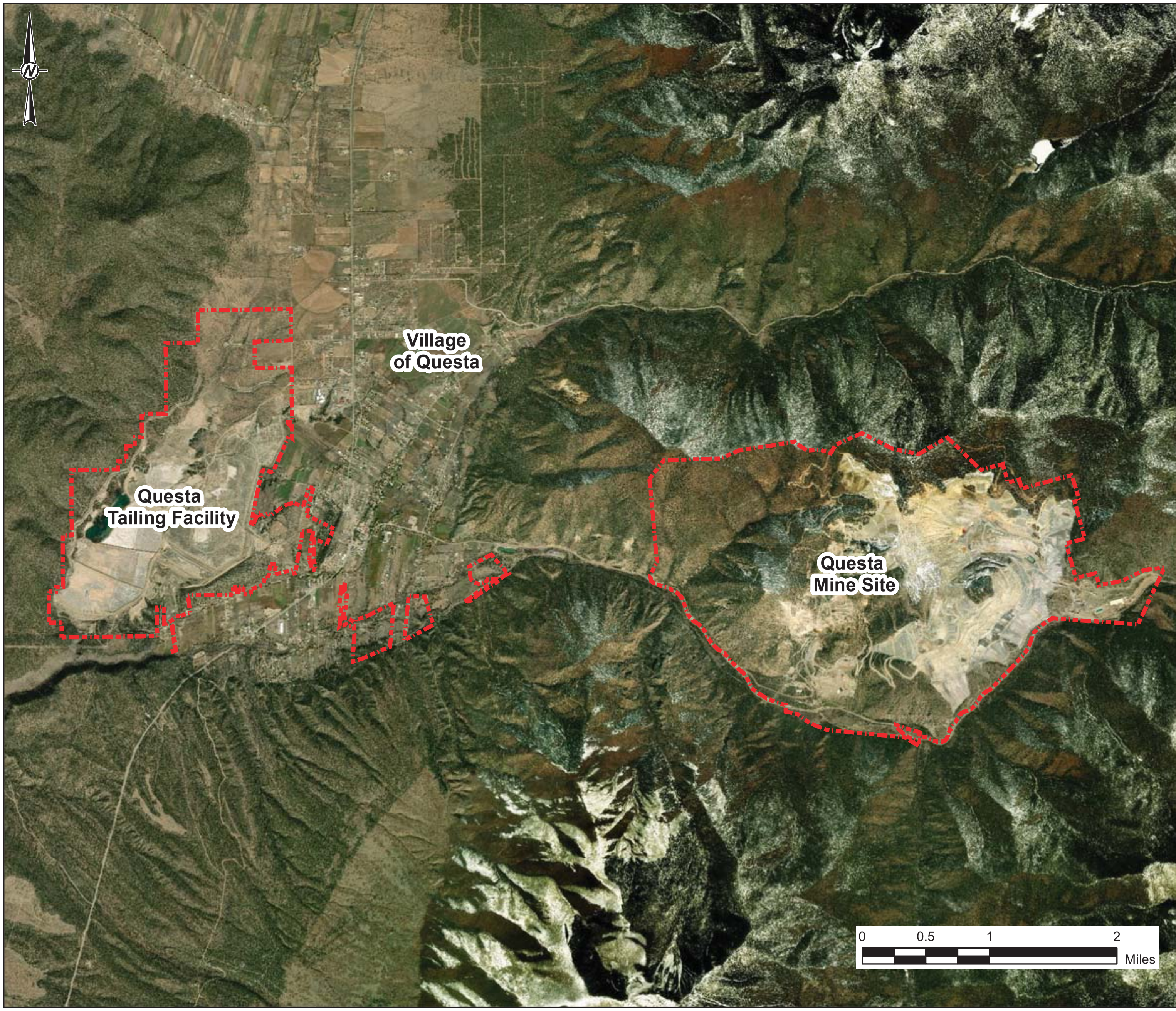
Figures



LEGEND

Permit Boundary

REFERENCE

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SOURCE: DIGITALGLOBE
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CLIENT
CHEVRON MINING, INC.
QUESTA, NEW MEXICO

PROJECT
FINAL DESIGN FOR DAM 1 TAILING FACILITY COVER DEMONSTRATION PILOT PROJECT

TITLE
SITE LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-15
PREPARED	DW
DESIGN	DW
REVIEW	DR
APPROVED	LM

PROJECT No.	CONTROL	Rev.	FIGURE
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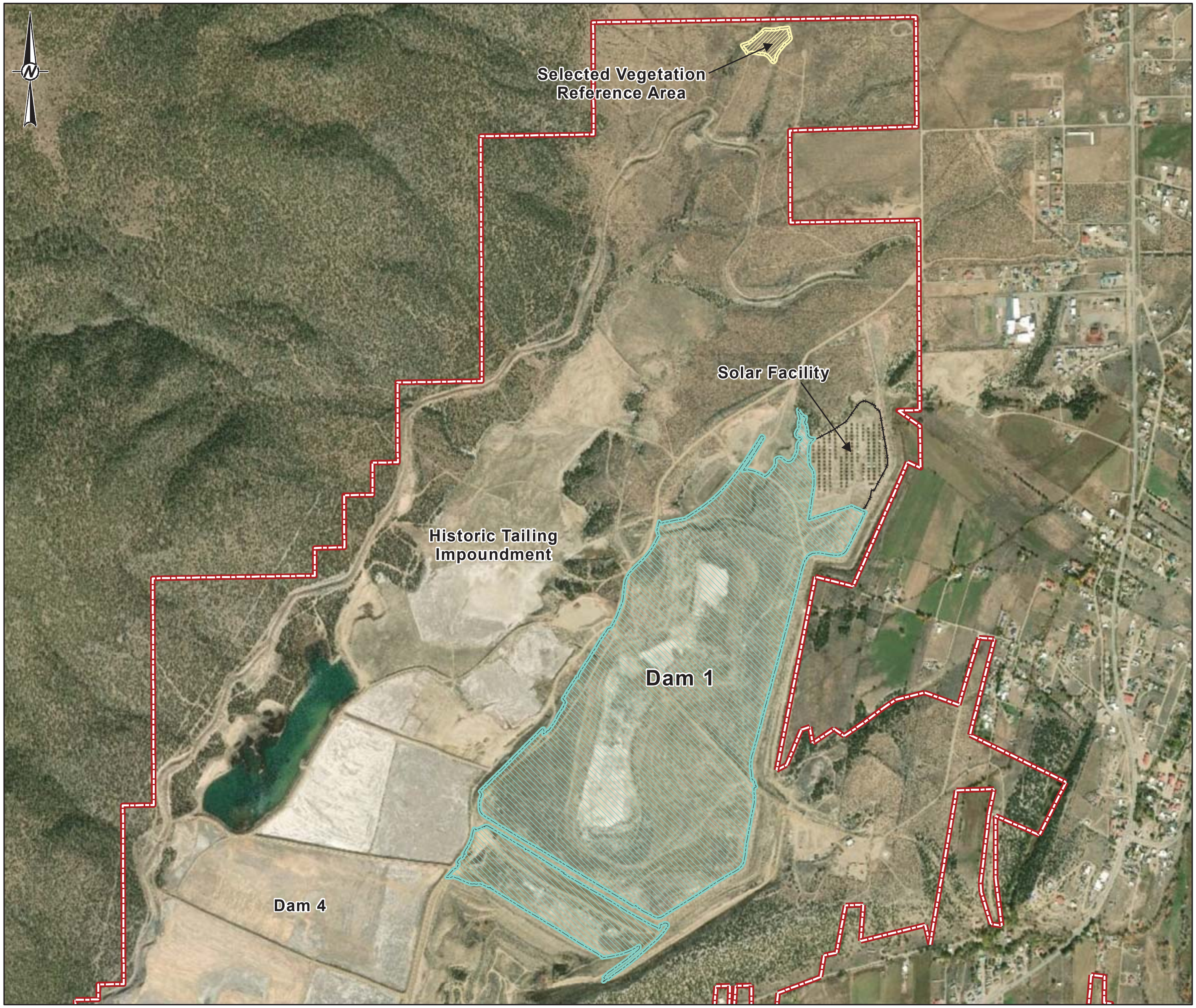

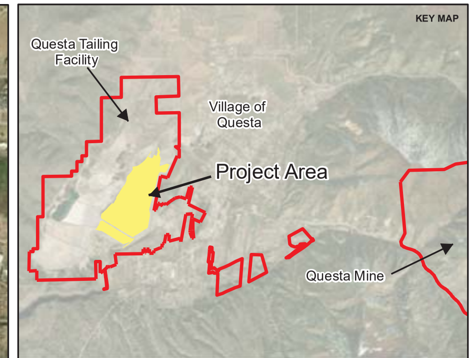

LEGEND

- Selected Vegetation Reference Area
- Project Boundary
- Solar Facility Boundary
- Permit Boundary

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Feet

NOTE(S)

REFERENCE(S)
1. IMAGERY DATE: OCTOBER 2016
2. IMAGERY SOURCE: DIGITALGLOBE
3. COORDINATE SYSTEM: STATE PLANE, NEW MEXICO - CENTRAL (3002, US FEET), NAD 1983

CLIENT
CHEVRON MINING, INC.
QUESTA, NEW MEXICO

PROJECT
FINAL DESIGN FOR DAM 1 TAILING FACILITY COVER DEMONSTRATION PILOT PROJECT

TITLE
GENERAL OVERVIEW OF THE QUESTA TAILING FACILITY

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-15
DESIGNED	DW
PREPARED	DW
REVIEWED	DR
APPROVED	LM

PROJECT NO.	CONTROL	REV.	FIGURE
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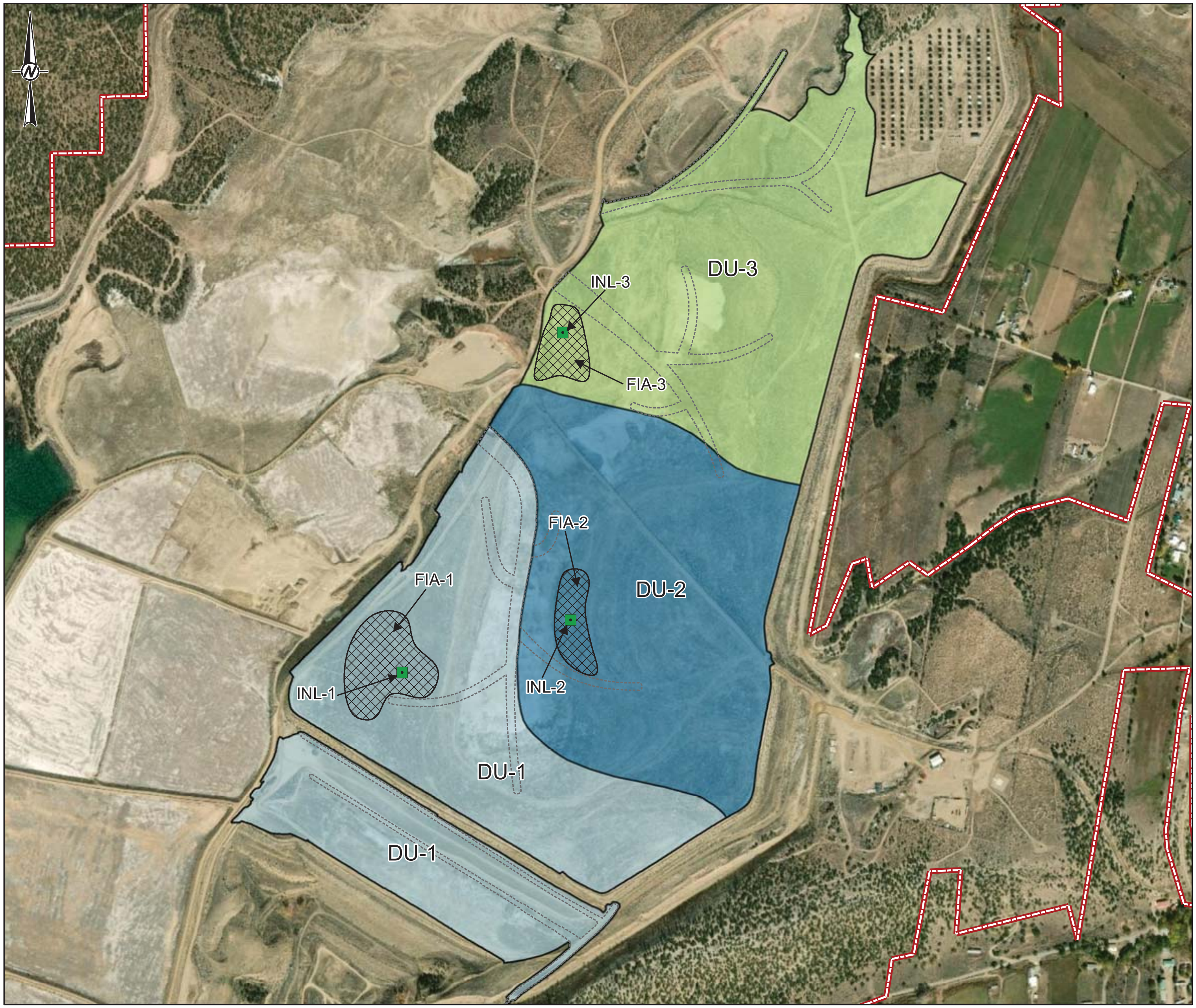

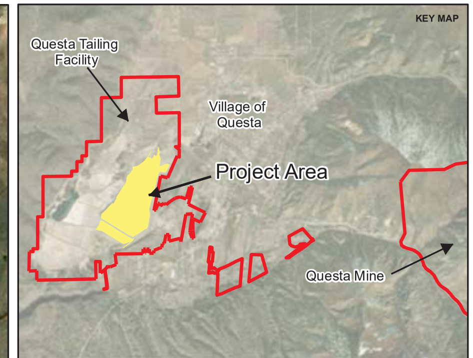

LEGEND

- Instrument Nest Locations - Approximate
- Focused Investigation Areas - Approximate
- Channel/Swale Boundaries
- DU-1
- DU-2
- DU-3
- Permit Boundary

0 500 1,000
Feet

NOTE(S)
1. DU: DECISION UNIT
2. FIA: FOCUSED INVESTIGATION AREAS
3. INL: INSTRUMENT NEST LOCATION

REFERENCE(S)
1. IMAGERY DATE: OCTOBER 2016
2. IMAGERY SOURCE: DIGITALGLOBE
3. COORDINATE SYSTEM: STATE PLANE, NEW MEXICO - CENTRAL (3002, US FEET), NAD 1983

CLIENT
CHEVRON MINING, INC.
QUESTA, NEW MEXICO

PROJECT
FINAL DESIGN FOR DAM 1 TAILING FACILITY COVER DEMONSTRATION PILOT PROJECT

TITLE
MONITORING PLAN DECISION UNITS, FOCUSED INVESTIGATION AREAS, AND INSTRUMENT NEST LOCATIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-15
DESIGNED	DW
PREPARED	DW
REVIEWED	DR
APPROVED	LM

PROJECT NO.	CONTROL	REV.	FIGURE
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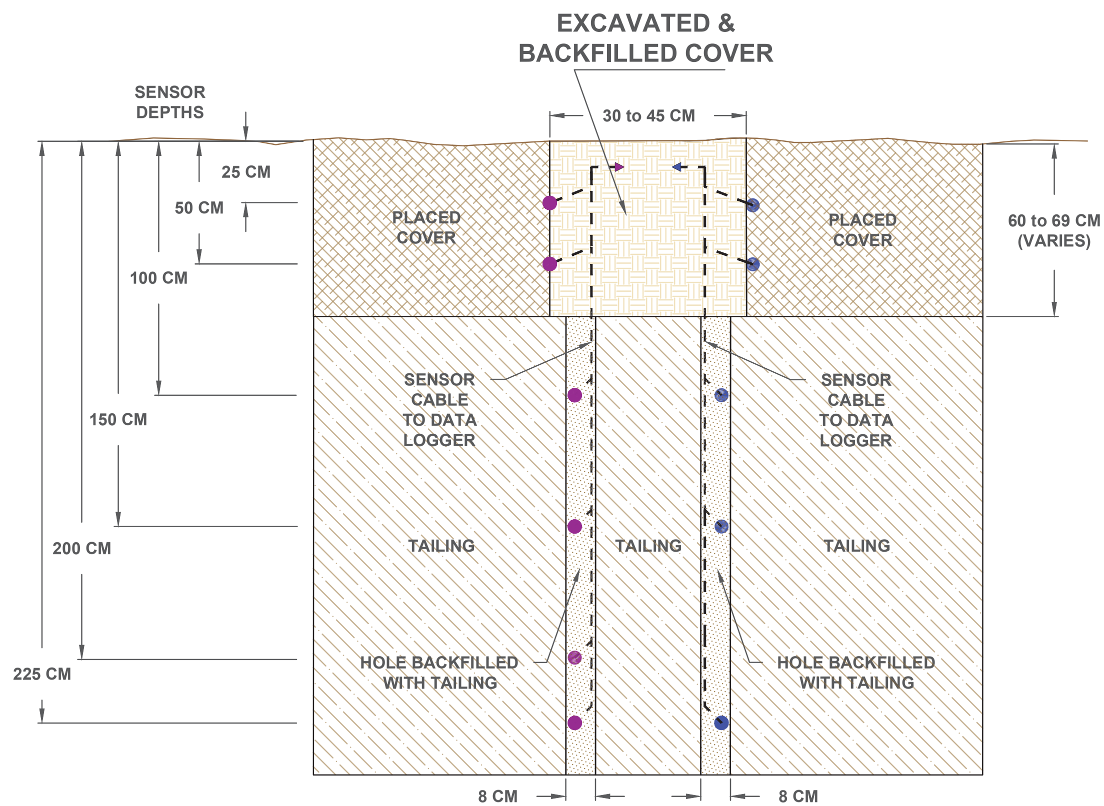

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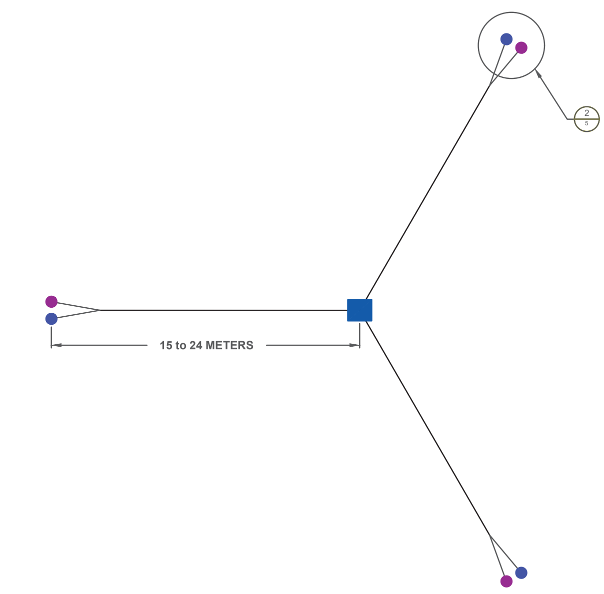

NOT TO SCALE 1 TYPICAL TEST PLOT LAYOUT

LEGEND

- HEAT DISSIPATION SENSOR (CAMPBELL MODEL 229)
- FREQUENCY DOMAIN REFLECTOMETER (DYNAMAX MODEL ML3)
- AUTOMATED MONITORING SYSTEM / DATA LOGGER
- CABLE RUN

LEGEND

- TAILING MATERIAL
- TAILING MATERIAL BACKFILL
- HEAT DISSIPATION SENSOR (CAMPBELL MODEL 229)
- CABLE RUN
- PLACED COVER MATERIAL
- EXCAVATED & BACKFILLED COVER
- FREQUENCY DOMAIN REFLECTOMETER (DYNAMAX MODEL ML3)

CLIENT
CHEVRON MINING, INC.
QUESTA, NEW MEXICO

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-15
DESIGNED	TS
PREPARED	DW
REVIEWED	TS
APPROVED	LM

PROJECT
FINAL DESIGN FOR DAM 1 TAILING FACILITY
COVER DEMONSTRATION PILOT PROJECT

TITLE
GENERALIZED TEST PLOT LAYOUT AND VADOSE ZONE INSTRUMENTATION

PROJECT NO.	CONTROL	REV.	FIGURE
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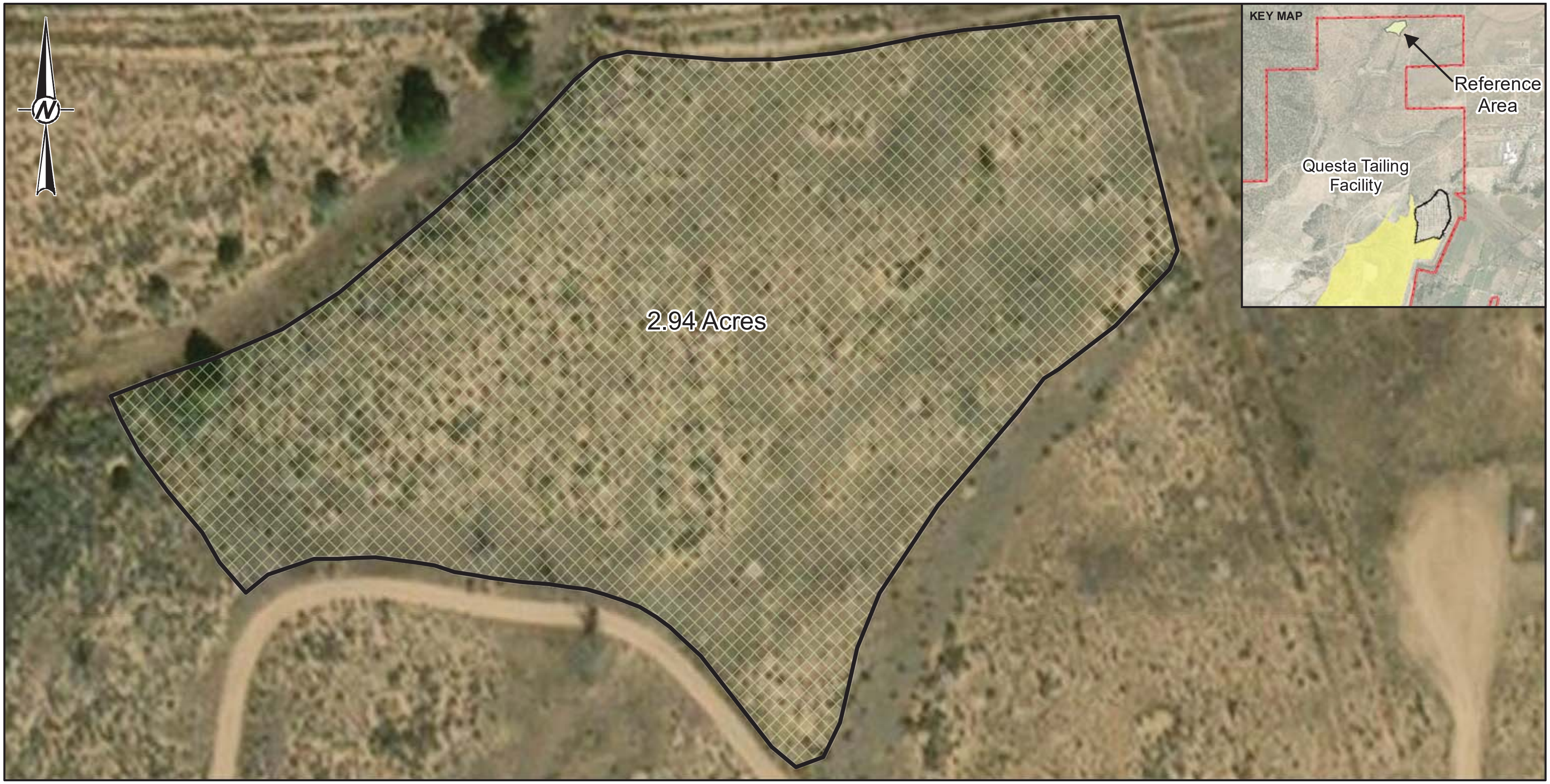

LEGEND

- Reference Area Boundary
- Permit Boundary

0 100 200
Feet

NOTE(S)

1. REFERENCE AREA IS 2.94 ACRES
2. STATE PLANE SYSTEM, NEW MEXICO - CENTRAL, NAD 1983

REFERENCE(S)

1. IMAGERY DATE: 2016-10-21, SOURCE: DIGITALGLOBE

CLIENT
CHEVRON MINING, INC.
QUESTA, NEW MEXICO

PROJECT
FINAL DESIGN FOR DAM 1 TAILING FACILITY
COVER DEMONSTRATION PILOT PROJECT

CONSULTANT
GOLDER

YYYY-MM-DD	2018-11-15
DESIGNED	DW
PREPARED	DW
REVIEWED	DR
APPROVED	LM

TITLE
SELECTED VEGETATION REFERENCE AREA

PROJECT NO.	CONTROL	REV.	FIGURE
189-9653	0007	A	6-3

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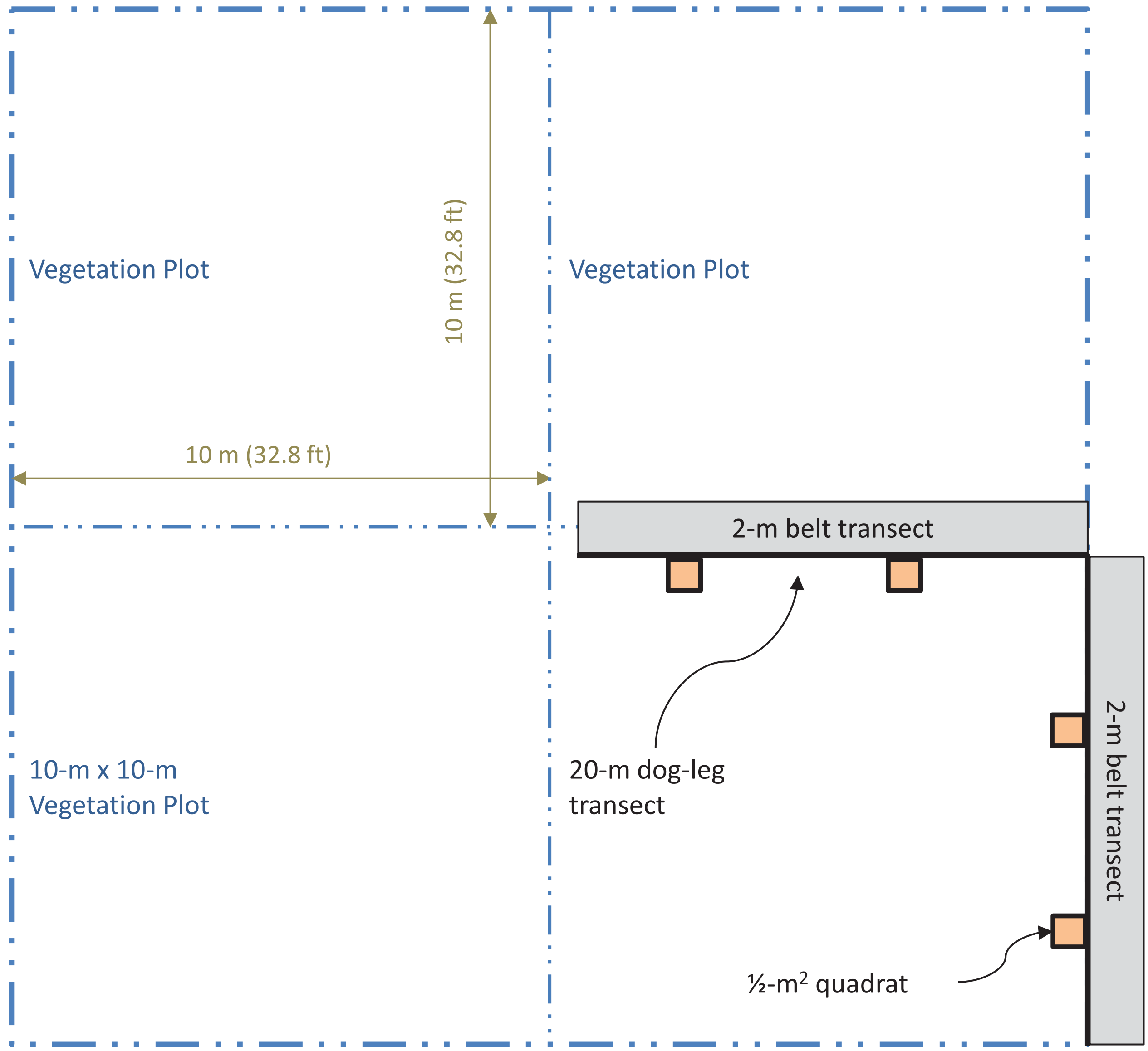
Figure 6-4: Vegetation Plot, Transect, and Quadrat Layout



not to scale

Appendix A

Design Criteria and Basis of Design Report

Final Design Criteria and Basis of Design Report

Tailing Facility Cover Demonstration Pilot Project

CHEVRON QUESTA MINE SUPERFUND SITE

QUESTA, NEW MEXICO

November 16, 2018

1.0 INTRODUCTION

This combined Design Criteria and Basis of Design Report for the Questa Tailing Facility Cover Demonstration Pilot Project (Pilot Project) provides the basis for developing the designs for the closure and reclamation of Dam 1 that is fully detailed in the Final Design Report for Dam 1 Tailing Facility Grading (Golder 2018). This report contains Golder Associates Inc.'s (Golder's) design criteria assumptions and approved decisions made by Chevron Mining Incorporated (CMI) that are the basis of the final grading design.

1.1 Site Location and Background

The Chevron Questa Mine Superfund Site is near the Village of Questa in Taos County, New Mexico. The mine is a former underground and open pit molybdenum mine located approximately 4 miles east of the Village of Questa. Tailing generated by the mill were transported in a pipeline to the Questa Tailing Facility located immediately west of the village.

The Record of Decision (ROD; USEPA 2010) requires CMI to cover and revegetate the tailing facility for source containment. A store and release/evapotranspiration (ET) cover system was determined to be an appropriate cover system for the climate conditions near Questa and the type of borrow materials that are locally available. A minimum 36-inch thick cover was required pending the results of on-going studies, as stipulated in the Mining and Minerals Division (MMD) Permit TA001RE-96-1 and New Mexico Environment Department (NMED) Permit DP-933. The cover was intended to reduce infiltration and percolation of water through the tailing material to ground water that could potentially cause an exceedance of ground water quality standards. The reduction of infiltration and percolation was also intended to minimize oxidation and acid generation of the tailing. Furthermore, the cover was intended to provide conditions that would allow for the re-establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas, and thereby conform to the MMD approved post-mining land use of wildlife habitat.

The ROD anticipated that the cover material would be sourced from alluvial deposits north of the tailing facility and placed using scrapers. In the mid-1990's, similar materials and methods were used to construct the interim cover on the surface of Dam 1. In the early 2000's, the vegetation on the interim cover was considered well-established with respect to vegetation density, species constancy and uniformity. Because the interim cover materials were not screened and the vegetation performance was adequate, no screening of materials for the final cover was required.

The ROD requires the final cover to be revegetated with grasses and forbs and possibly woody shrubs. Revegetation designs are intended to optimize the effectiveness of the cover to reduce infiltration and percolation through the underlying tailing to protect ground water, promote evapotranspiration from the cover system, and provide cover stability and protection from wind and water erosion. The revegetation designs were also intended to consider selecting plants with lower affinities to take up metals at levels that present risks to large herbivorous wildlife (e.g., deer and elk).

2.0 DESIGN CRITERIA

The technical parameters that are the basis of the engineering design criteria are described below.

2.1 Project Description

The Final Design Report for Dam 1 Tailing Facility Grading (Golder 2018) was prepared in accordance with the tasks outlined in Revision 2 of the Statement of Work (SOW) for Early Design Action, included as Appendix A to the Second Amendment to the Administrative Settlement Agreement and Order on Consent (AOC) for Early Design Actions, dated November 13, 2014. The Final Design Report includes all data collected and analyses conducted that support the final grading design. The objective of the final grading design is to achieve positive drainage of surface water runoff without affecting the integrity of the dams and considers long-term draindown and consolidation of tailing material, potential borrow source volumes and availability and appropriate design criteria. Per the SOW, the final grading designs for Dam 1 will ultimately be incorporated into the Tailing Facility remedial design.

The Pilot Project was developed in accordance with the SOW for the First Partial Remedial Design/Remedial Action Consent Decree filed August 9, 2016. CMI is required to reclaim approximately 270 acres of the Dam 1 tailing impoundment with the objective to: (1) determine whether a two-foot thick cover can be successfully designed, constructed, and maintained such that it is adequately protective of soil and groundwater, can be successfully revegetated, and can be maintained over time; and (2) support an inquiry into whether the CERCLA remedy, as it pertains to cover thickness at the tailing facility, should be modified accordingly. This project serves as a pilot demonstration project because it is the first area of the tailing facility to be addressed and because it will test the effectiveness of the 2-foot cover thickness during an initial five-year period.

The evaluation of 2-foot thick covers composed of local alluvium is predicated on the performance of similar covers in reducing net percolation and providing the conditions necessary to support a self-sustaining ecosystem. Studies of water relations conducted at Questa (Golder 2015b) indicate that hydraulic performance is improved with thinner covers (≈ 1-foot thick), but the potential for molybdenum uptake by plants is negatively affected (Intrinsik 2018). Somewhat thinner covers (e.g., < 20 inches thick) tend to increase the likelihood of burrowing animals bringing tailing to the surface, which further increases the potential for molybdenum uptake by plants and ingestion by wildlife. Thus, the cover design is intended to balance risks associated with groundwater protection and the promotion of wildlife habitat.

2.2 Design Requirements and Provisions

The grading plan was designed to provide positive drainage of surface water runoff without affecting the integrity of the dams considering the long-term draindown and consolidation of the tailing. Regrading operations are generally anticipated to be performed as a balanced top surface excavation and local fill placement to achieve the finished subgrade. Three primary top surface channels and 12 secondary swales will be constructed to convey surface water west to two interim detention ponds located on the Section 35 and Historic Tailing impoundments. The Dam 1 bench area utilizes two primary top surface channels and one downslope channel to convey surface water east to the existing East Diversion Channel. An estimated 1,025,700 cubic yards of alluvial borrow will then be placed across the regraded subgrade to achieve the target 2-foot soil cover thickness.

The cover will be composed of local alluvium as specified in the ROD with a nominal thickness of 2-feet or greater, pending the results of the Pilot Project. Because the cover is intended to support plant growth, it will be loosely placed or ripped to avoid excessive compaction. The cover will be seeded with plant species native to the region and with lower propensities for the uptake of molybdenum.

2.2.1 Waste Characterization

The tailing impoundments consist of stratified layers of mill tailing that can be categorized as “sand” and “fines,” as defined by the No. 200 standard sieve size. The complexity of stratification between the grain sizes varies across the impoundment, but field data indicates a distinguishable layer of fines at the bottom of each impoundment (Golder 2018). Additionally, the predominant material near the center of each impoundment is generally fines, with little or no overlaying sand.

The tailing is composed primarily of quartz and feldspars with lesser amounts of clays and calcite. The sulfide minerals include pyrite, galena (lead sulfide), chalcopyrite (copper-iron sulfide), and molybdenite (molybdenum disulfide). The tailing materials are near-neutral pH with an average pH of 7.4 and non-saline with electrical conductivities less than 2.2 deciSiemens per meter (dS/m) (URS 2009). SRK (1997) found sufficient neutralizing capacity to neutralize any acid that could be generated in the tailing. Neutralizing potential/acid-generating potential (NP/AP) ratios were predominantly greater than 1.5, indicating the bulk of the material is capable of neutralizing any acid that is generated (RGC 1998).

SRK (1996) found relatively little geochemical variability within the tailing. In general, the tailing had slightly elevated concentrations of chromium, copper, fluoride, molybdenum, and zinc. Concentrations of aluminum, arsenic, barium, chromium, copper, and magnesium in surface and near surface samples were higher than concentrations in samples collected at depth. These differences may be attributed to weathering.

2.2.2 Technical Design Standards

Appendix G of the Final Design Report for Dam 1 Tailing Facility Grading (Golder 2018) summarizes the engineering design criteria used to prepare the final level of design. Appendix J in the same report provides the technical specifications for construction activities to reclaim Dam 1 and the Pilot Project.

The specification for suitable Cover Fill includes all materials that are a loamy sand or finer with less than 70 percent coarse fragments (particles > 2mm) by volume. Materials that have a sand texture or have greater than 70 percent volumetric rock content will either be avoided or blended with finer materials prior to placement. Based on samples collected from the borrow area, all the identified borrow materials are suitable and meet this Cover Fill specification. Nonetheless, given the nature of the alluvial deposits it is possible that some unsuitable intervals may be encountered during the excavation process. Extremely coarse-textured intervals encountered during borrow excavation will be avoided or blended. As such, the final configuration of the borrow pit may deviate from the proposed design if unsuitable materials are encountered. Some blending of finer and coarser materials is expected as part of the excavation, loading and spreading process to construct the cover. The methods that will be employed for material handling and borrow area quality control are discussed in Section 7.1.4 of the Construction Quality Assurance Plan/Construction Quality Control Plan (Appendix C of the Tailing Facility Cover Demonstration Pilot Project – Final Remedial Design report).

2.2.3 Applicable or Relevant and Appropriate Requirements

Engineering design criteria were developed in accordance with the New Mexico rules and regulations as well as inputs needed for engineering analyses and design requirements consistent with the current state of the practice for tailing reclamation. Design criteria were also selected based on Golder's experience developing closure plans for similar facilities throughout the southwestern U.S.

Specifically, the design criteria comply with the regulations and agreements outlined by the U.S. Environmental Protection Agency's (USEPA's) ROD, and state permits issued by the NMED, New Mexico Energy Minerals and Natural Resources Department (EMNRD), and New Mexico Office of the State Engineer (NMOSE) for the Questa Tailing Facility.

- USEPA: Molycorp, Inc. ROD. December 20, 2010
- EMNRD:
  - Permit TA001RE, Rev 96-1, Questa Mine Site – Tailings
  - Closeout Plan Guidelines for Existing Mines. April 30, 1996
- NMED:
  - Discharge Permit, CMI Tailing Disposal Facility, DP-933, February 29, 2008
  - New Mexico Administrative Code (NMAC) 20.6.7 Supplemental Permitting Requirements for Copper Mining Facilities. New Mexico Water Quality Control Commission
- NMOSE: NMAC 19.25.2: Dam Design, Construction and Dam Safety

Final design criteria were developed to achieve the applicable or relevant and appropriate requirements (ARARs), pertinent codes and standards with respect to settlement (subsidence), slope stability, seismicity, hydrology and hydraulics, and cover thickness that were used to develop the engineering plans. The design criteria were discussed in detail on September 20, 2016 among Golder, CMI, USEPA and other local and state agency representatives in Santa Fe, New Mexico to ensure all parties agreed upon their selection and use before proceeding with the final level of design for the Dam 1 Tailing Facility Grading.

The implementation of the Pilot Project will significantly lessen the risks associated with direct contact of ecological receptors to tailing and essentially eliminate the risk of airborne exposure. The tailing will be contained, significantly reducing potential for contaminant transport, erosion, and mobility. Covering the tailing with alluvial materials and subsequent revegetation of the ET cap would stabilize the facility surface and decrease the risk of water percolation and potential contamination of both surface water and groundwater. The cover will also stabilize the tailing with respect to fugitive emissions and satisfy air quality regulations. All ARARs are expected to be met under the remedial action and satisfy federal and state surface regulations over the long term.

2.2.4 Design and Construction Technical Factors

The remedial action for Dam 1 is primarily a civil earthwork project that is both technically and administratively feasible and will use conventional construction practices, techniques, and earth moving equipment. Conventional construction practices such as excavation, consolidation, regrading, surface water conveyance, and revegetation will be used for tailing facility reclamation. The grading and construction of the soil cover and channel revetments would require the use of appropriate earth-moving equipment, which may include scrapers, loaders, excavators, dozers, and haul trucks. Local borrow sources for the cover materials and engineering materials (i.e., riprap, bedding, etc.) are suitable and readily available within the confines of the tailing facility. Design methods and requirements for soil covers are well understood.

Constructability was considered throughout the Dam 1 remedial design process. Knowledge of construction processes was integrated into the final grading designs to achieve the overall project objectives so that the project can be built in a timely, efficient, accurate, and cost-effective manner. Project objectives for the Dam 1 remedial action are to achieve positive drainage, facilitate constructability and the efficient conveyance of water, limit slope length to prevent soil erosion, provide a suitable substrate for establishing revegetation, and eliminate long-term maintenance requirements. Constructability was also assessed relative to physical and chemical characteristics of the tailing and borrow materials, settlement, slope stability, seismicity, hydrology and hydraulics, and cover thickness.

2.2.5 Environmental Control Measures

During the Pilot Project construction and operation and maintenance (O&M), CMI and its contractor(s) will work to minimize negative effects to the environment and the community. The Pilot Project will employ best management practices (BMPs) to reduce the impacts to the environment and the community. Subject to the approval of CMI, BMPs will be developed by the construction contractor to manage and monitor these impacts during construction. BMPs are defined as currently accepted, effective, and practical methods used to prevent or reduce environmental impacts of ground disturbing activities. BMPs include structural and/or engineered control devices, systems, and materials as well as administrative, operational, and/or procedural practices to minimize external impacts. Primary impacts associated with the construction work zone are expected to be noise, erosion, runoff, and dust emissions.

The remedial action will use currently accepted environmental control measures and BMPs to limit erosion and reduce sediment in runoff from disturbed areas during construction, operations and initial stages of reclamation. Before construction operations are initiated, erosion controls will be placed to minimize off-site impacts from disturbed areas. During construction, various site controls will be used to limit the transport of sediment offsite from wind and water erosion or resulting runoff. All sediment and erosion control measures will be inspected periodically, and repairs performed as needed.

Dust control measures will be implemented to mitigate environmental and health risks posed by dust generated during earth-disturbing activities. When necessary, water will be applied to reduce visible dust. Water will be applied at rates that do not generate runoff.

Short-term impacts to the surrounding community are expected to be minimal and associated with increased vehicular traffic and noise levels during the construction phase. Section 3.4 discusses the potential hazards associated with the increased vehicular traffic and traffic controls. Operating hours will be restricted to limit noise during the construction period. CMI will continue to maintain close communications with the Village of Questa and provide periodic updates to the community as the construction progresses.

2.3 Process

The general reclamation processes for the Dam 1 tailing impoundment are as follows:

1) Grading tailing and existing interim cover to achieve and maintain a positive slope gradient (0.5%)
2) Construct interim surface water management detention ponds and channel revetments for stormwater conveyance
3) Excavate soil and alluvial borrow materials and place on the regraded surface to construct a 2-foot thick cover
4) Revegetation

2.4 Operation and Maintenance Provisions

Normal O&M of the reclaimed tailing facility primarily relates to maintaining the integrity of the cover system. The cover should not show significant deterioration from erosion, slip-offs, subsidence, and/or the failure to establish vegetation that cannot be repaired through normal operation and maintenance.

Provisions to properly operate and maintain the reclaimed tailing facility include periodic inspections for signs of excessive erosion, ponding, and/or seeding failure and developing corrective action plans when a particular feature has the potential to jeopardize the cover's integrity or reduce cover performance.

Site inspections will focus on features that could potentially affect cover integrity:

- Erosion features will be assessed as to their origin, relative size, and the potential to expose tailing. Those features that have the potential to reduce cover performance, expose tailing, and require extraordinary O&M to stabilize will be rated as significant. In most instances a corrective action plan will be developed to repair significant erosion features. Erosion features that are smaller or less active will also be recorded, but if they are expected to stabilize and heal as plant cover increases, they will only be monitored to track their evolution. Armored drainage structures will also be inspected for performance and necessary maintenance.
- Evidence of subsidence and ponding (e.g., standing water, sediment deposition and desiccation cracks, pronounced and deep cracks in the cover, and dead and/or stressed plants affected by intermittent flooding) will be documented. An area where subsidence has resulted in ponding will be assessed as to its size and duration of ponding.
- Distinct areas within the reclamation where plant establishment is poor will be evaluated. Poor plant establishment is defined as a contiguous area of at least 1 acre in size having less than an average of 1 plant per square foot within the first few years. Information will be collected for such areas that includes possible reasons for poor vegetation establishment, evidence of volunteer species being recruited from adjacent undisturbed areas, surface soil conditions, herbivory, wildlife use, etc. Recommendations for reseeding a particular site will depend on the cause of the poor vegetation performance or failure, its apparent trajectory, and aerial extent. Monitoring will include identification of state-listed noxious weeds.

Normal O&M of the reclaimed tailing facility is expected to include:

- Stabilization of areas where tailing is exposed or has the potential to be exposed due to erosional processes
- Reestablish positive drainage by filling settlement areas, and
- Reseeding areas that have poor vegetation establishment.

3.0 BASIS OF DESIGN

This section provides a description of analyses conducted to select the design approach.

3.1 Assumptions

Golder conducted the Pre-Design Investigation in accordance with the Revised Pre-design Work Plan for Tailing Facility Grading (Golder 2015a). The Pre-Design Investigation provided field and laboratory data used to support the grading alternatives and assign engineering properties to the tailing material for engineering analyses, evaluate the availability and volumes of potential borrow sources for fill and cover options, and design grading alternatives.

The Pre-Design Investigation consisted of three primary components: (1) obtain up-to-date site topography, (2) investigate and characterize the existing tailing, and (3) explore potential borrow areas that may serve as a suitable source of fill and cover material for closure of the Tailing Facility. The Pre-Design Investigation consisted of the following tasks:

- An aerial survey of existing ground topography for the entire Tailing Facility was performed in 2015 to develop a digital terrain model (DTM). The DTM was used as the base for the Dam 1 Tailing Facility Grading final level of design.
- Cone Penetration Testing (CPT) at 31 locations across the site to assess the variability of the tailing material and identify “key layers” (zones or layers that exhibit similar properties such as moisture, density, and grain size) from which to obtain physical samples during a subsequent drilling and sampling program.
- Drill and sample soil at 10 locations across the site to obtain representative samples of the tailing “key layers” identified from the CPT data.
- Laboratory testing of select representative samples of tailing material to evaluate engineering properties.
- Compare the results of laboratory testing results to CPT correlated values and calibrate pertinent CPT correlation as needed.
- Test pit excavations at six potential borrow areas to characterize the site native soils and alluvial materials for suitability as a potential borrow for Cover Fill and to estimate the volume of suitable material available.
- Laboratory testing of select representative samples of potential borrow materials to determine material properties. Section 4.3.4 of the Revised Pre-design Work Plan for Tailing Facility Grading (Golder 2015a) describes the prescribed test methods. Test result reports are provided in Appendix D-2 of the same report.

Data from the Pre-Design Investigation that supported the engineering analyses for the grading plan were reported in the Revised Intermediate Design Report for Dam 1 Tailing Facility Grading (Golder 2016). Specific analyses related to settlement (subsidence), slope stability, seismicity, and hydrology and hydraulics were performed to develop the final grading plan. Section 8 of Final Design Report for Dam 1 Tailing Facility Grading

(Golder 2018) discusses these analyses at length. Supporting calculations for the engineering analyses are in Appendix H of the Final Grading Design report.

Calculated earthworks and revetment quantities for the amount of tailing material excavation and placement, borrow excavation, and channel revetment are provided in the Final Grading Design report (Golder 2018). Design drawings with earthwork quantities and a summary of the construction quantity estimate and material balance are provided in Appendix I-2 of the grading design report.

3.2 Contracting Strategy

CMI has initiated conversations with qualified construction contractors, but has not made a final selection. CMI will notify USEPA of the selected contractor(s) at least 30 days prior to initiation of 2019 construction activities.

3.3 Permits Plan

Work activities described in this Work Plan will be supplemented by other plans, including:

- Site Health and Safety Plan for Early Design Actions (ARCADIS 2012)
- Project Health and Safety Plan for the Tailing Facility Cover Demonstration Pilot Project
- Overall Site Plan for Early Design Actions (ARCADIS 2013a) including
    - Site Management Plan (Pollution Control and Mitigation Plan and Waste Management Plan)
    - Data Management Plan
    - Contingency Plan
- Construction Quality Assurance Project Plan (ARCADIS 2013b)

These plans are provided under a separate cover as required by the SOW (USEPA 2012).

3.4 Easements and Site Access

The construction contractor selected to execute the work will be primarily responsible to determine potential work zone transportation and management strategies, subject to the approval of CMI. CMI will approve site access, transportation to and from the site and all work zones, and traffic patterns for active construction equipment, prior to the commencement of construction activities. A Traffic Control Plan will be established to mitigate the potential hazards associated with the increased traffic in the Dam 1 Tailing Facility work area and surrounding community. The Traffic Control Plan will specify the physical (i.e., barriers) and administrative controls (i.e., speed limits, weather restrictions, or signage) to be utilized at the site including proposed vehicle ingress/egress route.

4.0 REFERENCES

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