Retrofitted Waste Pond
Construction Quality Assurance Plan

US Magnesium Rowley Facility

February 28, 2022

PREPARED FOR

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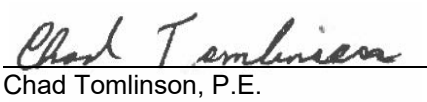
PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify, as a Professional Engineer in the State of Utah, that the information in this document was assembled under my direct supervisory control. This report is not intended or represented to be suitable for reuse by US Magnesium LLC or others without specific verification or adaptation by the Engineer.

I hereby certify, as a Professional Engineer in the State of Utah that this document has been prepared in accordance with industry standards and best-practices.



Chad Tomlinson, P.E.

February 28, 2022
Date

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ACRONYMS AND ABBREVIATIONS

µm	micrometer
ASTM	American Society for Testing and Materials
AASHTO	American Association of State Highway Transportation Officials
API	American Petroleum Institute
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
CQC	Construction Quality Control
DERR	Division of Environmental Response and Remediation
DWQ	Division of Water Quality
HBW	hydraulic barrier wall
OSHA	Occupational Safety and Health Administration
PLS	Professional Land Surveyor
QA	quality assurance
QC	quality control
RFI	request for information
RWP	Retrofitted Waste Pond
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

This Construction Quality Assurance Plan (CQAP) describes the quality control (QC) and quality assurance (QA) activities required for construction of the earthworks and hydraulic barrier wall (HBW) associated with the Retrofitted Waste Pond (RWP) at the US Magnesium Rowley Facility. The work includes construction of an earthen embankment and associated works as presented in the RWP Phase 1 Construction Drawings and Specifications and the installation of the HBW and associated work as presented in the RWP Phase 2 Construction Drawings and Specifications.

1.1 Purpose

During the course of the work, QA activities will involve reviewing Construction Contractor submittals, conducting observations of the work as it is completed, providing construction support, and performing field and laboratory testing of construction materials. A major function of the QA is to properly and adequately document that the work and associated QC testing is completed in accordance with the approved construction drawings and technical specifications.

Procedures presented in this CQAP are intended to identify challenges that may occur during construction and to establish guidelines for documentation of the resolutions. The QC testing program described in this CQAP outlines the methods and frequencies in which construction materials and installations are to be monitored or tested.

QC testing will be implemented by a contractor(s)/engineering firm(s) qualified to perform the QC observations, measurements, and testing. The QC firm will provide QC Monitors to implement the requirements in this CQAP and to document the work.

1.2 Scope

This CQAP establishes general administrative and documentation procedures that will be applicable for selected activities of construction. With respect to responsibilities, personnel qualifications, and specific monitoring and testing activities, this CQAP addresses those activities associated with the RWP Phase 1 earthworks and Phase 2 HBW installation.

1.3 Document Organization

The remainder of this document consists of the following sections:

- Section 2.0 Project Organization– Details the organizational structure for the project.
- Section 3.0 Personnel Qualifications and Training – Presents a summary of the minimum qualifications and training for QA/ QC personnel.
- Section 4.0 Construction QA Definitions and Applicable Organizations and Standards – Provides project definitions for QA/QC and defines the applicable organization standards for the project as they relate to QC testing and QA.
- Section 5.0 Construction Activities and Submittal Requirements – Details the construction activities to be performed and associated project submittal requirements as they pertain to QA.
- Section 6.0 Earthworks – Defines the minimum QC testing for project earthworks.
- Section 7.0 HBW Installation – Defines the minimum QC testing for the HBW installation.
- Section 8.0 Construction Quality Assurance Documentation – Defines the minimum documentation requirements for QA testing.
- Section 9.0 References.
- Appendix A Soil Compaction Field Form
- Appendix B In-Place Nuclear Testing Form

- Appendix C Record of Non-Compliance Test Form
- Appendix D Daily Field Report Form
- Appendix E Notice of Non-Compliance Log
- Appendix F Weekly Progress Report Form

2. PROJECT ORGANIZATION

This section describes the project organization for construction and associated construction quality assurance (CQA) activities. The following subsections address the organizations involved in the construction, their respective roles for the construction activities, and the methods of interactions and communications between organizations. An organization chart is presented in **Figure 2-1** that illustrates the organizational structure pertaining to this CQAP.

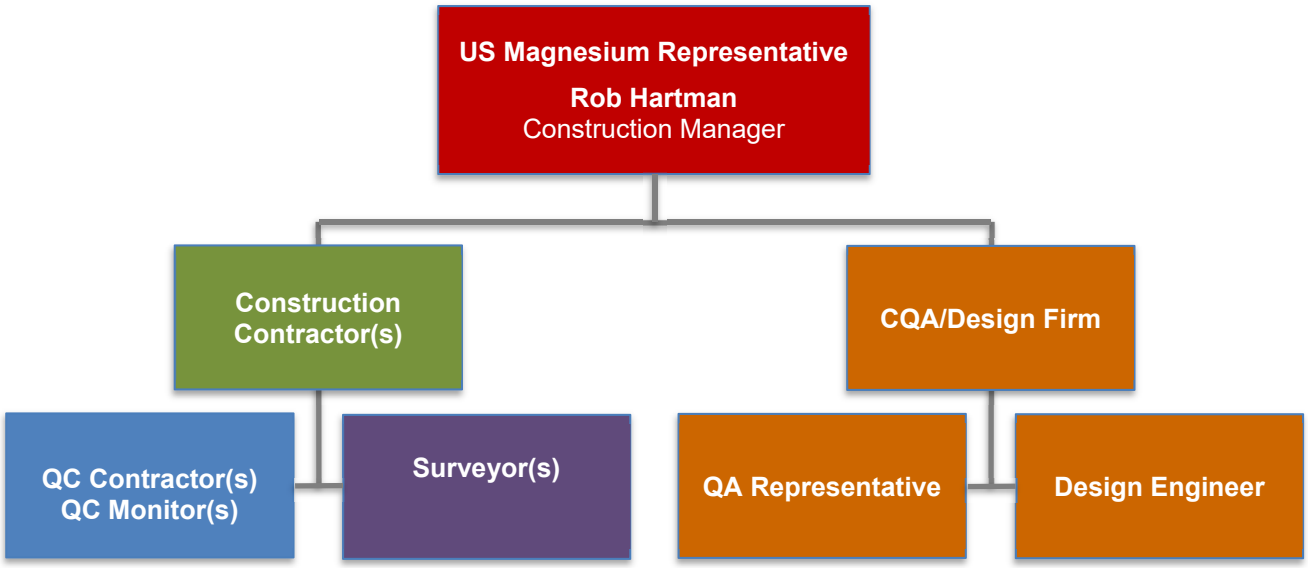

Figure 2.1- CQA Organizational Chart

2.1 Stop Work Authority

The US Magnesium Representative and Construction Manager will have the authority to direct the Construction Contractor to stop work at any time. In the event that site conditions become unsafe, any person may stop work until the unsafe conditions are addressed. The US Magnesium Representative and Construction Manager shall be notified immediately if work is stopped due to unsafe conditions.

2.2 Responsibilities and Authority

The project organization consists of the US Magnesium Representative and Construction Manager, the Construction Contractor, a Design Engineer, a QA Engineer, QC Contractor(s), and the QC Monitor(s). The responsibilities for the project and field team members are provided in the subsections below.

2.2.1 Construction Contractor(s)

The Construction Contractor(s) is responsible for completing the work in accordance with the project drawings and specifications. The Contractor(s) will be responsible for coordinating access and planning for the QC Contractor(s) to perform construction quality control (CQC). The Construction Contractor will report directly to the US Magnesium Construction Manager.

2.2.2 QC Contractor(s)

The QC Contractor(s) will be an independent firm(s) that will be responsible for performing inspections and testing as required by this CQAP.

2.2.3 QC Monitor(s)

The QC Monitor(s) is/are responsible for implementation of the QC testing program of this CQAP. The QC Monitor(s) will have responsibility for QC activities related to the construction, including testing and observations in accordance with the engineering drawings, technical specifications, and this CQAP. The QC Monitor(s) will perform the day-to-day QC tasks, including communicating and coordinating daily field tests with the Construction Contractor, correctly completing all necessary field data sheets on a daily basis, photographing construction progress, keeping a field and photograph log book that describes the construction activities, and completing and providing a daily field report to the US Magnesium Construction Manager, maintaining files and correspondence on a daily basis, and preparing any samples for shipment off site. The QC Monitor(s) will report to the Construction Manager and correspond directly with the QA Engineer.

2.2.4 Design Engineer

The Design Engineer is responsible for preparing construction drawings and technical specifications, addressing constructability issues, addressing requests for clarifications or changes to the construction drawings or specifications, approving final Construction Contractor submittals, and addressing unforeseen field issues. The Design Engineer will closely monitor all construction and QA activities and address issues that may arise during construction. The Design Engineer will coordinate with the US Magnesium Construction Manager and have close communication with the QA Engineer to ensure all issues are being addressed and documented. The Design Engineer will be a Registered Professional Engineer in the State of Utah and will ultimately be responsible for certifying that the work has been performed in accordance with the approved plans and technical specifications.

2.2.5 QA Engineer

The QA Engineer will have the overall responsibility for ensuring construction is conducted in compliance with this CQAP and will work closely with the US Magnesium Construction Manager and QC Contractor's QC Monitors. The QA Engineer will be responsible for reviewing QC testing reports and preparing documentation to be submitted to the Construction Manager and Design Engineer for the purpose of showing that the construction has been completed in compliance with the approved construction drawings and specifications, and any approved changes. The QA Engineer also has the responsibility to report issues and recommend remedial actions to the Construction Manager and Design Engineer if the Construction Contractor is not adhering to this CQAP or if the work does not meet requirements in the construction drawings and specifications.

2.2.6 QC Testing Laboratory(s)

The QC Testing Laboratory(s) will provide independent testing as directed by the QC Site Monitor(s). The QC testing will be in accordance with this CQAP and the technical specifications.

2.2.7 Regulatory Agencies

Work conducted under this project will be coordinated with the Division of Water Quality (DWQ), Division of Environmental Response and Remediation (DERR), and the United States Environmental Agency (USEPA). A US Magnesium representative will serve as the regulatory contact.

2.3 Project Meetings

This section includes a discussion of the various progress and status meetings that will be held throughout the performance of the work. The purpose of the meetings is to discuss work progress, plan work activities, and address issues related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to provide an opportunity for the CQA team to express concerns regarding quality, to relay test results, and to provide regular communication between organizations involved in the construction.

2.3.1 Pre-construction Meeting

A pre-construction meeting will be scheduled and held prior to beginning construction of each construction phase (Phase 1 and Phase 2). At a minimum, the meetings will be attended by the US Magnesium Representative and Construction Manager, the Construction Contractor's Project Manager, the QC Contractor Representative, the Design Engineer, and the QA Engineer. The DWQ, DERR, and EPA will be invited to attend. A portion of each meeting will be dedicated to the discussion of QA/QC issues. These QA/QC topics will include, but are not limited to, the following:

- Reviewing safety responsibilities and requirements.
- Reviewing the responsibilities of each organization.
- Reviewing lines of authority and communication for each organization.
- Providing each organization with relevant CQA and CQC documents and supporting information.
- Familiarizing each organization with this CQAP and its role relative to the design criteria, construction drawings, and specifications.
- Determining any changes to this CQAP that may be needed to document that the facility will be constructed to meet the specified requirements.
- Discussing the established procedures or protocol for observations and tests, including sampling strategies.
- Discussing the established procedures, or protocol, for handling construction deficiencies, repairs, and retests, including "stop work" conditions.
- Reviewing methods for documenting and reporting inspection data.
- Reviewing methods for distributing and storing documents and reports.
- Reviewing work area security and safety protocol.
- Reviewing the proposed project schedule.
- Discussing procedures for locating and protecting construction materials and for preventing damage of the materials from inclement weather or other adverse events or conditions.
- Conducting a site walk-around to review construction materials and inspect equipment storage locations.

Action items, assigned actions, and meeting minutes will be recorded and transmitted to the required distribution list and to meeting attendees.

2.3.2 Weekly Progress Meetings

Weekly meetings will be held at the site or via teleconference to discuss construction progress and plan for upcoming construction activities. At a minimum, the weekly progress meetings will be attended by the Contractor's Project Manager, US Magnesium's Representative, the QC Monitor(s), the QA Engineer, and possibly the surveyor, as needed. The DWQ, DERR, and EPA will be invited to attend the weekly progress meetings. The purpose of the meeting is to accomplish the following:

- Review safety topics and any safety incidents.
- Review the previous week's activities and accomplishments.
- Review planned activities for the upcoming week.
- Finalize resolution of issues from the previous week.
- Discuss potential challenges with the work planned for the upcoming week.

Meeting minutes will be recorded by a party identified by the Contractor's Project Manager and transmitted to the required distribution list and meeting attendees.

2.3.3 Problem or Work Deficiency Meetings

Additional meetings will be convened, as necessary, to address inspection deficiencies and nonconformances. Deficiencies observed by the QC Monitor(s) during construction will be brought to the attention of the Contractor's Project Manager and QA Engineer immediately. These deficiencies will be tracked in the QC Monitor's field logbook until resolved and included in the daily summary report. These documents will include the description of the deficiency and actions taken, or to be taken, to resolve the deficiency.

3. PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel. Documentation relating to qualifications will be maintained with the project CQA records.

3.1 Contractor's Project Manager

The Construction Contractors' Project Manager will have a minimum of 10 years of construction project management experience with large earthworks projects and installation of slurry walls as applicable for the Phase 1 and Phase 2 construction projects, respectively. The Phase 1 earthworks and Phase 2 HBW installation will likely be performed by different contractors.

3.2 QA Representative

The QA Engineer will have construction experience and will have sufficient practical, technical, and managerial experience to successfully support the QA activities discussed in this CQAP. The QA Engineer's qualifications will be documented by training records and a professional resume showing significant field experience with large earthworks construction.

3.3 QC Monitor(s)

At a minimum, the QC Monitor(s) will have a high school diploma and at least five years of construction-related experience, including at least three years of experience in earthwork construction, or a Bachelor of Science degree from a four-year college or university, and at least two years of experience conducting CQC monitoring for earthwork construction. The QC Monitor(s) must be capable of performing work with little or no daily supervision. Qualifications of the QC Monitor(s) shall be documented by training records and professional resumes and shall be reviewed and approved by the Design Engineer.

3.4 QC Testing Laboratory

The QC testing laboratory will be approved by the QA Engineer and will provide conformance testing required by this CQAP, as requested by the QC Monitor(s) and/or QA Engineer. The QC testing laboratory will be a third-party, independent testing laboratory, unaffiliated with the Design Engineer, materials supplier (e.g., sepiolite for the Phase 2 construction), or Construction Contractor or subcontractors.

3.5 Surveyor

It is anticipated that the earthworks contractor will utilize global positioning system (GPS) controlled equipment during the construction of the embankments but will also subcontract the services of a Utah licensed Professional Land Surveyor (PLS) to perform spot checks and final as-built surveys to confirm the design lines, grades and elevations are met. The surveyor selected by the Construction Contractor to support the construction work must be approved by the QA Engineer prior to the beginning of work.

3.6 HBW Specialist

The HBW specialist will work directly under the HBW Construction Contractor and will oversee all aspects of the HBW installation. The HBW Specialist must have had experience as a technical expert for at least three projects in all aspects of slurry wall construction including:

- Mixing and control of slurries
- Mixing and placement of backfill
- Dewatering

- Trench excavation
- Quality control testing.

4. CONSTRUCTION QUALITY ASSURANCE DEFINITIONS AND APPLICABLE ORGANIZATIONS AND STANDARDS

4.1 Construction Quality Assurance and Construction Quality Control

Construction Quality Assurance (CQA) — A planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

Construction Quality Control (CQC) — Those actions that provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

4.2 Use of the Terms in this CQA Plan

The definitions used in the context of this CQAP are provided below:

- CQA refers to means and actions employed by the QA Engineer to assure conformity with this CQAP, the technical specifications, and the construction drawings. CQA is provided by a party independent from the Construction Contractor and product supplier (for Phase 2).
- CQC refers to those actions taken by manufacturers, suppliers, Construction Contractors, and third-party QC Contractor(s), to ensure that the materials and the workmanship meet the requirements of the technical specifications and the engineering drawings.

4.3 Applicable Organizations

Organizations whose standards are referenced in this CQAP include:

- ASTM – American Society for Testing and Materials
- OSHA – Occupational Safety and Health Administration
- API – American Petroleum Institute

4.4 Applicable Standards

Reference to the standards of any society, institute, association, or governmental agency will pertain to the edition in effect as of the date of this CQAP, unless stated otherwise. Specific test standards for tests cited in this CQAP are provided in the technical specifications. These standards may be modified due to technological advances since completion of the technical specifications.

5. GENERAL CONSTRUCTION REQUIREMENTS

5.1 Prerequisite Contractor Training

5.1.1 Health and Safety Training

All contracted operating personnel will comply with US Magnesium's Contractor Safety Policy. As a part of contractor prequalification, US Magnesium requires that each prospective contractor receives a "US Magnesium Contractor's Safety Prequalification Form," which must be completed by the prospective contractors and reviewed by the US Magnesium safety department as a part of the contractor selection process. As specified in the Contractor Safety Policy, prior to starting work at US Magnesium, all contractor on-site supervisors and employees must attend a safety orientation. The orientation agenda consists of applicable information on the known potential fire, explosion, or hazardous chemical release hazards related to the contractor's work. The contactor's on-site employees also will be given an orientation tour of the work area they will be working in to identify specific hazards and ask questions.

Applicable US Magnesium safety policies (i.e., safe work permits, hot work permits, hearing protection, emergency action procedures, etc.) also will be explained. Each contractor employee will be subject to all applicable US Magnesium safety policies and procedures.

5.1.2 Project Familiarization

Prior to the start of construction activities, the Construction Contractor and the QC Monitor(s) will review and become familiar with the construction drawings and technical specifications. The QC Monitor(s) should also be familiar with the most recent construction schedule so that adequate resources (i.e., laboratory, field testing equipment, staff, and QC forms) including contingencies (i.e., backup equipment, alternate laboratory, and alternate QC staff) for CQC activities will be commensurate with the anticipated construction productivity and work schedule. All necessary measures should be taken to avoid delaying construction activities and the completion of the work.

5.2 Submittal and Work Acceptance Requirements

The Construction Contractor will provide submittals required by the CQA team in accordance with the construction drawings and specifications. When an area of the work site has been completed to the satisfaction of the Construction Contractor, the Construction Contractor will delineate the area and communicate with the QA Engineer that work in that area has been completed and is ready for final QA approval. Once the area has been inspected by the QA Engineer and QC testing in the area has been performed in accordance with this CQAP, the QA Engineer will communicate, in writing, to US Magnesium's Construction Manager that the delineated area meets the requirements in the construction drawings and specifications.

5.2.1 Construction Contractor Submittals

Construction Contractor submittals shall be submitted to US Magnesium's Construction Manager or designated representative and distributed to the CQA team unless otherwise directed by the Construction Manager. These submittals shall be reviewed and approved by the CQA team prior to procurement of respective construction materials or completion of associated work. Copies of all submittals shall be maintained with the project records.

5.2.2 Conformance Testing

Conformance testing of materials and constructed products shall be conducted at frequencies as specified in Sections 6 and 7 of this CQAP. The Construction Contractor(s) shall perform QC testing and document results for assessment and verification of conformance with project requirements. QA testing will be conducted and documented by the QA Engineer, as required. Copies of all conformance testing results shall be maintained with the project records.

5.2.3 Field Observations

The CQC and CQA teams shall observe construction activities associated with the project and record observations and testing results in assigned field books. Documentation from the field books will be organized and transferred onto daily field report forms that will be submitted to the US Magnesium Construction Manager or designated representative on a daily basis.

Non-compliance reporting shall be used by the CQC and CQA team as needed to report deficiencies, required remediation, and resolutions to issues. Completed non-compliance reports that thoroughly describe the need for additional work or suspect conditions shall be promptly submitted to the designated representative for the Construction Contractor and US Magnesium. The CQA team will regularly log each non-compliance issue as the project progresses to regularly track pending and/or resolved deficiencies.

Daily field reports and non-compliance reports will be maintained in the project records.

5.2.4 Requests for Information

The Construction Contractor(s) shall communicate issues such as constructability, discrepancies in the construction documents, requests for design support during construction, etc., to the CQA team and US Magnesium using a formal request for information (RFI) form (**Appendix A**). The CQA team will be responsible for responding to the RFI or coordinating with the US Magnesium to determine a response. Completed RFI forms and associated responses shall be maintained in the project records.

6. EARTHWORKS MONITORING

This section describes the earthwork construction activities that will be the responsibility of the Construction Contractor and QC monitoring requirements during the earthwork construction, which includes the following elements of construction:

- Clearing and Grubbing
- Borrow Pit Development
- Foundation Preparation
- Embankment Construction.

6.1 Foundation Preparation

The QC Monitor(s) will verify and document that the foundation of the embankment has been prepared in accordance with the construction drawings and technical specifications, as determined by the test methods and frequencies specified in this CQAP.

Upon completion of the foundation preparation, the QC Monitor(s) will perform the following tasks:

- Inspect the prepared foundation and note areas of weak or excessively weathered subgrade materials.
- Observe that the surface of the prepared foundation, including placement of the initial lift, is free of debris, ponded water, mud, ice, or frozen material.
- Verify that the prepared foundation material meets the requirements of the technical specifications, as determined by the QC testing methods and frequencies provided in **Table 6.1**.
- Observe and document foundation preparation and initial lift placement operations.

6.1.1 Construction Quality Control Testing

The frequency of soils testing for CQC purposes will conform to the minimum frequencies presented in **Table 6.1** for prepared foundation. Material properties will be determined from samples collected from the borrow area.

In-place nuclear density tests will be used for the verification of the in-situ dry unit weight of compacted foundation fill. If an in-place density test result fails to meet specification requirements, the QC Monitor(s) will relay to the QA Engineer the extent and nature of the defect by observations and/or additional testing, as necessary, to identify the limits of the area that do not meet project specifications. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the QC Monitor(s) will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the Construction Contractor, the QC Monitor(s) will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the Contractor in the area of the deficiency. All failing tests and retests will be recorded in the QC Monitor's field book, or on a compaction testing form and provided to the QA Engineer for review and approval. The approximate location of each test will be recorded based on pre-defined stationing.

6.2 Embankment Fill Placement

This section addresses fill placement associated with the embankment construction and specifies the earthwork QC testing program to be implemented for materials selection and evaluation, laboratory test requirements, field test requirements, and corrective action requirements.

6.2.1 Embankment Fill Placement and Compaction

QC Monitor(s) shall observe the embankment fill placement and compaction to verify and document the following:

- The material being placed meets the technical specifications requirements for fill materials, as determined by the test methods and frequencies specified in **Table 6.2**.

- The placement surface has been prepared as specified in the technical specifications.
- The compacted lift thickness is in accordance with the requirements of the technical specifications.
- The dry unit weight of the compacted fill meets specifications as determined by the test methods and frequencies described in **Table 6.2**.
- The geometry of the work conforms to the construction drawings.

6.2.2 Construction Quality Control Testing

The frequency of material testing for CQC purposes will conform to the minimum frequencies presented in **Table 6.2** for embankment fill. Material properties will be determined from samples collected either immediately after placement or from stockpiles.

In-place nuclear density tests will be used for verification of the in-situ dry unit weight of embankment fill. If an in-place density test result fails to meet specifications, the QC Monitor(s) will inform the QA Engineer the extent and nature of the defect by observations and/or additional testing, as necessary, to identify the limits of the area that does not meet project specifications. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the QC Monitor(s) will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the Construction Contractor, the QC Monitor(s) will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the Construction Contractor in the area of the deficiency. All failing tests and retests will be recorded in the QC Monitor's field book, or on a compaction testing form submitted to the QA Engineer for review and approval. The approximate location and elevation of each test will be recorded based on predefined stationing.

6.3 Surveying

Surveys will be performed by, or under the direction of, a PLS registered in the State of Utah. The surveyor will record elevations and in some instances grades of the fill layers (where applicable) including, but not limited to, those listed below:

- Location and elevation of each QC test location.
- Top of embankment (RWP Phase 1 final design elevation of 4218 feet above mean sea level [amsl]). It is the intent of the Phase I design that the final constructed embankment surface elevation achieves a minimum elevation of 4218 ft amsl.

The results of these surveys will be compiled in reports signed by the surveyor and submitted to the QA Engineer for review. The QA Engineer will then provide guidance to the Design Engineer on whether the work has been completed in accordance with the construction drawings and technical specifications. The surveyor will be required to survey each material layer in accordance with the requirements of this CQAP. A record drawing will be submitted to the Design Engineer for each area of work as the construction progresses and will form a component for progress payments.

6.4 Construction Testing

Embankment construction material sampling and testing will be performed by the QC Monitor(s) on borrow sources and in-place materials for verification of compliance with the technical specifications. A summary of the construction material testing and frequencies is provided in **Tables 6.1** and **6.2**. Applicable laboratory testing on borrow sources shall be conducted in accordance with this CQAP and the technical specifications prior to use. US Magnesium reserves the right to have additional QA testing performed on borrow and in-place materials at desired frequencies.

Table 6.1: Minimum Frequency of Testing for CQC Evaluation of Prepared Foundation

Test	Frequency	Standard Test Method
Testing During Construction		
Standard Proctor	1 per change in material or one for every 10,000 yd^3	ASTM D 698
Single Point Proctor	1 per 5,000 yd^3(minimum 1 per source or soil type)	AASHTO T 272
Unified Soil Classification System	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D 2487
Sieve analysis	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D 422
Atterberg limits	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D4318
In-Place Testing		
In-place wet unit weight	One test per 2500 yd^2 of embankment area per lift (minimum 2 tests per shift during placement of material)	ASTM D6938
In-place density (sand cone)	1 per 20 nuclear tests (minimum one test during in-place testing of material)	ASTM D 1556
In-place moisture content	One test per 2500 yd^2 of embankment area per lift (minimum 2 tests per shift during placement of material)	ASTM D6938
Standard count calibration	1 per day of fill placement (or for every 15 field tests whichever is more often)	ASTM D6938

ASTM – American Society for Testing and Materials
ft^2 – square feet

Table 6.2: Minimum Frequency of Testing for CQC Evaluation of Embankment Fill

Test	Frequency	Standard Test Method
Testing During Construction		
Standard Proctor	1 per change in material or one for every 10,000 yd^3	ASTM D 698
Single Point Proctor	1 per 5,000 yd^3 (minimum 1 per source or soil type)	AASHTO T 272
Sieve analysis	1 per 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D 422
Atterberg limits	1 pe 5,000 yd^3 (minimum 1 per source or soil type)	ASTM D 4318
In-Place Testing		
In-place wet unit weight	One test per 2500 yd^2 of embankment area per lift (minimum 2 tests per shift during placement of material)	ASTM D 6938
In-place density (sand cone)	1 per 20 nuclear tests (minimum one test during in-place testing of material)	ASTM D 1556
In-place moisture content	One test per 2500 yd^2 of embankment area per lift (minimum 2 tests per shift during placement of material)	ASTM D 6938
Standard count calibration	1 per day of fill placement (or for every 15 field tests whichever is more often)	ASTM D 6938

ASTM – American Society for Testing and Materials
ft^2 – square feet

7. HBW CONSTRUCTION MONITORING

This section describes the construction activities that will be the responsibility of the Construction Contractor and QC Monitor(s) during the installation of the HBW, which includes the following elements of construction:

- Slurry mixing
- Trench excavation, including slurry installation
- Soil and sepiolite backfill mixing
- Soil-sepiolite trench backfilling.

7.1 Sepiolite

The QC Monitor(s) will verify and document that the sepiolite to be used for the HBW meets the requirements of the technical specifications, as determined by the test methods and frequencies specified in this CQAP.

Prior to construction, the Construction Contractor shall submit the following to US Magnesium and the HBW QC Contractor and the QA Engineer:

- The name of the sepiolite supplier, the source of the sepiolite, and a sample of the sepiolite
- For each proposed source of sepiolite, the contractor must submit the results of the following tests: viscometer (API 13A); and residue larger than 75 micrometers (µm) (API 13A)
- For each truck or railcar shipment of sepiolite, the Construction Contractor must submit the results of the following tests: YP/PV ratio (API 13A), filtrate loss (API 13A), and moisture content (ASTM D2216).

During construction, the Construction Contractor shall submit the following to US Magnesium and the HBW QC Contractor and QA Engineer:

- For each designated load of sepiolite, the manufacturer's certifications and laboratory test results that demonstrate that the sepiolite meets contract specifications.
- A weekly log of sepiolite deliveries that includes the following information: date, source, time of delivery, weight, and laboratory quality control test results supplied by the manufacturer.

7.2 Trench Excavation

This section addresses the monitoring of the excavation of the HBW trench to be conducted by the HBW Specialist and QC Contractor (QC Monitors).

7.2.1 Trench Depth and Alignment

The QC Monitor(s) and HBW Specialist shall observe the excavation of the HBW trench and document the following:

- The top and bottom trench elevation at 20-foot horizontal intervals.
- Elevation at which the confining layer is encountered at 20-foot horizontal intervals.
- Sampling of the approximate top of confining layer. A grab sample will be collected from the top of the confining clay layer from the start of the HBW alignment and every 500 ft of excavated trench and analyzed for grain size distribution (ASTM D422) and Atterberg Limits (ASTM D4318).
- Collect sample cuttings from the bottom of the trench at 20-foot horizontal intervals.
- Confirmation that the trench has been excavated a minimum of one bucket in depth (minimum 3 feet) into the confining layer at 20-foot horizontal intervals.
- Observations and segregation of oolitic sands encountered during excavation. To account for swelling of the soil-sepiolite backfill, horizons potentially containing oolitic gravels/sands will be preferentially wasted and placed within the extent of the RWP.

- The geometry of the work conforms to the construction drawings.

7.2.2 Surveying

Surveys will be performed by, or under the direction of, a PLS registered in the State of Utah. The surveyor will record elevations and coordinates of the HBW (where applicable) including, but not limited to, those listed below:

- Coordinates and elevation of the HBW centerline
- Beginning and ending coordinates of each completed HBW panel.

The results of these surveys will be compiled in reports signed by the surveyor and submitted to the QA Engineer for review. The QA Engineer will then provide guidance to the Design Engineer on whether the work has been completed in accordance with the construction drawings and technical specifications. A record drawing will be submitted to the Design Engineer for each completed section of the HBW as the construction progresses and will form a component for progress payments.

7.3 Trench Slurry

This section addresses the monitoring of the HBW slurry to be conducted by the HBW Specialist and QC Monitor(s) and specifies the QC testing program to be implemented for the HBW slurry.

7.3.1 Slurry at Mixing Area

The HBW Specialist and QC Monitor(s) shall inspect the slurry mixing operation to confirm that the operation is resulting in a well-mixed and consistent slurry. QC testing of the slurry at the mixing area shall be conducted in accordance with requirements listed in **Table 7.1**.

7.3.2 Slurry Inside Trench

During the installation of the slurry into the trench, the HBW Specialist and QC Monitor(s) shall observe that the slurry does not segregate and will record the top elevation of the slurry in the trench matches the elevation of the top of berm. QC testing of the slurry installed inside the trench shall be conducted in accordance with requirements listed in **Table 7.1**.

7.4 Sepiolite-Soil Backfill

This section addresses the monitoring of the sepiolite-soil backfill to be conducted by the HBW Specialist and QC Monitor(s) and specifies the QC testing program to be implemented for the trench slurry.

7.4.1 Soil

Samples of the soil excavated from the trench and used in the soil-sepiolite backfill shall be tested in accordance with requirements listed in **Table 7.2**.

7.4.2 Soil-Sepiolite Backfill Inside Trench

The Construction Contractor shall obtain samples of the soil-sepiolite backfill installed inside the trench during construction in accordance with requirements listed in **Table 7.2**.

7.5 Construction Testing

Construction material sampling and testing will be performed by the QC Monitor(s) on the slurry and soil-sepiolite backfill for verification of compliance with the technical specifications. A summary of the required construction material testing and corresponding frequencies is provided in **Tables 7.1** and **7.2**. Applicable laboratory testing on borrow sources shall be conducted in accordance with this CQAP and the technical specifications prior to use. US Magnesium reserves the right to have additional QA testing performed on borrow and in-place materials at desired

frequencies. Costs associated with additional QA testing, at the option of US Magnesium, will be the responsibility of US Magnesium.

Table 7.1: Minimum Frequency of Testing for Trench Slurry

Test	Frequency	Standard Test Method
Mixing Area		
Marsh Funnel Viscosity	Twice per 8-hour shift	API RP 13B-1
Density	Twice per 8-hour shift	ASTM D4380
Filtrate loss	Twice per 8-hour shift	API RP 13B-1
pH	Twice per 8-hour shift	API RP 13B-1
Sepiolite Content	Twice per 8-hour shift	Weight-Volume
Inside Trench		
Marsh Funnel Viscosity	Two tests per 8-hour shift, 15 feet from slurry in trench at 20 feet distance from toe of backfill, trench mid-depth and bottom	API RP 13B-1
Density	Two tests per 8-hour shift, 15 feet from slurry in trench at 20 feet distance from toe of backfill, trench mid-depth and bottom	ASTM D4380
Sand Content	Two tests per 8-hour shift, 15 feet from slurry in trench at 20 feet distance from toe of backfill, trench mid-depth and bottom	API RP 13B-1
Filtrate Loss	One test per 8-hour shift, 15 feet from slurry in trench at 20 feet distance from toe of backfill, trench mid-depth and bottom	API RP 13B-1

API – American Petroleum Institute
ASTM – American Society for Testing and Materials
ft^2 – square feet

Table 7.2: Minimum Frequency of Testing for CQC Evaluation of Soil-Sepiolite Backfill

Test	Frequency	Standard Test Method
Soil Testing During Construction		
Particle Size Analysis	One test for every 500 yd^3	ASTM D422
Moisture Content	One test for every 500 yd^3	ASTM D2216
Atterberg limits	One test for every 500 yd^3	ASTM D4318
Soil-Sepiolite Testing Inside Trench During Construction		
Particle Size	Two tests per day, or once every 200 linear feet of installed HBW, at 25 vertical foot vertical intervals, whichever is greater.	ASTM D422
Hydraulic Conductivity	One test per day or once every 200 linear feet of installed HBW at 25 vertical foot vertical intervals, whichever is greater.	ASTM D5084
Slump	Two tests per 8- hour shift.	ASTM C143
Density	Two tests per 8- hour shift.	ASTM D4380

ASTM – American Society for Testing and Materials
ft^2 – square feet

8. CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

8.1 Documentation

A major function of CQA is to ensure that the work has been properly and adequately documented in accordance with the construction drawings and specifications. This section describes the minimum required QA/QC documentation.

8.1.1 QA/QC Testing Documentation

The QC Monitor(s) and QA Engineer will prepare daily field reports, field data sheets, sample labeling schemes, and chain-of-custody procedures as they are needed. Below is a list of QA/QC testing field forms to be used and example forms are provided as appendices:

- Soil Compaction Field Form (**Appendix A**)
- In-Place Nuclear Testing Form (**Appendix B**)
- Record of Non-Compliance Test Form (**Appendix C**)

8.1.2 Daily Field Reports

Daily field reports, provided as **Appendix D**, will be completed by the QC Monitor(s). Additionally, QA and QC personnel will record field observations and the results of field tests either in their assigned field book or on field data sheets. Field books assigned to CQC and CQA personnel will be labeled with a unique number. When not in use, field books will be left in the field records file. After each book is filled (or at the end of the project), the field book will be retained in the QA Engineer's project files. Each page of the field book will be numbered, dated, and initialed by the QA/QC personnel. At the start of a new work shift, the QA/QC personnel will list the following information at the top of the page:

- Job name
- Job number
- Date
- Name
- Weather conditions
- Page number (if pages are not pre-numbered)

The remaining individual entries will be prefaced by an indication of the time at which they occurred. If the results of test data are being recorded on separate sheets, it will be noted in the field book. Entries in the field book will include, but not be limited to, the following information:

- Reports on any meetings held and their results
- Equipment and personnel being used in each location, including construction subcontractors
- Descriptions of areas being observed and documented
- Descriptions of materials delivered to the site, including any quality verification (vendor certification) documentation
- Descriptions of materials incorporated into construction
- Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration
- Decisions made regarding use of material and/or corrective actions to be taken in instances of substandard quality
- Reporting of issues and corrective measures used to substantiate decisions made
- Unique identifying sheet numbers of inspection data sheets.

At the end of each day, the QA/QC field personnel will summarize the day's activities on a Daily Field Report form (**Appendix D**). The Daily Field Report will include a brief summary of the day's activities and highlight any unresolved issues that must be addressed by the QA Engineer or by the QC Monitor(s) the following day. The Daily Field Report and a copy of the field book notes for each day will be distributed as follows:

- US Magnesium Representative
- US Magnesium Construction Manager
- Construction Contractor
- QA Engineer.

8.1.3 Inspection Data Sheets

All observed field and laboratory test data will be recorded on either a paper or electronic Inspection Data Sheet and retained in the Construction Contractor's project file. At a minimum, each Inspection Data Sheet will include the following information:

- Unique identifying sheet number for cross-referencing and document control
- Description of the inspection activity
- If appropriate, location of the inspection activity or location from which the sample was obtained
- Type of inspection activity and/or procedure used (reference to standard method when appropriate)
- Any recorded observation or test data, with all necessary calculations
- Results of the inspection activity and comparison with specification requirements
- Identification of any personnel involved in the inspection activity
- Signature of the individual(s) performing the CQC activity.

8.1.4 Record Drawing Maintenance

The Construction Contractor will maintain a complete set of the construction drawings labeled "Red-Line" as-built drawings and will mark changes as the construction progresses. At the completion of the project, the Red-Line as-built drawings will be submitted to the Design Engineer, and the Design Engineer will electronically update the native CAD files as the Record Drawings.

8.1.5 Non-Compliance Reporting

A "non-compliance" is considered to be a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. If a deficiency cannot be repaired or replaced to the satisfaction of the QA Engineer within the guidelines established by this CQAP, then such a deficiency will be considered a non-compliance and will be documented in a non-compliance form (**Appendix F**). The non-compliance form will be submitted to the US Magnesium Construction Manager for disposition and initiation of a corrective action process. All situations will be brought to the attention of the Design Engineer, US Magnesium Construction Manager, and the QA Engineer for concurrence. All documentation relating to these situations will be retained in the project QA records and reported to DWQ verbally or electronically via email.

A deficiency that is discovered during work activities that has a process already established to correct the deficiency (i.e., failed compaction test) will be tracked by the QC Monitor(s) until it is corrected. A non-compliance report is not required in these cases.

8.1.6 Progress Reports

The Construction Contractor's Project Manager will prepare a progress report each week, or at time intervals established at the pre-construction meeting. An example Weekly Progress Report form is provided in **Appendix G**.

At a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control.
- The date and project name.
- A summary of work activities accomplished during the progress reporting period.
- Identification of areas or items inspected and/or tested during the reporting period that is addressed by the report.
- A summary of the quality characteristics being evaluated, with appropriate cross-references to specifications and/or drawings.
- References to the construction specifications or drawings defining the acceptance criteria for each inspected characteristic.
- A summary of inspection and test results, failures, and retests.
- A summary of construction issues, deficiencies, and/or defects occurring during the progress reporting period.
- A description of how deficiencies were resolved.
- A summary of other issue resolutions and dispositions.
- An updated project schedule.

The progress report will be submitted to the US Magnesium Construction Manager or designated representative no more than two days after the last reporting day in the progress reporting period.

8.1.7 Final Documentation

Daily field reports, inspection sheets, issue identification and corrective measures reports, acceptance reports, photographic records, progress reports, drawings, drawing revisions, and other pertinent documentation will be retained by the QA Engineer as permanent project QA records to be retained by the Design Engineer. At the completion of the project, a final CQA report that incorporates such information, along with as-built drawings, will be prepared by the CQA team. The report will include documentation of each construction component monitored by CQA personnel and will be signed, stamped, and certified by the Design Engineer.

The Design Engineer will be responsible for generation of the final as-built Record Drawings, based on survey information provided by a PLS licensed in the State of Utah (refer to Section 6.3 for survey requirements) and red-lined drawings provided by the Construction Contractor. The as-built records will include scale drawings depicting depths, plan dimensions, elevations, and fill thicknesses for the Phase 1 earthwork and the Phase 2 HBW. The final Record Drawings will accompany the CQA report and will be submitted to US Magnesium's Construction Manager and forwarded to the appropriate regulatory agencies for approval for each phase of the RWP construction.

8.1.8 Storage of Records

During construction, the QC Monitor(s) will be responsible for all CQC documents. This includes the QC Monitor(s)' copy of the design criteria, plans, procedures, and specifications; the CQAP; and the originals of all the data sheets and reports. The field records will be kept in metal cabinets, or on metal shelving, within a facility designed to mitigate potential fire hazards. At the completion of the project, all completed documents will be routed to the QA Engineer including all the original field books, maintenance of a records index, access control, and duplicate records requirements. One copy of the final CQA Report and final Record Drawings will be retained on the Facility as part of the Project File.

8.1.9 Storage of Archive Construction Material Samples

The QC Monitor(s) will be responsible for storing construction material samples collected during the duration of the project. All samples will be stored neatly in a cool, dry location as approved by the QA Engineer. The QC Monitor(s) will coordinate with the QA Engineer to determine which samples will be archived at the project completion.

9. REFERENCES

American Association of State Highway Transportation Officials (AASHTO), 1993. Standard Method of Test for One-Point Method for Determining Maximum Dry Density and Optimal Moisture, AASHTO T 272. January 1 .2018

American Petroleum Institute (API), 1993. Specification for Drilling-Fluid Materials, API Specification 13A. Fifteenth Edition. May 1 .1993.

American Petroleum Institute (API), 2003. Recommended Practice for Field Fluid Testing Water-Based Drilling Fluids, API RP 13B-1. December. 2003.American Society for Testing and Materials (ASTM), 1997. 1997 Annual Book of ASTM Standards, Volume 4.08: Soil and Rock (I). American Society for Testing and Materials, Philadelphia, Pennsylvania.

APPENDIX A:
Soil Compaction Field Form

APPENDIX B:
In-Place Nuclear Testing Form

APPENDIX C:
Record of Non-Compliance Test Form

APPENDIX D:
Daily Field Report Form

APPENDIX E:
Notice of Non-Compliance Log

APPENDIX F:
Weekly Progress Report