

HARDROCK PROJECT CONCEPTUAL EXPLOSIVES AND BLASTING MANAGEMENT PLAN



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1.0 INTRODUCTION AND ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN OVERVIEW

Greenstone Gold Mines (GGM) is committed to minimizing environmental effects through the implementation of mitigation measures, monitoring and adaptive management for the Hardrock Project (the Project) within Environment Management and Monitoring Plans (EMMPs) for construction and operation. Through the EMMPs, the Project's environmental risks and opportunities are addressed in a comprehensive, systematic, planned and documented manner to meet the following objectives:

- The Project is carried out in compliance with existing legislation, consistent with Federal and Provincial guidelines, best practices and GGM corporate policies;
- Measures to mitigate environmental effects are documented;
- Benefits from the Project are enhanced; and
- Reporting is structured to inform adaptive management and continual improvement.

The EMMPs guide environmental management for the Project and are progressively developed as the Project moves through the EIS/EA, permitting, and construction, and updated based on continual improvement during operations through adaptive management.

EMMP development begins during the EIS/EA stage with the preparation of Conceptual Environmental Management Plans. These EMMPs are broad in their level of detail, commitment-based and focused on the construction and operation phases of the Project. They include input received from consultation during the Draft EIS/EA stage. The closure phase is addressed in the Conceptual Closure Plan. The level of detail in the EMMPs advance as the Project moves through more detailed engineering and planning and as permit/regulatory requirements are available.

1.1 Environmental Management and Monitoring Plans

The Project's Environmental Management System, includes a comprehensive set of management and monitoring plans collectively referred to as Environmental Management and Monitoring Plans (EMMPs). The EMMPs outline environmental protection measures to mitigate potential environmental effects.

The EMMPs include:

- Water Management and Monitoring Plan;
- Conceptual Waste Rock Management Plan;
- Conceptual Emergency Response Plan;
- Conceptual Waste Management Plan;
- Conceptual Erosion and Sediment Control Plan;
- Conceptual Greenhouse Gas Management and Monitoring Plan;
- Conceptual Air Quality Management and Monitoring Plan;
- Conceptual Spill Prevention and Response Plan;

- Conceptual Soil Management Plan;
- Conceptual Noise and Vibration Management and Monitoring Plan;
- Conceptual Explosives and Blasting Management Plan;
- Conceptual Aquatic Management and Monitoring Plan;
- Conceptual Biodiversity Management and Monitoring Plan; and
- Conceptual Archaeology and Heritage Resource Management Plan.

These Plans are considered “living” documents and will be updated as needed in support of environmental management activities during future permitting, development and operation phases.

2.0 PROJECT SUMMARY

Mining of the Hardrock deposit has been designed as an open pit. The process plant will operate 365 days per year with a Life of Mine (LOM) of approximately 15 years. The mill throughput ranges from 24,000 tonnes per day (tpd) for approximately the first two years of operation (i.e., Mill Phase 1), increasing to 30,000 tpd for the balance of operation (i.e., Mill Phase 2). The overall Project development schedule will consist of the following main phases, during which various Project activities will be completed:

- Construction: Years -3 to -1 with early ore stockpiling commencing after the first year of construction.
- Operation: Years 1 to 15, with the first year representing a partial year as the Project transitions from construction to operation.
- Closure:
 - Active Closure: Years 16 to 20, corresponding to the period when primary decommissioning and rehabilitation activities are carried out.
 - Post-Closure: Years 21 to 36, corresponding to a semi-passive period when the Project is monitored and the open pit is allowed to fill with water creating a pit lake.

The key components of the Project are as follows:

- open pit
- waste rock storage areas (WRSAs) (designated as WRSA A, WRSA B, WRSA C and WRSA D)
- topsoil and overburden storage areas
- ore stockpile
- crushing plants and mill feed ore storage area
- process plant
- tailings management facility (TMF)
- water management facilities for contact water including collection ditches and ponds
- power plant and associated infrastructure

- liquefied natural gas plant
- explosives facility
- buildings and supporting infrastructure
- water supply and associated infrastructure
- sewage treatment plant
- effluent treatment plant
- lighting and security
- site roads and parking areas
- watercourse crossings and habitat compensation/offsets
- Goldfield Creek diversion
- onsite pipelines
- fuel and hazardous materials
- aggregate sources
- temporary camp

Project activities include the relocation of existing infrastructure currently located within the PDA, including a portion of Highway 11, a Ministry of Transportation (MTO) Patrol Yard, and Hydro One Networks Inc. (Hydro One) facilities.

3.0 MANAGEMENT AND MONITORING PLAN PURPOSE

3.1 Purpose

The purpose of the GGM Hardrock Project Conceptual Explosives and Blasting Management Plan is to provide direction for the safe storage, handling and use of explosives and explosive components at the Project, in order to ensure the safety of the public and site personnel, and protect both the environment and Project infrastructure.

3.2 Performance Objectives

Objectives are established to drive continuous improvement in environmental performance and are consistent with the overall strategic goals of the Project and GGM policies. Objectives are measurable (if practicable), monitored, communicated, and updated as appropriate. When planning how to achieve its environmental objectives, GGM will determine the required actions, resources, responsibilities, timelines, how they will be integrated into existing business processes, and how the results will be evaluated.

In support of GGM's overarching environmental objective (to work to prevent or mitigate any environmental impacts, meet or exceed regulatory requirements and strive to continually improve our environmental practices and performance), GGM has established the following performance objectives for the safe storage, handling and use of explosives and explosive components that considers the key Project interactions and compliance obligations.

This Explosives and Blasting Management Plan is designed to meet four performance objectives, as follows:

- To have a Workplace Hazardous Materials Information System (WHMIS) in place at the commencement of construction of the Project, that will continue for the life of the Project with adjustments as required to reflect changing types and levels of blasting activities and the knowledge gained over time.
- To maintain an inspection procedure that confirms the effectiveness of the explosives storage and manufacturing facilities, that includes maintaining an inventory of explosives, as well as their handling, transportation and application, that ensures compliance with established safety systems throughout the life of the Project.
- No unintended property damage or injury to persons or wildlife onsite or adjacent.

4.0 SCOPE

The scope of the Conceptual Explosives and Blasting Management Plan applies to the area of the Project that will undergo changes through construction and/or operation to accommodate the advancement of Project and associated monitoring. The Conceptual Explosives and Blasting Management Plan applies to the construction and operation phases of the Project with closure phase included in the Conceptual Closure Plan.

The Conceptual Explosives and Blasting Management Plan applies to individuals working for or on behalf of GGM, including employees and contractors, which have a role and/or accountability for the development, implementation and maintenance of this EMMP.

GGM will make reasonable efforts that suitably qualified (licenced where applicable) contractors are used for the transport of materials, supplies and waste materials, and that contractors have appropriate controls and management plans in place to reduce the likelihood of incidents during transport. Similarly, Project components under the management and maintenance by third parties are outside the scope of this EMMP. The scope of the Conceptual Explosives and Blasting Management Plan applies to Project infrastructure and management under the care and maintenance of GGM.

5.0 PLANNING

5.1 Organizational Roles and Responsibilities

All persons working for or on behalf of GGM, including employees and contractors, have a role in the successful implementation and maintenance of the Conceptual Explosives and Blasting Management Plan. Table 5-1 outlines roles and responsibilities for this Plan activities.

Table 5-1. Conceptual Roles and Responsibilities

Role	Responsibility
Explosives Contractor (Foreman and other personnel as delegated)	<ul style="list-style-type: none"> • Management, manufacture, storage, transport and blasting of explosives. • Regular reporting (timing to suit project requirements) with Mine Manager on quantities of materials and mixed explosives on site. • Communications regarding timing of transportation of explosives materials to site security. • Implementation of best management practices for the containment of explosives materials, including spilled materials and clean-up of the same.
Mine Manager	<ul style="list-style-type: none"> • Responsible overall mining activities
Drill and Blast Supervisor	<ul style="list-style-type: none"> • Coordinating with explosives contractor the delivery of explosives to the open pit to meet mine plan and operational requirements • Notification procedures for general public prior to blast events, should work be required in areas of potential public access (e.g. if blast radius extends to Trans Canada Highway 11, or Kenogamasis Lake). • Responsible for clearing area of public if applicable, and cordoning off of blast zone at access points. • Responsible for notification of all clear after blast event and removing access barriers for public (if required). • Stop work and secure areas in the event of inadvertent explosive discharge. • Implement procedures outlined in Emergency Response Plan. • Establishment of notification procedures for GGM staff and contractors prior to blast events and protocol for countdown to event and local notifications at access point(s) to blast zone. • Responsible for clearing area if applicable, and cordoning off of blast zone at access points. • Responsible for notification of all clear after blast event and removing access barriers.
Health and Safety Manager	<ul style="list-style-type: none"> • Ensures proper training delivered to staff regarding blasting notification procedures and blast zone area for safety of persons and wildlife. • Takes active role in investigation and reporting/regulatory notification in the event of incidents.
Workers / Supervisors	<ul style="list-style-type: none"> • Be aware of blasting schedule and movements of explosives around the site and responsive to notifications to avoid blast zone area. • Be familiar with appropriate emergency response procedures. Immediately cease work in an affected area, ensure safety of self and others, and report inadvertent explosive discharge according to procedures outlined in Emergency Response Plan.
OPP / Fire / Ambulance	<ul style="list-style-type: none"> • Assist with cordoning off areas from the public, if applicable. Respond to emergencies as requested by authorized site personnel according to procedures outlined in Emergency Response Plan.

5.2 Compliance Obligations

The Conceptual Explosives and Blasting Management Plan is developed and implemented to comply with applicable legislative, regulatory, permit and other relevant obligations, outlined in the following sections.

5.2.1 Environmental Assessment Process Requirements

5.2.1.1 Provincial Terms of Reference

As described in the Approved Terms of Reference, the EA includes a variety of environmental protection and management measures to guide the planning, design, construction, operation and closure of the Project (section 4.1.4) and identification of a monitoring framework related to compliance and effects monitoring (section 8.2).

5.2.1.2 Federal Environmental Impact Statement Guidelines

The EIS Guidelines for the Hardrock Project include development and implementation of follow-up and monitoring programs (section 8.0). The follow-up program verifies the accuracy of the effects assessment and the effectiveness of the measures implemented to mitigate the adverse effects of the Project. The goal of a monitoring program is to ensure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of the Project and to provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety.

5.2.1.3 Draft EIS/EA Report

Section 24 of the Draft EIS/EA includes a listing of proposed Follow-up Monitoring and Environmental Management Plans, which included a commitment to produce a Conceptual Explosives and Blasting Management Plan. This Plan is intended to detail procedures and protocols regarding material storage and blasting operations. The plan will outline control measures to be followed in order to prevent effects to operations and limit vibration beyond the PDA. It will also address the storage and mixing of explosives

Subsequent to the draft EIS/EA submission, comments were raised by several parties requesting additional clarification on the type and quantity of explosives material to be used and additional information of the blasting methodology. Available information has been incorporated to develop this Conceptual Explosives and Blasting Management Plan. This conceptual plan will be updated for construction and operation updated an explosives contractor is in place to inform details on storage, manufacturing and use.

5.2.2 Regulatory Requirements

5.2.2.1 Federal Regulatory Requirements

The manufacture and use of explosives in Canada is governed by the federal *Explosives Act*. Section 6 that prohibits the manufacture of explosives except in a licensed factory, and the storage of explosives except in a licensed magazine.

Additional requirements are provided in:

- The *Explosives Regulations, 2013* (SOR/2013-211) outline the requirements for an application for a license;
- *Ammonium Nitrate Storage Facilities Regulations* (CRC, c 1145);
- *Transportation of Dangerous Goods Regulations* (SOR/2001-286);

- *Environmental Emergency Regulations* (SOR/2003-307 as amended by SOR/2011-294); and
- NRCan's (2014) Guidelines for Bulk Explosives Facilities.

5.2.2.2 Provincial Regulatory Requirements

There are no additional Provincial requirements governing the storage and use of explosives at the Project.

5.2.2.3 Municipal Regulatory Requirements

There are no additional Municipal requirements governing the storage and use of explosives at the Project.

5.2.3 Other Agreements, Commitments, Requirements

GGM will develop measures to coordinate external emergency response with local municipal administration and first response agencies in accordance with the Emergency Response Plan.

6.0 SUPPORT

6.1 Identification/Inventory of Resources

For a description of explosives storage and use, see section 7.1.

6.2 Competence, Training and Awareness

GGM requires that persons working under its management, including employees and contractors, have the knowledge, understanding, skills and abilities to complete work in a manner that protects the environment. The following actions will be established to provide worker competency, training and awareness:

- Training in communications procedures leading up to a blast (e.g. notification signals, blast notice posting locations, timing of notifications);
- Training in general procedures during blasting (e.g. personnel movements on site, blast zone); and
- Training in emergency response and communication measures in the event an incident;

7.0 Implementation of Mitigation Measures

7.1 General Approach

Emulsion will be used to provide the explosives needed for mining. The approach to emulsion production involves the use of an emulsion truck, which allows the mixing of ammonium nitrate

solution (ANSOL) and fuel to form emulsion directly at the blast hole location in the pit. The storage facility will house bulk ingredients required for producing the emulsion explosives used in the blast holes. The ingredients (ANSOL, fuel, gasser and water) are not considered explosives as they will be stored in separate tanks and not mixed until located at the blast hole.

In Year -1, the bulk emulsion ingredients will be stored onsite in individual temporary container systems. During operations, the bulk emulsion ingredients will be stored in a dedicated onsite facility. The facility will be constructed by GGM and operated by an explosives contractor. It will house a mechanic garage, heated storage, air compressor room, boiler room, electrical room, truck wash bay, loading bay, blasting personnel offices, and washrooms. ANSOL and diesel fuel tanks will be located outside of the building. The facility will be equipped to deal with spills of hazardous materials. The storage facility will be designed and sited in accordance with the *Explosives Act* and regulations as published by the Explosives Regulatory Division of Natural Resources Canada (NRCan).

Magazines will be utilized in the PDA to store packaged explosive products and blasting accessories at the site. Magazines will be kept locked at all times when an authorized person is not present. Clearly visible “Danger Explosives” and “No Smoking or Open Flame” signage will be posted on the magazines and warning signs will be on the road approaching the storage areas. The magazines will be dedicated to storing blasting accessories such as boosters, delays, detonating cord and detonators, as well as a limited quantity of packaged explosives for specialty blasting purposes. The detonators and delays will be stored in a separate magazine as required by regulations. Access to the magazines will be restricted by a locked gate to authorized personnel and logbooks will be kept in each magazine for tracking purposes. The magazines will be supplied by owner/operator and permitted in coordination with the contractor.

GGM will award a contract to a competent and licensed explosives supplier. Blasting will be carried out by the specialized contractor working in coordination with the mine team.

7.2 Explosives Transport

Transport of explosives throughout the Project will be undertaken by the explosives contractor using dedicated trucks operated by properly trained and authorized personnel, and in accordance with applicable laws, regulations, and conditions of approval.

Explosives will be transported from the explosives storage and manufacturing facilities to the open pit by way of the internal Project haul road. Only those explosives which are intended for immediate use will be transported; there will be no stockpiling/storage of explosives at locations other than the explosives storage and manufacturing facilities.

During the construction phase of the project, there is the potential for a temporary magazine onsite for storage of pre-packaged explosives, until such time as the explosives storage and manufacturing facilities has been constructed.

7.3 Blasting Procedures

Blast designs will be developed by GGM technical team. Blasting activities, including transport, set up, and detonation will be carried out by appropriately trained, licensed, and authorized personnel only. No other personnel will be permitted within the blasting zone, which is inclusive of the anticipated blast (fly) rock area.

Blasting activities will include mine production blasting, block rock with blast holes drilled in several rows, and pit wall pre-split blasting, consists of a row of closely-spaced holes along the design excavation limit of interim and final walls. Blasts will be planned and implemented to optimize the amount of explosives used. Blast hole loading and firing activities will be performed during the day only and blast firing is expected to be five blasts a week. Blast firing will occur mainly during lunch time when mine operators are outside of the open pit. Prior to blasting, a blast clearance will be provided to the blasting team from the Greenstone Regional Airport and Nakina Airport and internally from GGM personnel.

Staff will be notified of blasts by various means which may include (but are not limited to): daily health and safety “tailgate” meetings, signage at standard locations around the site, mine radio announcements, and electronic means. An alarm system will be in place to provide an audible warning signal prior to blasting, and to indicate an all clear signal following the blast. The Project is closed to public access for mine safety and it can be assumed that the public would not be present in this area. It would therefore not be necessary to provide advance notice.

Blast patterns and timing will be optimized to minimize the quantity of explosives to be used, and minimize the potential for extraneous noise and vibration.

A blast setback zone around the open pit, where entrance by personnel is prohibited during blasting, will be developed with the mine engineering team, taking into account the anticipated typical blast size. This zone may extend as much as 300 to 400 metres from the edge of the open pit. No blasting will occur in proximity to fuel storage facilities.

In order to avoid harassment of animals, the immediate area of the blast will be surveyed by Project environmental staff within a few hours prior to a blast, with blasting temporarily suspended should sensitive species (moose, bear) or Species at Risk be observed. Operation may continue once the animals have moved on from the area. Where possible, measures may be taken (such as noisemakers) to discourage animals from occupying these areas during blast times. Only where a danger to wildlife exists will deterrents be used.

Blasting is not expected to occur within waterbodies. For blasting which occurs within the vicinity of a fish-bearing waterbody, the detailed blast design will consider DFO regulatory requirements.

Archaeological sites are not known to occur in the open pit area based on the field work carried out. If blasting were to be required in the vicinity of an identified archaeological site, precautions would be taken to ensure fly rock and vibration does not disturb the site. Protective covering and other appropriate measures may be taken to ensure the integrity of the site. Blasting in these areas will be carried out in consultation with the site environmental manager.

To reduce the potential for damage as a result of vibration effects from Project activities construction activities are to be avoided within 60 m of CHR 1 (heritage residence owned by GGM and used as a staffhouse). A buffer zone of 60 m will be used to isolate CHR 1 from Project activities. By isolating activities, the resource can be retained *in situ* with minimal effects anticipated in order for the building to be used to support construction and operation personnel. Site plan controls, such as flagging, can be put in place to prevent potential indirect effects as a result of the Project. These controls will be indicated on applicable construction mapping and communicated to the construction team leads.

If Project activities need to encroach upon the 60 m buffer zone, GGM will consult a qualified building condition specialist, specializing in structures built to 20th century or later Euro-Canadian constructions standards, prior to the commencement of Project activities. If the building is deemed to be unsafe, it may be demolished as per the Conceptual Archaeological and Heritage Resource Management Plan.

Adaptive management will be undertaken to address concerns related to aspects related explosives and blasting as they arise. Potential scenarios may include changes to the way Project personnel are notified of the blasting schedule, complaints from nearby property owners, potential for damage to Project infrastructure or harm to the environment. The Conceptual Noise and Vibration Management and Monitoring Plan provides monitoring and mitigation measures related to these aspects at the various points of reception (PORs) in the vicinity of the Project.

Mitigation and monitoring activities associated with decommissioning, reclamation and rehabilitation during the closure phase is presented in the Conceptual Closure Plan.

8.0 MONITORING, EVALUATION AND REPORTING

8.1 Monitoring, Measurement, Analysis and Evaluation

The purpose of the monitoring program is to evaluate and document if the Conceptual Explosives and Blasting Management Plan successfully achieves its performance objectives of safe storage, handling and use of explosives and explosive components at the Project.

Activities may include:

- Weekly reporting from explosives contractor of quantities of explosives and explosive components on hand;
- Reporting of weekly explosives usage (timing and quantities);
- Recording of complaints and subsequent follow up (monthly and/or weekly);
- Timely reporting of incidents and near misses with regard to the manufacture, transport, and use of explosives at the Project.
- Information collected will be reviewed by the Drill and Blast Supervisor to determine the effectiveness of the mitigation measures in this plan and adjustments made as needed in accordance with the adaptive management approach for the Project.

8.2 Reporting

The form and frequency of follow-up reporting will be determined as the Project progresses through EA and permitting, however, it is anticipated that those elements relevant to the Conceptual Explosives and Blasting Management Plan will be assembled into a formal summary report and provided to interested parties on an annual basis during construction and operation and during closure in years when monitoring is carried out. The reporting will be used to inform adaptive management reviews. Receiving, documenting and responding to communication from external interested parties, including complaints, will also form part of reporting under this Plan.

8.3 Continual Improvement

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning from their outcomes. Adaptive management provides the flexibility to address/accommodate new circumstances, to adjust monitoring, implement new mitigation measures or modify existing measures.

GGM will identify and correct incidents with appropriate and lasting measures aimed to prevent reoccurrence and/or similar occurrences. The Adaptive Management Framework (Figure 8-1), provides a formalized approach to:

- formally track and monitor activities;
- report and as needed investigate incidents, including non-conformance and non-compliance events;
- develop and implement corrective and preventive actions; and
- continue monitoring and update relevant EMMPs.

Corrective actions will be assigned as appropriate, including actions to prevent their reoccurrence. Corrective actions will vary according to the results of incident investigation and in consideration of other incidents related to the Conceptual Explosives and Blasting Management Plan.

GGM is committed to the continual improvement of its environmental management and performance. As part of the GGM Adaptive Management Framework, the Conceptual Explosives and Blasting Management Plan will be assessed annually to verify implementation and the continued suitability, adequacy and effectiveness of the Plan. The review will identify elements of this EMMP in need of revision, and evaluate performance against established performance objectives.

Figure 8-2 presents the overall approach to developing and advancing the EMMPs from the final EIS/EA to the construction Phase of the Project. The first stage of EMMP development begins with preparation of Conceptual Environmental Management Plans as part of the final EA/EIS.

These Conceptual EMMPs are commitment-based and broad in their level of detail. The EMMPs guide environmental management for the Project and are progressively developed as the Project moves through the EA/EIS, permitting, and construction, and updated based on continual improvement during operations through adaptive management.

9.0 REFERENCES

Environment Canada. 2009. Environmental Code of Practice for Metal Mines. 108p.

Natural Resources Canada (NRCan). 1995. Quantity-Distance Principles User's Manual. Published by the Explosive Regulatory Division of Natural Resources Canada.

Natural Resources Canada (NRCan). 2014. Guidelines for Bulk Explosives Facilities – Minimum Requirements. Revision #6, February 2014. Published by the Explosive Regulatory Division of Natural Resources Canada.

10.0 FIGURES

Figure 8-1: Hardrock Project Adaptive Management Framework

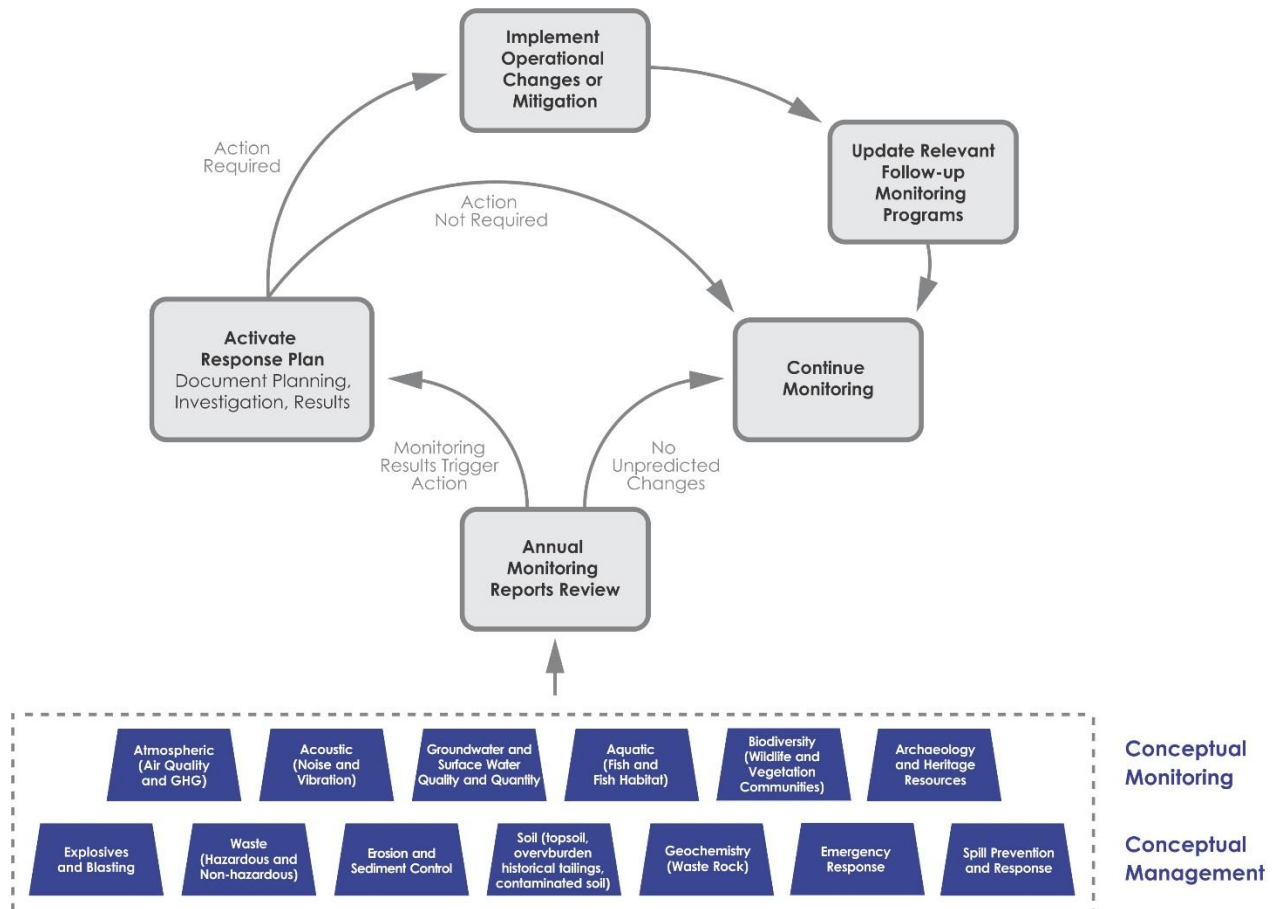


Figure 8-2: Environmental Management and Monitoring Plan Development EA to Construction

