Hardrock Project

Noise and Vibration Management and Monitoring Plan

HP-MG004-EV-130-0004_0

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List of Abbreviations

DFO	Fisheries and Oceans Canada
dBA	A-weighted decibels
EAC	Environmental Advisory Committees
EC	Environment Canada
ECA	Environmental Compliance Approval
EIS/EA	Environmental Impact Statement/Environmental Assessment
EMMPs	Environmental Management and Monitoring Plans
GGM	Greenstone Gold Mines GP Inc.
KPa	kilopascal
LOM	Life of Mine
MECP	Ministry of Environment Conservation and Parks
MTO	Ministry of Transportation
NVMMP	Noise and Vibration Management and Monitoring Plan
PDA	Project development area
PPV	peak particle velocity
STC	Sound Transmission Class
TDR	Technical Data Report
TMF	tailings management facility
WRSA	waste rock storage areas

1 Introduction and Environmental Management and Monitoring Plan Overview

Greenstone Gold Mines GP Inc. (GGM) is committed to minimizing environmental effects through the implementation of mitigation measures, monitoring and adaptive management for the Hardrock Project (the Project) within Environmental Management and Monitoring Plans (EMMPs) for construction and operation. The Noise and Vibration Management and Monitoring Plan (NVMMP) describes monitoring to address regulatory and permit requirements and outlines how monitoring results will be used to guide management decisions.

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 industry practices, GGM corporate policies, and commitments made to Aboriginal groups and communities during Project review
- Predictions of environmental effects identified in the environmental assessment are confirmed
- Measures to mitigate environmental effects are documented, their effectiveness is assessed, and needs for further mitigation are identified as needed
- Benefits from the Project are enhanced
- Reporting is structured to inform adaptive management and continual improvement.

The EMMPs guide environmental management for the Project And they are being progressively refined as the Project moves through permitting and construction phases. The EMMPs will be updated based on continual improvement during operations, using an adaptive management approach.

An adaptive management process, including a framework for ongoing review of monitoring data and mine site performance, is used to identify whether further mitigation measures are needed. This process is described in Section 7.4.

2 Mine Overview

The Hardrock deposit will be mined as an open pit. The process plant will operate 365 days per year with a Life of Mine (LOM) of approximately 15 years. Mill throughput will range from 24,000 tonnes per day (tpd) increasing to 30,000 tpd as conditions warrant. The overall Project development schedule will consist of the following main phases:

- Construction: Years -3 to -1, with early ore stockpiling commencing after the first year of construction.

- Operation: Years 1 to 15, with Year 1 representing a transition from construction to operation.
- Closure: Years 16 to 20 for Active Closure and Years 21 to 36 for Post-Closure.

Key mine components of the Project development area (PDA) are an open pit, waste rock storage areas (WRSAs), overburden storage areas, ore stockpile, ore crushing and mill feed ore storage activities, process plant, water management facilities, tailings management facility (TMF), power plant and associated infrastructure, and explosives facility. Ancillary Project components are buildings, service water supply and associated infrastructure, sewage and effluent treatment plants, site roads, watercourse crossings, realignments, and habitat compensation/offsets, onsite pipelines and piping, fuel and hazardous materials storage, aggregate sources, and temporary camp. Existing infrastructure currently located within the PDA will be relocated, including a portion of Highway 11, a Ministry of Transportation (MTO) Patrol Yard, and Hydro One Networks Inc. (Hydro One) facilities.

3 Purpose of the Noise and Vibration Management and Monitoring Plan

The purpose of the NVMMP is to describe monitoring to address regulatory and permit requirements and outline how monitoring results will be used to guide management (e.g., implementation of additional mitigation measures), as follows:

- Describe requirements for the routine management and maintenance of sources of noise and vibration during construction and operation.
- Describe requirements for monitoring noise and vibration during various stages of the Project, as the basis of asserting compliance of Project activities against predictions described in the Final Environmental Impact Statement/Environmental Assessment (EIS/EA).
- Identify applicable noise and vibration monitoring criteria for the Project.
- Develop a monitoring program to verify effectiveness of the mitigation measures implemented and confirm compliance with requirements for Project activities (construction, operation, and blasting) as identified in the Project Noise and Vibration Technical Data Report (TDR; Stantec 2017) prepared for the Environmental Assessment (EA) and the Environmental Compliance Approval (ECA) for Air/Noise. Blasting activities during construction and operation are a source of impulsive noise and transient (short term) vibration effects. Due to the nature of this source, blasting noise and vibration is measured separately from regular construction and operation activities.
- Provide guidance for abatement if exceedances are found during compliance verification.

- Identify communication protocol requirements in the event of exceedances and a procedure for verifying and addressing complaints.

The NVMMP applies only to Hardrock Project activities and addresses only noise and vibration management issues that involve off property areas. Workplace noise and vibration and worker exposure assessments, controls, and mitigation measures are not under the scope of this NVMMP; workplace conditions are covered under occupational noise and vibration.

3.1 Performance Objectives

Objectives and targets are established to drive continuous improvement in environmental performance and are consistent with the overall strategic goals of the Project. Objectives are measurable (where possible), monitored, communicated, and updated as appropriate.

In support of GGM's overarching environmental objective (i.e. to work to prevent or mitigate adverse environmental effects, meet or exceed regulatory requirements, and strive to continually improve our environmental practices and performance), GGM has established the following performance objectives for noise and vibration that consider key Project interactions and compliance obligations:

1. Reduce adverse environmental effects through implementation of mitigation measures, monitoring, and adaptive management.

2. Investigate Project-related noise or vibration complaint as per GGM's Complaint Protocol (HP-GGM-CR-003-0049). Attended and/or unattended measurement may be required as part of the complaint investigation process.

3. Verify Project-related noise and vibration compliance as committed in the EIS/EA.

3.1.1 Triggers and Thresholds for Action and Adaptive Management

Triggers for further action within an adaptive management structure need to be robust (based on sufficient data to describe variability), reliable (easily and consistently measurable), and meaningful (reflect potential adverse effects on the environment). For the NVMMP, cautionary levels are set as the trigger for adaptive management to avoid exceedance of the applicable provincial and federal criteria. Adaptive management for noise and vibration will be used as follows:

- to address situations in which the objectives or standards are exceeded; the process for responding to these events (reviewing causes, assessing the need for additional mitigation measures) is described in the adaptive management process in Section 7.4

- to guide the continual improvement process

- to incorporate changes to the management and monitoring plan related to introduction of new regulatory requirements, revised objectives or criteria, or updated best practices or technology.

Further information about the adaptive management process is provided in Section 7.4.

4 Scope

The NVMMP applies to Project infrastructure and management under the care and maintenance of GGM. It does not include components managed or maintained by third parties. This document covers the following:

- Geographic scope - area of the Project that will undergo changes through construction and/or operation to accommodate the advancement of Project, and associated monitoring
- Temporal scope - construction and operation phases
- Regulatory scope – applicable laws and regulations, described in Table 4-1.

The NVMMP applies to individuals working for or on behalf of GGM, including employees and contractors, who have a role and/or accountability for the development, implementation, and maintenance of this NVMMP. GGM will make reasonable efforts to use suitably qualified (licenced where applicable) contractors for the transport of materials, supplies and waste materials, with appropriate controls and management plans in place to reduce the likelihood of incidents during transport.

Table 4-1: Regulatory Requirements that Apply to the Noise and Vibration Management and Monitoring Program

Type of Requirement	Relevant Act or Document	Details
Environmental Assessment Process Requirement	Federal Decision Statement Conditions	A decision statement was issued by the Canadian Environmental Assessment Agency under Section 54 of the *Canadian Environmental Assessment Act* on December 10, 2018 that outlined a series of conditions in which GGM must comply. This NVMMP addresses the following conditions: • 3.2 The Proponent shall develop, prior to the start of blasting activities in or near water, and implement, during blasting activities in or near water, mitigation measures to avoid or prevent adverse effect to fish and fish habitat from the use of explosives in a manner consistent with the Fisheries Act and its regulations. When developing these measures, the Proponent shall take into account Fisheries and Oceans Canada's Measures to avoid causing harm to fish and fish habitat including aquatic species at risk as it pertains to the use of explosives

Table 4-1: Regulatory Requirements that Apply to the Noise and Vibration Management and Monitoring Program

Type of Requirement	Relevant Act or Document	Details
		in or near water. The Proponent shall submit these measures to the Agency before implementing them. • 3.15 The Proponent shall develop, prior to the start of blasting activities in or near water and in consultation with relevant authorities, a follow-up program to determine the effectiveness of the mitigation measures as it pertains to the adverse environmental effects of blasting on fish and fish habitat, including aquatic listed species at risk. The Proponent shall implement the follow-up program during blasting activities. As part of the implementation of the follow-up program, the Proponent shall: ○ monitor instantaneous pressure and peak particle velocity during the first blasting event; ○ if the results of the monitoring referred to in conditions 3.15.1 demonstrate that modified or additional mitigation measures are required to protect fish and fish habitat, including aquatic listed species at risk, from blasting, develop, prior to the next blasting event and in consultation with relevant authorities, modified or additional mitigation measures pursuant to condition 2.7; and ○ implement the modified or additional mitigation measures referred to in condition 3.15.2 during all subsequent blasting events. The Proponent shall submit these measures to the Agency before implementing them.
	Provincial Environmental Assessment Certificate Conditions	A Provincial Environmental Assessment Certificate was issued by the Ministry of the Environment, Conservation and Parks (MECP) in March 2019. This NVMMP addresses the following conditions: • Condition 23 Noise Monitoring and Reporting
Regulatory Requirements and Guidelines	Federal	Guidance provided in Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada 2017) (see Section 4.1.1) DFO: Measures to avoid causing harm to fish and fish habitat found at https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html

Table 4-1: Regulatory Requirements that Apply to the Noise and Vibration Management and Monitoring Program

Type of Requirement	Relevant Act or Document	Details
	Provincial	MECP Noise Pollution Control (NPC) guidelines documents NPC-102, NPC-103, NPC-119 and NPC-300 (see Section 4.1.2)
	Environmental Compliance Approval Requirements	It is expected that the ECA for the Project will contain specific terms and conditions regarding monitoring, reporting, source testing, complaint resolution, etc. This section of the NVMMP will be updated upon receipt of the ECA to reflect the terms and conditions.
	Municipal Regulatory Requirements	Municipality of Greenstone noise by-law (By-law No. 03-28)
Other Commitments and Requirements	N/A	This section will be updated as commitments are identified during the permitting process. It is expected that monitoring requirements not required by specific regulations will be identified in a Follow-up Agreement.

4.1 Regulatory Requirements

The NVMMP was developed and implemented to comply with applicable legislative, regulatory, permit and other relevant obligations, outlined in the following sections. These are described in MECP guidelines documents NPC-102, NPC-103, NPC-119 and NPC-300.

4.1.1 Federal Regulatory Requirements

Health Canada provides guidance in the document *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* (2017). However, Health Canada also endorses provincial limits for noise from a project and, therefore, the provincial noise requirements are considered and discussed in Section 4.1.2. Federal guidelines on overpressure limits to protect the health of fish have been developed by DFO (Table 4-2).

There are no federal guidelines or regulations, guidance, or quantitative limits for vibration available related to human health, so the provincial requirements discussed in Section 4.1.2 are used. Federal guidelines for the protection of fish from vibrations (peak particle velocity) from the use of explosives have been developed by DFO (Table 4-3).

4.1.2 Provincial Regulatory Requirements

The performance objectives for project activities are quantitative thresholds or targets provided by regulatory guidelines (MOE 1978a, 1978b, 1978c) or other applicable guidance documents. These and other applicable criteria are summarized in Table 4-2 for noise and Table 4-3 for vibration.

For noise, NPC-300 provides sound level limits at points of reception (PoR) applicable to construction and operation activities. Sound levels are given for Class 2 and Class 3 acoustic environments (classes defined in terms of types of receptors) for daytime and evening/nighttime periods. For blasting overpressure (sound level), NPC-119 provides limits for noise at PoRs in terms of cautionary and not to exceed limits.

For vibration during construction, there are no federal or provincial criteria limits for the sensitive receptor, and therefore, the limits as provided in the City of Toronto Bylaw (514-2008) can be considered as best practice limits (see Table 4-3). In practice, however, the construction vibration for the Project does not need to be monitored as the receptors are well outside the vibration Zone of Influence (ZoI).

For vibration during operation, ISO 2631-2 provides guidance pertaining to upset limits of vibration exposure to humans within a dwelling or structure. The quantitative limit provided in ISO 2631-2 relates to a level that causes annoyance regardless of time of day based on prolonged or continuous exposure and is 0.14 mm/s measured as root square mean (RMS) velocity. This also addresses concern of vibration impact on structure/buildings as the structural thresholds are much higher. For vibration during blasting, NPC-119 provides limits for receptor locations.

Cautionary limits are also provided in Table 4-2 and Table 4-3 to warn the team when compliancelimits are approaching. Compliance limits provided in Table 4-2 and Table 4-3 are not to be exceeded by the Project.

Table 4-2: Construction and Operation Noise Criteria

Activity	Description	Criterion Source	Period	Cautionary Limits [1]	Threshold (Not to Exceed Limit)
Construction and Operation	Steady Sound Levels - Class 2 Areas	NPC-300	Daytime	47 dBA	50 dBA
			Evening & Nighttime	42 dBA	45 dBA
	Steady Sound Levels - Class 3 Areas	NPC-300	Daytime	42 dBA	45 dBA
			Evening & Nighttime	37 dBA	40 dBA
Blasting	Impulsive Noise	NPC-119	Daytime only	120 dB	128 dB
Blasting	Overpressure	DFO	Anytime	47 KPa	50 KPa

Note: [1] Project cautionary limits are established for the construction operation phases for monitoring purpose only.

Table 4-3: Vibration Criteria

Activity	Criterion Source	Frequency of Vibration [Hz]	Vibration Peak Particle Velocity Cautionary Limits [mm/s]	Vibration Peak Particle Velocity Threshold (Not to Exceed Limit) [mm/s]
Construction	Best Practice from City of Toronto bylaw (514-2008)	Less than 4	5	8
		4 to 10	12	15
		More than 10	22	25
Operation [1]	ISO 2631-2	RMS	N/A	0.14
Blasting	NPC-119	Any	10	12.5
Blasting	DFO	Any	10	13

Note: [1] Project operation vibration limits are provided in RMS values.

4.1.3 ECA Requirements

It is expected that the Environmental Compliance Approval (ECA) for the Project may contain specific terms and conditions with respect to noise and vibration monitoring. This section of the NVMMP will be updated upon receipt of the ECA to reflect its terms and conditions.

4.1.3.1 Municipal Regulatory Requirements

The Municipality of Greenstone has published a noise by-law but does not have by-laws regarding vibration. By-law No. 03-28 (CMG 2003) includes a list of the sounds that are deemed to disturb or likely to disturb inhabitants of the community. The by-law primarily focuses on residents and their individual noise emissions. For example, the by-law specifies that "No owner shall cause or permit the creation, presence or existence of any noise or unusual sound that disturbs or are likely to disturb any inhabitant of the Municipality of Greenstone." No specific clauses for industrial facilities are noted in the noise by-law, and therefore, the NVMMP will primarily focus on provincial requirements.

5 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 NVMMP. Table 5-1 outlines roles and responsibilities for noise and vibration management and monitoring activities.

Table 5-1: Conceptual Roles and Responsibilities

Role	Responsibility
Construction Manager (for construction phase) Mine Manager (for operation phase)	• Collaborate with the Environmental Superintendent to plan and implement noise and vibration effect management during construction activities and the operation phase. • Collaborate with the Environmental Superintendent to provide noise and vibration awareness and safety training to Project personnel and contractors.
Environmental Superintendent	• Collaborate with the Construction Manager and Mine Manager, as described above. • Collaborate with the Construction Manager and Mine Manager to communicate compliance obligations and provide training to employees and contractors related to EMMP. • Identify, document, track, and maintain up-to-date compliance obligations related to EMMP goals. • Completion of reporting requirements.
Environmental Supervisor	• Organize and schedule monitoring activities. • Oversee implementation of monitoring activities by Environmental Monitors/Technicians.
Environmental Monitors/ Technicians	• Review and provide input into NVMMP. • Participate in implementation of mitigation measures and monitoring. • Provide input into any future revisions of the NVMMP and adaptive management as required. • Communicate results of monitoring to their community.
Environmental Advisory Committees (EAC)	• Review and provide input into NVMMP. • Provide input into any future revisions of the NVMMP and adaptive management as required. • Meet regularly and report EAC activities to the Implementation Committee.
Drill and Blast Supervisor	• Coordinate with explosives contractor on delivery of explosives to the open pit to meet mine plan and operational requirements. • Implement notification procedures for general public prior to blast events, as needed. • Establish notification procedures for GGM staff and contractors prior to blast events, 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. • Responsible to notify the Environmental Superintendent of any changes, updates or additions to the blasting plan.

Table 5-1: Conceptual Roles and Responsibilities

Role	Responsibility
Equipment Operator	• Comply with EMMP requirements as directed with Construction, Operation or Environmental Superintendent
Employees / Contractors	• Follow outlined compliance obligations related to NVMMP, including noise and vibration reporting requirements.

5.1 Communication

5.1.1 Notification of Exceedances to Triggers

If the monitored noise and vibration levels exceed the cautionary limits, the respective GGM manager (Construction/Operation) and Project team will be notified that the compliance limits for the Project are approaching.

If the monitored noise and vibration levels exceed the compliance limit as presented in Table 4-2 and Table 4-3, then the respective GGM manager (Construction/Operation) and Project team will be notified and an investigation into the root cause of the exceedance will be undertaken. The investigation will lead to adaptive management to resolve the issues.

If the fisheries threshold criterion is exceeded, especially during spring spawning period (April 1 through June 20), use of explosives should be reduced or setback distance should be increased as part of mitigation, and DFO shall be notified about the exceedance and subsequent action taken.

5.2 Support

5.2.1 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. Personnel assigned to monitoring, compliance testing and mitigation activities are expected to have met the educational and appropriate training commensurate with their duties. Such training may consist of classroom lectures, workshops, teleconferences or on-the-job training.

An annual review of the NVMMP will be conducted with the appropriate GGM personnel.

6 Implementation of Mitigation Measures

6.1 General Approach

To mitigate Project noise and/or reduce noise complaints, the following measures will be used:

- Advise nearby residents of major noise generating activities or expected changes to the noise sources and/or activities in their area (e.g., development of pit, TMF, WRSA, and construction of process plant and Highway 11).
- Implement GGM's Complaint Protocol (HP-GGM-CR-003-0049).
- Where possible, conduct blasting on weekdays, typically mid-day. GGM will also endeavor to avoid blasting on statutory holidays. If the blasting days and/or time are expected to change, notify the residents in the area in advance.
- Where possible, schedule major construction activities near residential areas to take place during daytime (i.e., 07:00 h to 19:00 h) to avoid complaints.
- For the development plan for WRSA A, consider strategies to limit potential noise disturbance at MacLeod Provincial Park during the camping season and at other nearby residential receptor locations. This may include reducing nighttime activities on the east portion of the WRSA during the camping season and/or establishing rock berms.

6.2 Construction Noise and Vibration

Construction noise is not predicted to be a concern with the implementation of standard measures for mitigating noise emissions. These measures will include the following:

- Where possible, schedule major construction activities to take place during daytime hours (i.e., 07:00 to 19:00).
- Install noise mitigation measures (e.g., muffler systems) on construction and other mobile equipment and properly maintain equipment.
- Where possible, turn off construction equipment when not in use.
- Where possible, locate construction equipment in such a way that no receptors are within the vibration ZoI of the equipment.

The list of mitigation required for construction noise sources and mitigation details will be updated in the NVMMP once the detailed acoustic assessment in support of the Environmental Compliance Approval (ECA) is completed.

6.3 Operation Noise and Vibration

The following mitigation measures are considered for the Project design:

- Install noise mitigation measures (e.g., muffler systems) on construction and other mobile equipment, and properly maintain the equipment.
- If necessary, incorporate acoustical enclosures into equipment to limit overall noise emissions.
- The doors to the plants will be kept closed and the doors will have a minimum Sound Transmission Class (STC) of STC 20 or better.
- Air inlet and discharge silencers for exhaust stacks and radiator exhausts associated with diesel or natural gas-fueled generators may be required.

Where possible, locate equipment in such a way that no receptors are within the vibration ZoI of the equipment.The list of mitigation required for operation noise sources will be updated in this NVMMP once the detailed acoustic assessment in support of the ECA is completed.

6.4 Blasting Overpressure (Noise) and Vibration

To mitigate blasting noise and vibration, and/or reduce noise complaints, the following measures will be used:

- Adapt charge size and blast pattern to meet noise and vibration criteria listed in Table 4-2 and Table 4-3 of this document.
- Charge size will be adjusted based on the proximity to a waterbody to comply with DFO guidelines.
- Reduction in the weight of explosives per hole, the number of blast holes or other adjustments to the blasting procedure to limit the potential vibration impacts on fish habitat to 13 mm/s during spawning season, if avoidance is not feasible due to production scheduling in the east pit.
- Implement GGM's Complaint Protocol (HP-GGM-CR-003-0049) to address vibration and overpressure (noise) complaints.

- Where possible, conduct blasting on weekdays, typically mid-day and avoid blasting on statutory holidays. If the blasting days and/or time are expected to change, notify the residents in the area in advance.

6.5 Closure

Noise and vibration monitoring is not anticipated for the closure phase of the Project. If blasting or use of heavy construction equipment are expected for demolition during closure phase, appropriate monitoring and/or noise and vibration mitigation shall be implemented.

Noise and vibration effects on the environment during activities associated with active closure (decommissioning and rehabilitation) are expected to be equal to or less than the intensity of the construction phase since similar types but lower volumes of equipment are anticipated. Thus, it is conservative to conclude that the predictable worst-case noise level due to the active closure of the Project would be less than that expected during the construction phase of the Project.

Activities during the active closure phase will be reviewed to determine any requirements for monitoring at a time closer to when operations are expected to conclude.

7 Monitoring, Evaluation and Reporting

7.1 Monitoring

The Environmental Supervisor and Environmental Monitors/ Technicians are responsible for the monitoring program. Monitoring will be conducted to measure sound and vibration levels at locations adjacent to the Project or that are potentially affected adversely by the Project. The blasting activities from construction and operation are a source of impulsive noise and transient (short-term) vibration effects. Due to the nature of this source, blasting noise and vibration is measured separately from regular construction and operation activities.

7.1.1 Equipment Requirements

Equipment used for construction and operation noise monitoring program shall meet the following requirements:

- Type 1 integrating sound level meters capable of recording hourly sound pressure levels in dBA.
- Battery powered units to complete automated (unattended) noise monitoring.
- Sound level meters capable of recording short audio files in the event of exceedance, to verify the source of noise.

- Sound level meters capable of recording 1-hour L_{EQ} (energy equivalent sound levels) and L_{90} sound levels (L_{90} is the sound pressure level that is exceeded 90% of the time for that one hour). The L_{90} sound level is used to assess severity of the impact, not to support enforcement of regulatory requirements.
- Sound level meters calibrated in the last two years by manufacturer or independent accredited laboratory. A copy of the calibration certificates will be appended to the monitoring report.
- Calibration verified with a portable field-calibrator before and after the measurements.
- Portable field-calibrator calibrated within the last year by manufacturer or independent accredited laboratory.

Blast monitoring equipment used as a part of the surveys will meet the following performance specifications described in NPC-119:

- Capable of logging peak sound pressure level in dBL (linear values)
- Capable of logging vibration as peak particle velocity in mm/s (PPV)
- Battery powered units to complete automated monitoring (unattended)
- Calibrated within the last two years by the manufacturer or an independent accredited laboratory
- Set to log instantaneous air overpressure and ground vibration velocity

To address noise complaints, the equipment capable of measuring spectral data (1/3rd octave) is used for attended monitoring. Other requirements such as monitoring locations, monitoring periods, monitoring frequency and reporting requirements are discussed in the following sections.

7.1.2 Monitoring Locations

The locations of the monitors are identified based on the receptor locations with respect to the Project, blasting and construction activities. The dwellings south of the Project (L004 and L005) and east of the Project (L003) were acquired by GGM since the EIS/EA was completed, so are excluded from the NVMMP. The noise monitoring station at L002 is removed from the program as it is an inactive aggregate pit.

7.1.2.1 Construction

The locations of noise and vibration monitors for construction will be dependent on the type, duration and location of the construction activities. Major construction activities constitute any Project noise and/or vibration activities that potentially impacts receptors, including development of the pit, TMF,

WRSA, and construction of the process plant and Highway 11. Noise monitors will be deployed for major construction activities at (or as near as possible to) the nearest PoR(s) from those activities.

Construction vibration monitoring is required only for receptors within the ZoI of the equipment. Based on the TDR, the receptors are well outside the vibration ZoI and, therefore, construction vibration monitoring is not required.

Table 7-1 summarizes the monitoring program with potential monitoring locations for construction.

Figure 7-1 shows the receptor locations identified as monitoring locations. The monitoring will be carried out during the period when the majority of the equipment, especially those listed in Table 7-1, are in operation in a given area and will be confirmed based on the Project Schedule.

Table 7-1: Summary of Construction Noise Monitoring Program

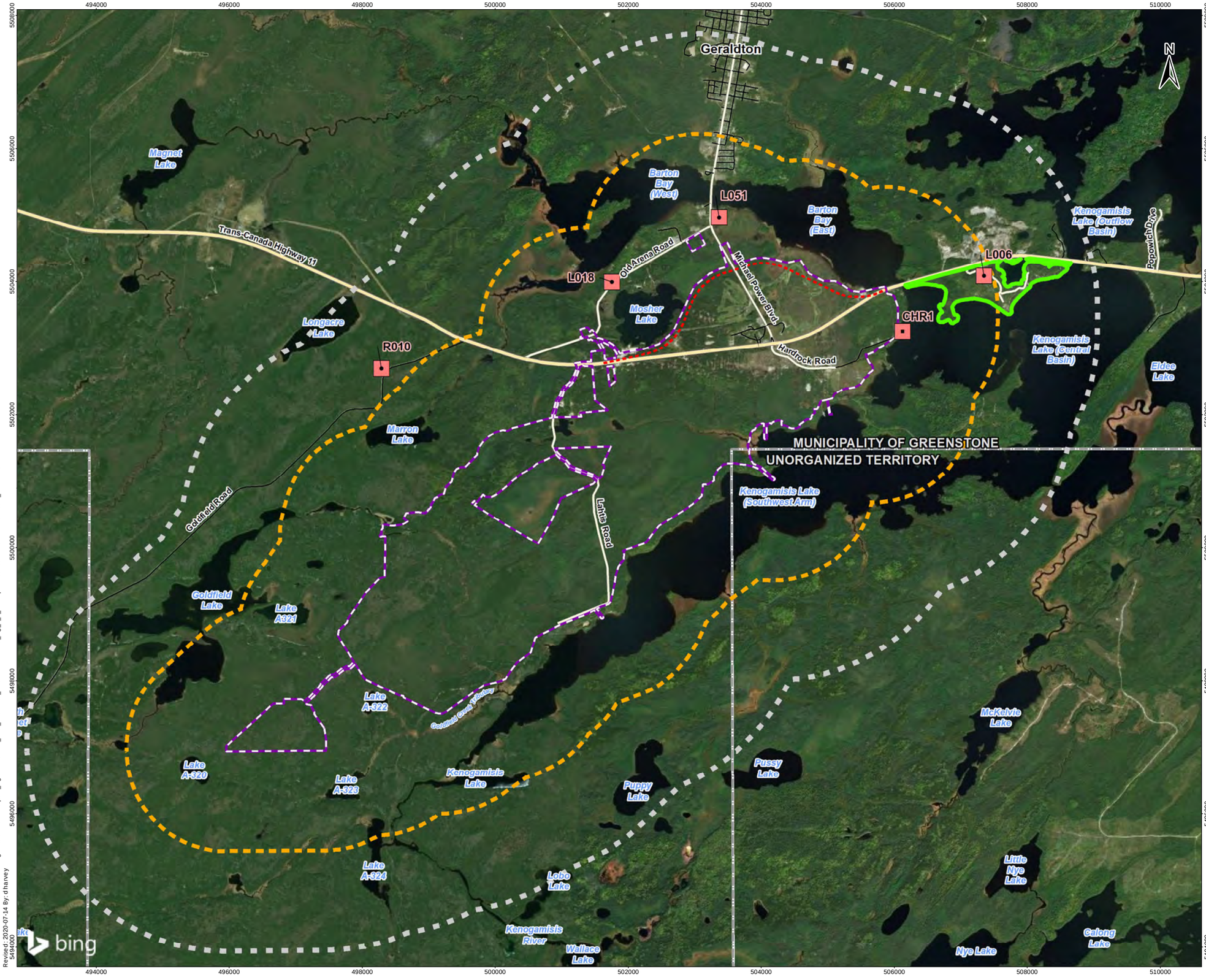
Project Phase (Year)	Activity Location	Significant Noise Sources	Monitoring Period/Frequency [1]	Type of Monitor [2]	Monitoring Location (PoR)
Construction (Year -3 to -1)	Open Pit and WRSA-A	Shovel, Drill, Loader and Grader	Minimum one week per year during construction or until compliance is achieved	Noise	L006[3]
	TMF, WRSA-D and Highway 11	Haul Route, Shovels, Loader and Grader			L051[3]

Notes: [1] Minimum one week of monitoring is recommended for short-term monitors.

[2] Vibration monitoring would be required only if the PoR is within the construction vibration ZoI of the Equipment. No PoRs are identified within construction vibration ZoI in the TDR (see Figure 7-2).

[3] Long-term noise monitoring locations (continuous monitoring) during operation.

[4] GGM will consult with Ontario Parks on the exact location of the monitor in MacLeod Provincial Park. GGM understands that a research authorization permit from Ontario Parks will be required.



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Revised: 2020-07-14 By: dharvey

Stantec

Legend

- Monitoring Location
- Regional Study Area
- Local Study Area
- Project Development Area
- New Highway 11 Alignment
- Macleod Provincial Park

Receptor Label Prefixes
L = Local Assessment Area
R= Regional Assessment Area

0 1 2 km

1:55,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Aerial Imagery: © 2020 Microsoft Corporation © 2020 Maxar ©CNES (2020) Distribution Airbus DS

Client/Project

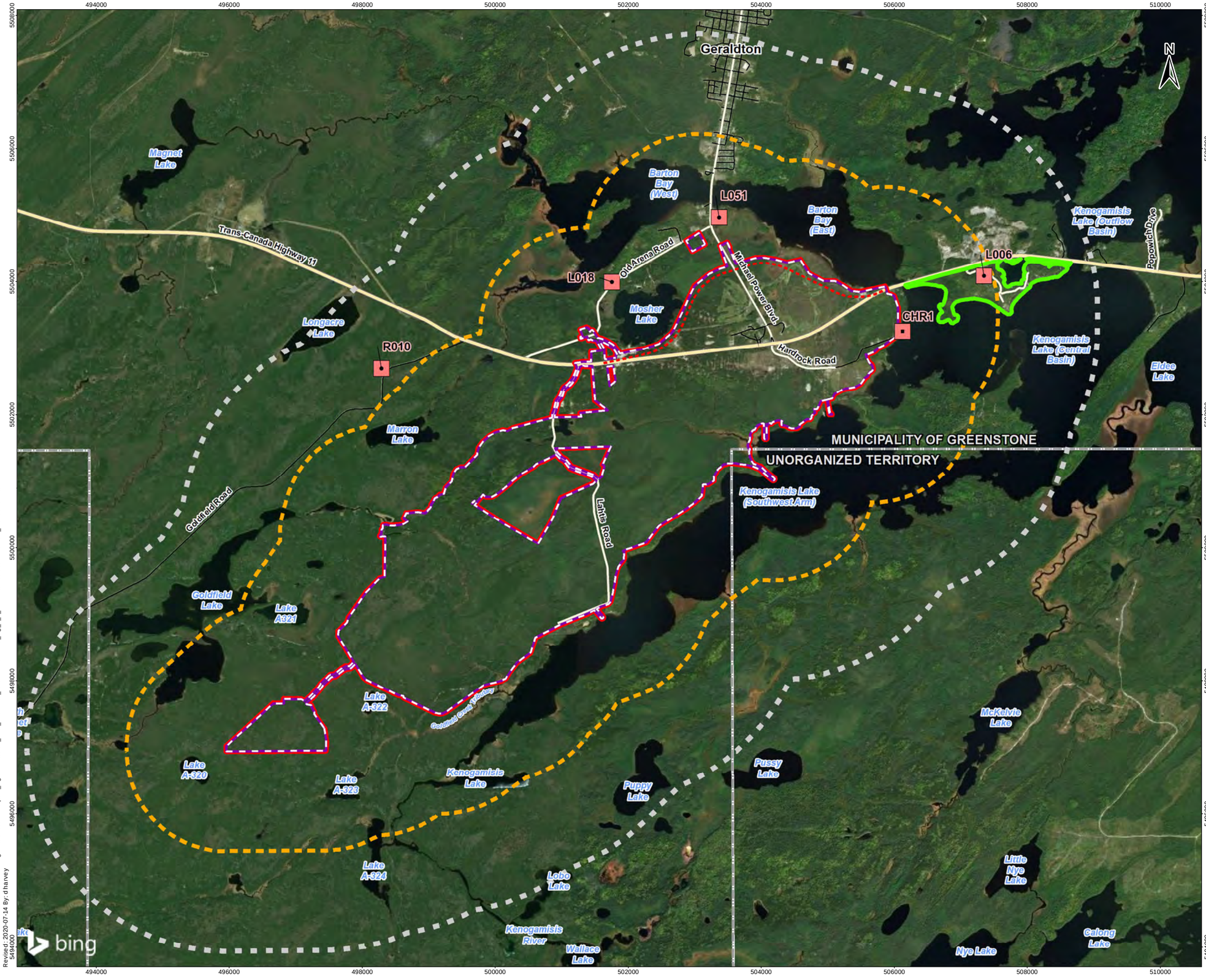
Greenstone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.

7-1

Title

Receptor Locations Identified for Noise and Vibration Monitoring



Stantec

Legend

- Vibration Zone of Influence 5 mm/s PPV
- Closest Receptors
- Regional Study Area
- Local Study Area
- Project Development Area
- New Highway 11 Alignment
- Macleod Provincial Park

Receptor Label Prefixes
L = Local Assessment Area
R= Regional Assessment Area

0 1 2 km

1:55,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
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Client/Project

Greenstone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.

7-2

Title

Construction Vibration Zone of Influence

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Revised: 2020-07-14 By: dharvey

7.1.2.2 Operation

The operational noise monitoring locations are selected based on receptor locations with respect to the major project components. Noise monitors will be deployed at receptor location(s) that are nearest to operation activities and at the periphery of major noise contributing areas including:

- Process plant area and on-site power generation
- Roadways (WRSA and tailings)

Monitoring will be conducted for a minimum of one week per year or until compliance is achieved. The frequency of monitoring and/or requirements for additional monitoring will be reviewed and may be modified for this component of the Program based on completed monitoring results and operational changes.

Operation vibration monitoring is required only for the receptors that are within the ZoI of the equipment. Based on the TDR, the receptors are well outside the vibration ZoI for operation and, therefore, operation vibration monitoring is not required, except for blasting as described in Section 7.1.2.3.

Table 7-2 summarizes the monitoring program with potential monitoring locations for the Project operation. Figure 7-1 shows the receptor locations chosen for the monitoring.

Table 7-2: Summary of Operation Noise Monitoring Program

Project Phase (Year)	Activity	Significant Noise Sources - Locations	Monitoring Period/Frequency	Type of Monitor	Monitoring Location (PoR)
Operation (Year 1 to 15)	Regular	Loader, Water Pump, Rock Breaker, Haul Route and Shovels - Open Pit, WRSA-A and WRSA-C	Minimum one week per year or until compliance is achieved	Noise	L006 [1, 2]
		Loader, Rock Breaker, Haul Route, Shovels, Crusher and Generator - WRSA-A, WRSA-C, WRSA-D and Processing/Power Plant			L018
					L051 [1]
		Loader, Rock Breaker, Haul Route and Generator - WRSA-C, WRSA-D, TMF and Power Plant			R010

Notes: [1] These are long-term noise monitoring locations (continuous monitoring).

[2] GGM will consult with Ontario Parks on the exact location of the monitor in MacLeod Provincial Park. GGM understands that a research authorization permit from Ontario Parks will be required.

The long-term noise monitoring at the proposed locations will be carried out until the District Manager provides notification that the continuous monitoring is no longer required for these locations.

7.1.2.3 Blasting

The monitoring locations for blasting are selected based on receptor locations with respect to the blasting location. Vibration and overpressure monitors will be deployed for initial blasting events for construction and operation and will be located as close as possible to the receptor anticipated to be the most affected.

The vibration monitors deployed outdoors within a residence property will be within 7 m of the building as per NPC-119. A second monitor will be located at or near the PDA boundary close to the cultural heritage resource (CHR1), a residential building owned by GGM. Additional monitors near inhabited areas (Rosedale Point neighborhood and Macleod Provincial Park) will also be considered.

Measures to protect fish and fish habitat should be implemented as per Section 6.4.

Blasting activities will be ongoing up to several times per week during the daytime period over the construction and operation phases. Monitoring will be conducted during blasting activities until compliance is confirmed, at which point monitoring may be reduced or discontinued.

Table 7-3 summarizes the monitoring program and lists potential monitoring locations for blasting. Figure 7-3 shows the two monitoring locations selected to monitor potential effects of blasting on fish. Monitoring locations FH01 and FH02 are at the high-water mark and water level may be too low during dry periods, and therefore, these locations may potentially be moved closer to the lake shoreline depending on the level of water during the measurement.

Table 7-3: Summary of Blasting Monitoring Program

Project Phase (Year)	Activity	Period/Frequency	Type of Monitoring	Monitoring Location
Construction/ Operation (Year -3 to 15)	Blasting	Minimum for 3 days of blasting or compliance is achieved/beginning of each phase and in the event of complaints	Overpressure	L006
			Overpressure and Vibration	L051
			Overpressure and Vibration	CHR1
Construction/ Operation (Year -3 to 15)	Blasting	During each blast event. Blast monitoring may be discontinued if subsequent blasting uses an equal or lesser blast charge and is located farther away from fish habitat. Blast monitoring will be re-initiated if there is potential to exceed 50 KPa overpressure threshold in fish habitat.	Overpressure	FH01 FH02
Construction/ Operation (Year -3 to 15)	Blasting	April 1 to June 20 (spawning season) during each blast event. Blast monitoring may be discontinued if subsequent blasting uses an equal or lesser blast charge and is located farther away from fish habitat. Blast monitoring will be re-initiated if there is potential to exceed 10 mm/s PPV threshold in fish habitat.	Vibration	FH01 FH02

504000

WC-G
WC-E
WC-I
Trans-Canada Highway 11
WC-D
WC-GH
Hardrock Road
FH01
FH02
Kenogamisis Lake (Central Basin)
WC-J1
Kenogamisis Lake (Southwest Arm)
N
bing
0 100 200 m
1:8,000

504000

V:\01609\active\60960865\drawing\MXD\Noise\Report_Figures\Noise _and_Vibration_MMP\160961293_Fig_7_3_FishBlastMonitoringLocations_20200714.mxd
Revised: 2020-07-20 By: dharvey

Stantec

Legend

- Fish Blasting Monitoring Location
- Kenogamisis Lake High Water Mark (329.85 masl)
- Kenogamisis Lake Conservative High Water Mark (330 masl)
- Open Pit- Full Extent
- Contour Line (10m intervals)
- Highway
- Major Road
- Local Road
- Watercourse- Permanent
- Watercourse- Intermittent
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N

2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

3. Orthographic Imagery Source: © 2020 Microsoft Corporation © 2020 Maxar ©CNES (2020) Distribution Airbus DS

July 2020
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Client/Project

Greentsone Gold Mines GP Inc (GGM)
Hardrock Project

Figure No.

7-3

Title

Receptor Locations Monitoring Potential Effects on Fish

7.2 Evaluation

The monitoring data collected will be analyzed to evaluate Project compliance. For construction and operation noise monitoring, the monitor will record 1-hour L_{EQ} and L_{90} sound levels. The L_{90} sound level is used to assess severity of the impact. The noise monitors will also be set to record short triggered audio events. The microphones for the monitors will be fitted on a vertical mast, approximately 2 m above the ground, and will be provided with a windscreen and bird-deterrent wires. Audio recordings will be reviewed if there is a noise complaint that requires evaluation.

Monitored sound levels could be affected by meteorological conditions. To account for this influence, weather data from onsite weather stations or the nearest Environment and Climate Change Canada location will be reviewed.

For the noise monitoring program, and as defined in NPC-103, inclement weather conditions are considered to have occurred if humidity levels are above 90% or there is precipitation during that period, wind speed exceeded 20 km/hour, or temperature is outside the operating range of the monitor (i.e., below -10 °C or above +50 °C).

7.3 Reporting

The form and frequency of follow-up reporting will be determined as the Project progresses through permitting (MECP ECA). The monitoring and reporting will be used to inform adaptive management of Project noise and vibration. Receiving, documenting and responding to communication from external interested parties, including complaints, will also form part of reporting under this Plan.

7.3.1 Annual Reporting

A formal monitoring report will be completed as part of the NVMMP and provided to relevant parties each year during construction and operation. The reporting will consider adaptive management of Project noise and vibration (see Section 7.4).

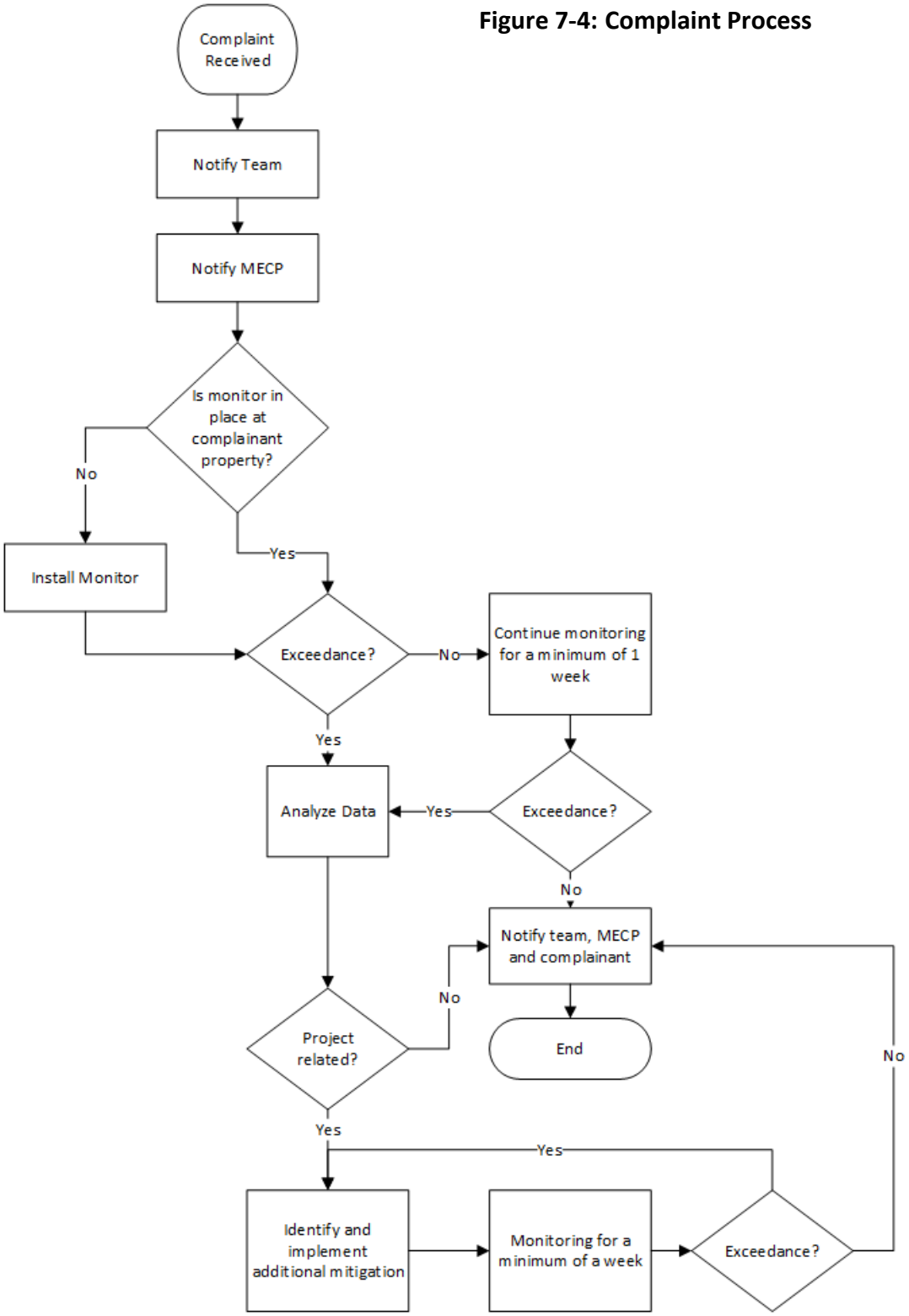
7.3.2 Complaint Reporting Process

GGM is committed to reduce adverse environmental effects through implementation of mitigation measures, monitoring, and adaptive management. After receiving any Project-related noise or vibration complaint, GGM will investigate the complaint using qualified personnel as per GGM's Complaint Protocol (HP-GGM-CR-003-0049). Additional attended measurements and/or unattended monitoring may be required as part of the complaint investigation process.

GGM will work with the complainant to resolve any issues. However, if the complaints are persistent and repetitive in nature (received from the same complainant and/or multiple complaints on the same issues), GGM will involve the MECP and other agencies as necessary. The MECP may pose its own questions, request further information, or conduct a site investigation where necessary. The Agency may also issue a stop work order for the activity or the equipment of concern.

Figure 7-4 presents the complaint process for the investigation and responding to complaints related to Noise and Vibration.

Figure 7-4: Complaint Process



7.4 Continual Improvement (Adaptive Management)

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 (both physical and administrative).

GGM will identify and correct incidents with appropriate and lasting measures aimed to prevent reoccurrence and/or similar occurrences. The Adaptive Management Framework (Figure 7-5) provides a formalized approach to:

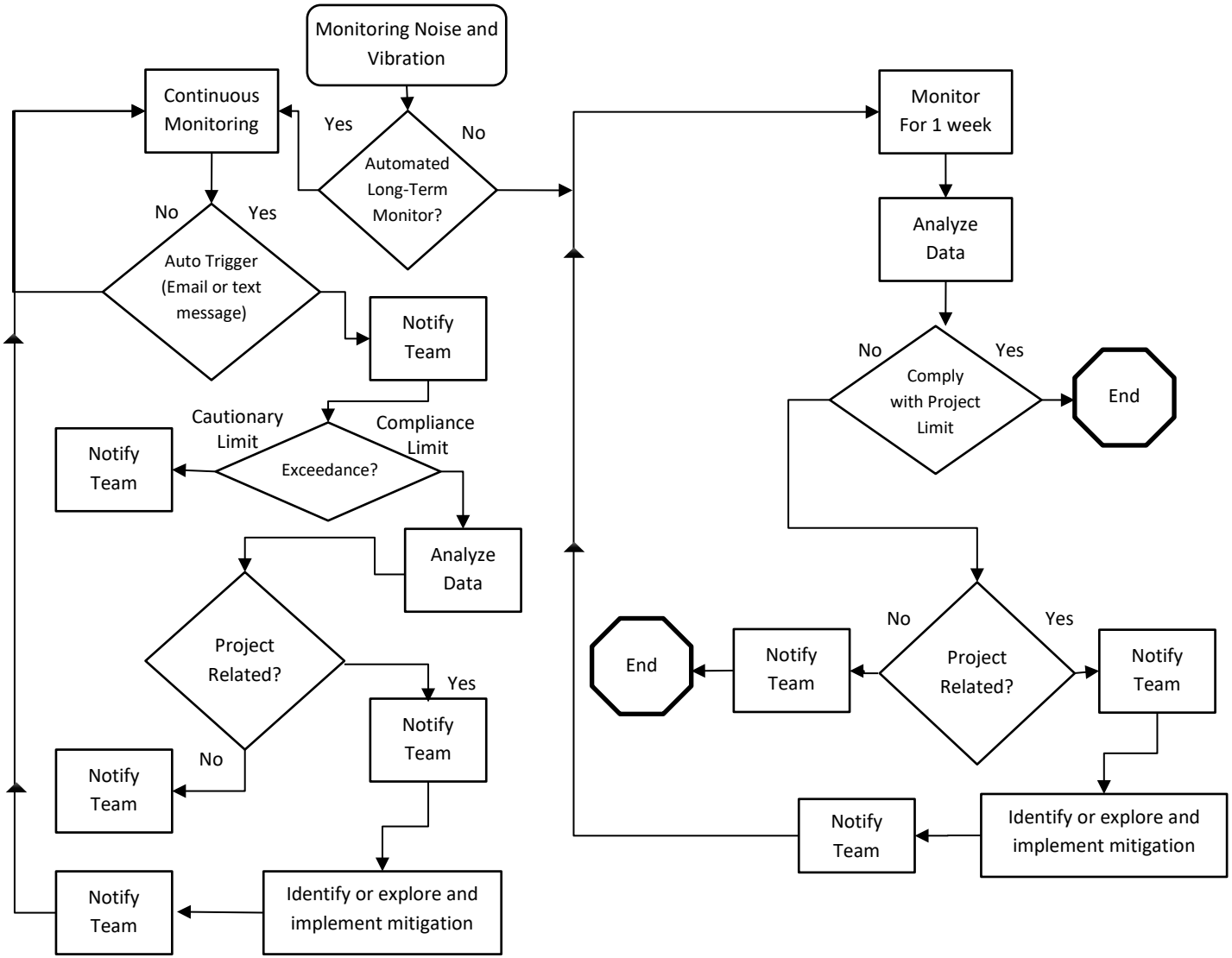
- Formally track and monitor activities
- Report and as needed investigate incidents, including non-conformance and non- compliance events
- Develop and implement corrective and preventive actions
- Continue monitoring and update the NVMMP.

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 noise and vibration management.

The following is a typical process of noise and vibration adaptive management program:

- Monitor noise and/or vibration levels at the identified receptor or complainants' locations
- Evaluate construction, operation or blasting process that caused exceedance of applicable criteria during monitoring, if any
- Identify the equipment or activities that cause exceedance at the receptor or complainants' location(s)
- Implement control measures physically (implementing noise and/or vibration control options for the sources – i.e., installing noise barriers, silencers, acoustic louvres etc.) or administratively (changing location of the source, operating time of the sources, operating duration, number of sources etc.)
- Continue monitoring noise and/or vibration at the receptor locations until compliance is achieved.

Figure 7-5: Adaptive Management Framework



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

8 REFERENCES

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