Environmental Management Strategy for Exploration Drilling

Prepared for

Evolution Mining NZ Pty Ltd

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Executive Summary

Evolution Mining NZ Pty Ltd (ENZ) is the holder of Mineral Exploration Permit 51985 which covers 2,984 Ha near Puhipuhi, Northland which is prospective for both gold and silver.

The area is geothermal in origin and has a history of being mined for mercury which is present in the area in the form of cinnabar.

An environmental management strategy has been prepared for Evolution Mining Limited's proposed exploration drilling program at Puhipuhi, Northland.

The philosophy behind the proposed environmental management strategy is one of identifying the potential environmental risks then, when developing the exploration drilling program eliminating, isolating or minimising the risks.

Management plans are used to prescribe how various exploration activities are carried out in order to ensure that the identified environmental risks are minimised.

Monitoring is used to assess the effectiveness of the management plans, and if necessary, the management plans are revised to maximise their effectiveness.

The key environmental risk posed by exploration was found to be the disturbance of soil containing elevated levels of mercury which, if not managed correctly, could lead to sediment runoff into streams and an increase in release of water soluble mercury into the environment. This risk can be managed via good drill site location, choice of drill rig, drill site setup, and the provision of effective stormwater and sediment and erosion control measures.

A range of other recommendations are made to address other identified potential environmental risks.

Exploration drilling, properly planned and managed, will have lower environmental impact than the clearing of land, or the formation of tracks and roads.

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1.0 Introduction

Evolution Mining NZ Pty Ltd Pty (ENZ) is the holder of Mineral Exploration Permit 51985 which covers 2,984 Ha near Puhipuhi, Northland which is prospective for both gold and silver.

The area is geothermal in origin and has a history of being mined for mercury which is present in the area in the form of cinnabar.

Through consultation with the local community, and through ongoing media attention, ENZ is aware that local stakeholders are concerned about potential environmental effects of exploration and any future mining.

ENZ has initiated a number of baseline environmental studies to supplement historical work and provide information that can be used to both address concerns, and inform the management of any future exploration or mining activities.

ENZ wishes to ensure that they have a robust environmental management system in place to address actual and potential impacts of exploration drilling.

The purpose of this document is to develop an environmental management strategy for potential exploration drilling that is informed by the baseline environmental studies in order to minimise the potential environmental impact.

2.0 Environmental management strategy philosophy

The philosophy behind the proposed environmental management strategy is one of identifying the potential environmental risks then, when developing the exploration drilling program:

- Eliminate;
- Isolate; or
- Minimise the risks.

Management plans are used to prescribe how various exploration activities are carried out in order to ensure that the identified environmental risks are minimised.

Monitoring is used to assess the effectiveness of the management plans, and if necessary, the management plans are revised to improve their effectiveness.

This philosophy is very similar to that used when developing Health and Safety systems.

3.0 Identification of the key environmental risks

The key environmental risks were identified from a combination of sources:

- Permit or consent conditions
- Local stakeholder concerns
- Environmental baseline monitoring results
- Generic exploration drilling program activities

Each of these areas are summarised as follows.

3.1 Permit or consent requirements

ENZ is proposing to carry out exploration drilling under Mineral Exploration Permit 51985 issued by New Zealand Petroleum and Minerals.

The Permit contains no specific environmental conditions but does specify that "on completion of activities the permit holder must carry out restoration of the permit area in accordance with all regulatory requirements, consents and industry good practice"[1].

Review of local regulations by ENZ has confirmed that they require no other permits or consents in order to carry out exploration drilling within Mineral Exploration Permit 51985.

3.2 Other requirements

A portion of the Mineral Exploration Permit 51985 is DOC Estate. ENZ has obtained an authority to undertake minimum impact activities on public conservation land under exploration permit 51985. Conditions to this authority specify measures that must be taken to avoid the spread of PTA, the Kauri Dieback Disease, the spread of weeds, and that any samples taken must be obtained through hand held, non-mechanical methods only.

The Whangarei District Plan (Part D – Environmental Rules – Countryside and Coastal Countryside Environmental Rules) contains rules regarding permitted levels of noise can be generated by an activity that must be adhered to (see Section 4.5).

Provisions in the Hazardous Substances and New Organisms Act (HSNO) will need to be complied with when undertaking exploration drilling when transporting, storing and using potentially hazardous substances such as diesel.

Any drilling fluids or cuttings disposed in an off-site landfill will need to meet that landfill's waste acceptance criteria as defined by the MfE[2].

Consideration has also been given as to whether the proposed exploration drilling requires falls under the remit of the Environmental Protection Authority

[1] Minerals Exploration Permit 51985
[2] Module 2: Hazardous Waste Guidelines. Landfill Waste Acceptance Criteria and Landfill Classification, MfE, 2004

(EPA). The EPA is concerned with, among other things, major infrastructure projects of national significance which does not include exploration drilling activities.

3.3 Environmental baseline results

PDP has been engaged by ENZ to undertake baseline monitoring prior to any potential exploration drilling.

The key results are as follows:

- Groundwater quality testing of bores and springs in the area found that mercury and arsenic concentrations are below the New Zealand Drinking Water Guidelines with the exception of water from one historic exploration drillhole that returned arsenic above the Maximum Allowable Values;
- Previous surface water quality testing (GNS 2015[3]) shows that mercury concentrations in Puhipuhi stream water are mostly below detection, but are slightly elevated (up to 0.24ppb) at some locations compared to regional background levels (<0.1 ppb). All Puhipuhi surface water samples to date have met NZ drinking water standards for mercury (7 ppb);
- Historical soil testing (GNS 2015[4]) has measured mercury concentrations greater than 1 ppm in many soil samples; and
- Historical sediment sampling (NRC 2014[5]) has measured mercury concentrations above the ANZECC (2000) guideline low value (Trigger value) of 0.15 ppm throughout the Waiariki catchment;

From these results the key exploration drilling environmental risk is the disturbance of soil which, if not correctly managed, could result in sediment runoff into streams and a potential increase of water soluble mercury into the environment.

3.4 Local stakeholder concerns

There are a number of stakeholders within the permit area including the current landowners and Ngati Hau. Discussions with Ngati Hau and ENZ (who are

[3] Data Review of the Distribution of Mercury at Puhipuhi and Recommendations to Minimise Release of Mercury to the Environment During Exploration Drilling, GNS Science consultancy Report 2015/150, July 2015

[4] Data Review of the Distribution of Mercury at Puhipuhi and Recommendations to Minimise Release of Mercury to the Environment During Exploration Drilling, GNS Science consultancy Report 2015/150, July 2015

[5] Puhipuhi Water and Sediment – Heavy Metal Testing Programme 2013 – 2014, NRC

engaged with many of the local landowners) have highlighted the following concerns:

- Interconnection of groundwater aquifers causing a degradation in aquifer water quality;
- Mobilisation of mercury from subsurface to the surface environment as a result of drilling;
- Degradation of drinking/stock/irrigation water quality;
- Impact of mercury on wildlife in the streams/rivers and in particular koura and tuna; and
- Protection of Maori artefacts/historical dwellings/human remains.

Section 3.2 has shown that the local surface and groundwater, while containing mercury levels below the NZ Drinking Water Standard, do show elevated levels compared to regional background levels at some locations within the permit area. Care should be taken not to cause any further elevation in water mercury levels.

3.5 Generic exploration drilling program activities

Individual activities within an exploration drilling program can result in areas of potential environmental risk including the following:

- Soil disturbance during drill site establishment;
- Storm water and sediment control;
- Water for use in drilling operations;
- Storage and disposal of drilling cuttings and fluids;
- Noise from drill rig operation;
- Dust from disturbed soils;
- Increase traffic; and
- Drill site rehabilitation.

3.6 Summary of key exploration drilling activities

Based on a review of Sections 3.1 to 3.4, the following activities associated with exploration drilling could produce potential environmental effects and require management during exploration drilling operations.

- Drill site establishment;
    - Protection of Maori artefacts/historical dwellings/human remains;

- Soil disturbance;

- Sourcing of water for use in drilling operations;
- Storage and disposal of drilling fluids and cuttings;
- Interconnection of groundwater aquifers;
- Noise from drill rig operation;
- Drilling related traffic;
- Dust;
- Drill site rehabilitation.

Each of these areas is discussed in the following section.

4.0 Management of potential effects

Each of the activities identified in Section 3.5 and the associated environmental effects will be discussed with respect to how they can be:

- Eliminated
- Isolated, or
- Minimised

For each activity where the potential environmental effect cannot be eliminated or isolated, a range of controls will be assessed to determine the most appropriate management strategy for the situation in order to minimise the environmental effect.

4.1 Drill site establishment

The establishment of the drill site has, along with any site access roads or tracks, the largest potential for soil disturbance of any exploration drilling related activity.

- The drill site should be located at least 20m away from a waterway in order to **minimise** the risk of sediment runoff entering the waterway.
- In selecting drill site locations, consideration should be given to selecting sites and access routes that minimise opportunities for ground disturbance.
- Sediment and erosion control measures should be implemented where required on any access roads.

There are three main types of drill rig that can be utilised; track mounted, fly (man-portable) or truck mounted.

Consideration should be given to the type of drill rig to be used. A track-mounted or fly rig/man-portable rig is preferred, if practical, to minimise soil disturbance on paths of access;

Truck mounted rigs generally require a level drill pad to be formed which may involve some degree of soil disturbance.

It is recommended that if the drill site requires excavation to provide a level platform:

- Geosynthetic cloth and gravel are laid down over the disturbed soil in order to reduce sediment runoff and provide a stable platform for the drill rig;
- Stormwater and sediment runoff should be managed by a perimeter drain leading to one or more sediment traps before the stormwater is released to a surface waterway; and
- Excavated topsoil piles should be covered with mulch or cloth.

Track mounted rigs do not require a drill pad to be formed as the drill platform is able to be levelled with hydraulics and the weight of the drill rig is spread over a wider area via the tracks. As there is little if any soil disturbance, storm water and sediment management is generally not required, however consideration should be given to the following recommendations:

- A perimeter diversion and catch drain leading from the work area to one or more sediment traps before the stormwater is discharged;
- Construction of a timber or synthetic working platform to protect the immediate work area from soil disturbance due to foot traffic and vehicle movements;
- Selection of suitable access routes and drill sites to minimise opportunity for soil disturbance;
- Any area of soil disturbance should have stormwater and sediment runoff management in place to ensure that sediment loss into nearby waterways is **minimised**.

In order to **minimise** the potential impact of disturbing any Maori artefacts, historical dwellings or human remains, representatives of the local hapu, Ngati Hau, should be consulted regarding proposed drill sites prior to finalisation of the location.

4.2 Sourcing of water for use in drilling operations

Water is required for the formulation of drilling fluid, which consists of water plus inert, biodegradable additives such as polymers and clays that are used to assist the drilling process.

The main purpose of the drilling fluid is to:

- Line the borehole with a protective coating (referred to as wallcake);
- Keep the drill bit lubricated, cool and clean during drilling;
- Carry drill cuttings, consisting of finely ground rock slurry, from the drill bit to the surface for disposal.

Water for drilling could be sourced from local streams or farm dams, subject to landowner consent; however care must be taken to ensure that the stream is accessed in a manner that does not cause damage to the stream banks and/or an increase in sediment in the waterway.

Access from a bridge or culvert should **minimise** any potential for damage to the stream bank.

The New Zealand Environmental Standard for Drilling of Soil and Rock, NZS 4411:2001, specifies that the water must be sufficiently clean to avoid the contamination of ground water. Stream water must be tested to confirm that it meets this requirement and **eliminates** the potential to contaminate groundwater.

4.3 Storage and disposal of drilling fluids and cuttings

Two methods of managing drilling fluid and cuttings can be used; open pits dug close to the drill rig, or surface tank based fluid reticulation systems.

Open earthen pits can be used as a settling area to separate solids and fluids (which can be recycled back into the drill hole). The cuttings remain in the pit and are either covered over at the completion of drilling or dug out and trucked to a separate disposal site. This method is standard industry practice. In-ground sumps should be lined with appropriate impermeable material or medium to prevent loss of fluid and cuttings to ground.

Surface tank based fluid reticulation systems contain the fluid and cuttings in above-ground tanks while the fluid is cleaned of solids before being recirculated back into the drill hole. The use of surface tank-based fluid reticulation systems is best practice and the preferred method of managing drilling fluids and cuttings from an environmental perspective.

- It is recommended that the potential for loss of drilling fluid or cuttings to ground be **eliminated** through the use of a surface tank-based reticulation system with disposal of waste products offsite at an approved landfill.

4.4 Protection of groundwater and aquifers

The New Zealand Environmental Standard for Drilling of Soil and Rock, NZS 4411:2001 requires that all aquifers and permeable zones of differing pressure,

water quality and temperature shall be sealed to prevent the interconnection and/or wastage of groundwater between aquifers and permeable zones.

In addition the NZ Drilling Standard requires that the annular space between the bore casing and the hole shall be sealed from the surface to whatever depth is necessary to prevent the contamination or pollution of groundwater by surface or shallow subsurface sources, to control subsurface pressures, and to prevent movement of the casing.

It is recommended that groundwater and aquifers are protected both during and on completion of drilling by use of the following standard industry practices:

- Use of appropriate drilling fluids to seal the annulus of the hole;
- Use of grouting techniques to seal individual aquifers as they are encountered;
- Use of grouting techniques to completely seal drill holes to a depth of at least 150m on completion of drilling.

In this manner individual aquifers are isolated and mixing of different aquifers is prevented.

4.5 Noise from drill rig operation

The primary source of noise from the operation of a drill rig consists of that from a diesel engine which powers the pumps and hydraulics. There may also be noise events such as clangs and bangs that occur in making up and breaking out the drill string.

The engine noise is generally not an issue in the rural environment unless the drill hole location is in close proximity to a residence, whereas banging and clanging events can create noise nuisance.

Whangarei District Council plan specifies that the following limits may not be exceeded, as measured at any point within the notional boundary of a residential unit on any other site:

(i) 50 dBA L_{10} between the hours of 0700 and 2200; and

(ii) 35 dBA L_{10}, and 60 dBA L_{max}, between the hours of 2200 and 0700.

Drilling noise is expected to meet these guidelines, however it is recognised that sensitivity to noise can vary. Recommendations in regard to noise include the following:

- Drillers should be deterred from unnecessary hammering and clash of drill string and rig as much as is practical.

- It is recommended that the impact of drill rig noise be **minimised** by location of drill holes away from residences (if possible).
- Consideration can be given the use of engineered solutions for noise minimisation;

4.1 Drilling related traffic

Exploration drilling will create increased levels of traffic in the local area related to the transport of the drill rig and associated equipment to and away from site, the daily transport of drillcore from site and the daily transport of staff to and from work.

Overall the increase in traffic volume will not be significant.

The impact of increased drilling related traffic can be **minimised** by ensuring any large, slow moving truck movements are scheduled for times of the day that do not interfere with known regular road use, including the school bus run, milk tanker collection and stock movement across or along the road).

4.2 Dust

The selected drill method (diamond core drilling) does not inherently create dust, because the drill process is assisted by downhole circulation of fluid. However, dust can be generated from soil disturbed during the formation of the drill pad or site access tracks (if required). The importance of minimising the exposure of disturbed soil was discussed in Section 4.1.

It is recommended that in order to **minimise** exploration drilling related dust the disturbance of soil is kept to a minimum. In especially dry and/or windy conditions a water truck can be used to damp down and suppress dust if required.

4.3 Rehabilitation

Rehabilitation of the drill site is a key activity to ensure that any long term effects of exploration drilling is minimised.

As soon as practical following the completion of the work at a drill site the area should have any remedial earthworks carried out and be revegetated. Storm water and sediment control measures should be kept in place until the vegetation is in place and there is no potential for sediment erosion.

5.0 Management plans

Management plans are typically used to ensure that operations achieve their objectives by specifying the relevant measures to be implemented, monitoring and the responses required if the actual effects differ from those expected.

For the proposed exploration drilling, the following management plans are required:

- Exploration management plan;
- Erosion and sediment control management plan;
- Water management plan; and
- Waste management plan.

The various management plans will refer to a number of procedures which will detail how specific activities are carried out, e.g.

- Site Environmental Monitoring Procedure;
- Land Disturbance Procedure; and
- Progressive Land Rehabilitation Procedure.

6.0 Monitoring requirements

Monitoring is required to assess the effectiveness of management plans to control and minimise actual effects. The type and frequency of monitoring will be specified in the individual management plans however it is expected that it will comprise of a combination of:

- Regular audits, including drillsite rehabilitation audit; and
- Audits following significant changes such as heavy rainfall or changes in drill site operation.

7.0 Revision of management plans

To maximise their effectiveness management plans need to be regularly reviewed and updated. This should occur following any monitoring audits to ensure that any potential operational improvement is captured and acted upon.

8.0 Summary and conclusion

The exploration drilling related activities that could pose potential environmental effects, and therefore require management, have been identified.

Each of the activities identified, and the potential associated environmental effects, have been discussed to determine options for eliminating, isolating, or minimising the effect.

The key environmental risk posed by exploration drilling was found to be the disturbance of soil containing elevated levels of mercury which, if not managed correctly, could lead to sediment runoff into streams and potential increase of water soluble mercury into the environment. This risk can be managed via good drill site location, choice of drill rig and the provision of effective stormwater and sediment and erosion control measures.

Other key recommendations include:

- Drill sites should be located at least 20m away from a waterway in order to **minimise** the risk of sediment runoff entering the waterway;
- In selecting drill site locations, consideration should be given to selecting sites and access routes that **minimise** opportunities for ground disturbance;
- Consideration should be given to the type of drill rig to be used. A track-mounted or fly rig/man-portable rig is preferred, if practical, to **minimise** soil disturbance on paths of access;
- Any access roads should have erosion and sediment control measured in place to ensure that sediment loss is **minimised**:
- Any area of soil disturbance should have stormwater and sediment runoff management in place to ensure that sediment loss into nearby waterways is **minimised**;
- In order to **minimise** the risk of disturbing any Maori artefacts, historical dwellings or human remains, representatives of the local hapu, Ngati Hau, should be consulted regarding proposed drill sites prior to finalisation of the location;
- Access to steams for water should be from a bridge or culvert to **minimise** any potential for damage to the stream bank;
- Prior to use in drilling operations, stream water must be tested to confirm that it is of a quality that will not contaminate groundwater;
- Surface tank based fluid reticulation system with disposal of waste drilling fluid and cuttings offsite at an approved landfill be used to **eliminate** potential leaching into groundwater;
- Drilling activities adhere to the New Zealand Environmental Standard for Drilling of Soil and Rock, NZS 4411:2001 to eliminate the risk of interconnecting groundwater aquifers;

- Exploration drilling related dust is minimised by keeping the disturbance of soil to a minimum and damping down areas with water to suppress dust if required;
- Drill rig noise should be **minimised** by location of drill holes away from residences (if possible);
- Drilling Standard Work Procedures should include consideration of **minimising** work noise.
- Consideration can be given the use of engineered solutions for noise minimisation; and
- Conduct remedial earthworks and revegetate drill sites and access roads as soon as practical following the completion of the work. Storm water and sediment control measures should be kept in place until the vegetation is in place and there is no potential for sediment erosion.

Management plans will be used to ensure that the recommendations given above are implemented by specifying the relevant measures to be implemented, monitoring and the responses required if the actual effects differ from those expected.