**LICENCE NUMBER: L8675/2012/1**
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**SUBMISSION DATE: 20/7/2012**
**EXPIRY DATE: 29/9/2018**

# PREMISES DETAILS

**LICENCEE AND OCCUPIER OF PREMISES**
Millennium Minerals Limited
Ground Floor, 10 Kings Park Road
West Perth WA 6005
ACN: 003 257 556

**PREMISES**
Nullagine Gold Operation
Golden Eagle Project
Mining Lease M46/186
NEWMAN WA 6753

**PRESCRIBED PREMISES CATEGORY**

**Table 1: Prescribed premises summary**

| Category number* | Category Description* | Category Production or Design Capacity* | Premises Production or Design Capacity# | Premises Fee Component** |
|---|---|---|---|---|
| 5 | Processing or beneficiation of metallic or non-metallic ore | 50 000 tonnes or more per year | 1 500 000 tonnes per year | More than 500 000 but not more than 5 000 000 tonnes per year |
| 7 | Vat or in situ leaching of metal | 5 000 tonnes or more per year | 1 500 000 tonnes per year | More than 500 000 but not more than 5 000 000 tonnes per year |
| 85 | Sewage facility | More than 20 but less than 100 cubic metres per day | 50 cubic metres per day | Not applicable |
| 89 | Putrescible landfill site | More than 20 but less than 5 000 tonnes per year | 100 tonnes per year | Not applicable |

* From Schedule 1 of the Environmental Protection Regulations 1987
# From application
** From Schedule 4 of the Environmental Protection Regulations 1987

This Environmental Assessment Report (EAR) has been drafted for the purposes of detailing information on the management and mitigation of emissions and discharges from the prescribed premises. The objective of the EAR is to provide a risk assessment of emissions and discharges, and information on the management of other activities occurring onsite that are not related to the control of emissions and discharges from the prescribed premises activity. This does not restrict the

the Department of Environment Regulation (DER) to assessing only those emissions and discharges generated from the activities that cause the premises to become prescribed premises.

**BASIS OF ASSESSMENT**

The Nullagine Gold Operation (Nullagine Operation) has been assessed as a "prescribed premises" under category numbers 5, 7, 85 and 89, within Schedule 1 of the Environmental Protection Regulations 1987.

*Category 5 - Processing or beneficiation of metallic or non-metallic ore: premises on which –*

*(a) metallic or non-metallic ore is crushed, ground, milled or otherwise processed;*
*(b) tailings from metallic or non-metallic ore are reprocessed; or*
*(c) tailings or residue from metallic or non-metallic ore are discharged into a containment cell or dam.*

*Category 7 - Vat or in situ leaching of metal: premises on which metal is extracted from ore with a chemical solution.*

The Nullagine Operation will process approximately 1 500 000 million tonnes per annum (Mtpa) of metallic (gold-bearing) ore using conventional milling and carbon-in-leach (CIL) techniques.

*Category 85 – Sewage facility: premises –*

*(a) on which sewage is treated (excluding septic tanks); or*
*(b) from which treated sewage is discharged onto land or into water.*

Millennium Minerals Limited (MML) operates a Sewage Treatment Plant (STP) which is capable of treating up to 50 cubic metres of sewage per day.

*Category 89 – Putrescible landfill site: premises on which waste (as determined by reference to the waste type set out in the document entitled "Landfill Waste Classification and Waste Definitions 1996" published by the Chief Executive Officer, as amended from time to time) is accepted for burial.*

MML has constructed a putrescible landfill with a capacity of 100 tonnes each year.

# 1.0 BACKGROUND

## 1.1 GENERAL COMPANY DESCRIPTION

MML is a Western Australian based gold explorer that has been exploring in the Nullagine region of the East Pilbara since 2002. MML has stated commitments to environmentally sound management that aim to ensure there are no significant impacts to the surrounding environment, in particular the Nullagine Water Reserve.

## 1.2 LOCATION OF PREMISES

The Nullagine Operation is located ten km south of Nullagine township in the Pilbara Region of Western Australia on the Mining Tenement M46/186. The site is accessed via the Newman-Nullagine Road. A site layout map is provided in Figure 1. The Nullagine Operation mining leases occur within the Chichester sub-region of the northern Pilbara bioregion as defined in the Interim Biogeographical Rationalisation for Australia (IBRA).

### Climate

Climate in the region is semi-arid to arid with two distinct seasons (wet and dry) and an average annual rainfall of approximately 300 mm. Evaporation rates are commonly ten times annual rainfall, however, the region is subject to flooding following significant rainfall events.

**Topography**
Geology has also played a significant role in current landform development where granitic and basalt terrains show a subdued topography and the sedimentary units result in a more dissected and rugged landscape with well developed drainage that flows north into the ephemeral Nullagine River. Colluvial and alluvial material forms natural valley fill deposits.

**Vegetation and flora**
The Pilbara Region contains primarily tree and shrub-steppe communities, featuring *Eucalyptus* trees, *Acacia* shrubs, "soft" spinifex *Triodia pungens* and "hard" spinifex *T. wiseana*. No plant taxon or ecological communities listed as Threatened pursuant to Schedule 1 and 2 respectively of the *Environmental Protection and Biodiversity Conservation Act 1999*, were recorded in the surveyed area. A clearing permit (CPS 1011/1) was granted on the 13 January 2007, this has since been extended until the 16 January 2015.

**Nullagine Water Reserve**
The Nullagine Operation is located within the southern portion of the Nullagine Water Reserve. This reserve was established in 2001. The section covering the Nullagine Operation was originally classified as a Priority one (P1) Water Source Protection Area. Tailings Storage Facilities (TSFs), STPs and landfills for solid waste disposal are listed as incompatible land uses within a P1 water reserve (as per the Department of Water's (DoW) Water Quality Protection Note entitled "Land use compatibility in Public Drinking Water Source Protection Areas").

Following hydrogeological studies carried out by MML and their groundwater consultants, and in consultation with the DoW and Water Corporation, part of the Nullagine Water Reserve has been reclassified as Priority three (P3).

The decision to reclassify the water reserve was based on an assessment of the distance between the Nullagine Operation and the town water supply bore, the geology surrounding the site and the management mechanisms to be adopted by MML. The studies suggested that it is unlikely that the Nullagine Operation will result in pollution of the Nullagine town water supply. Despite this finding, management at the Nullagine Operation will need to continually take into account its proximity to the Nullagine Water Reserve through regular monitoring, management actions and contingency planning. MML has recognized this issue by stating a commitment to maintain water quality in the Nullagine Water Reserve.

## 1.3 PROCESS DESCRIPTION

The Nullagine Gold Operation will mine and process approximately 1 500 000 Mtpa of gold ore per year for five years with supplementary ore derived from other prospects in the district.

The Nullagine Operation (see Figure 1) includes the following major components:

- dewatering infrastructure (no discharge);
- raw water containment dam;
- process water containment dam;
- five open cut pits;
- haul roads;
- waste rock dumps;
- run of mine (ROM) pad;
- crushing and grinding circuit (Category 5 prescribed activity);
- conventional CIL plant (Category 7 prescribed activity);
- elution circuit and gold-room (Category 7 prescribed activity); and
- 42.6 ha TSF at stage 1 (Category 5 prescribed activity).

Other ancillary infrastructure includes:

- accommodation village;
- 8.5 MW diesel power station (nine diesel generators - seven operation at any one time (7.6 MW) and two as a contingency measure);
- putrescible landfill;
- reverse osmosis plant (RO plant);
- STP;
- bulk fuel storage - two fuel farms (110 000 L each fuel farm);
- workshops; and
- office buildings.

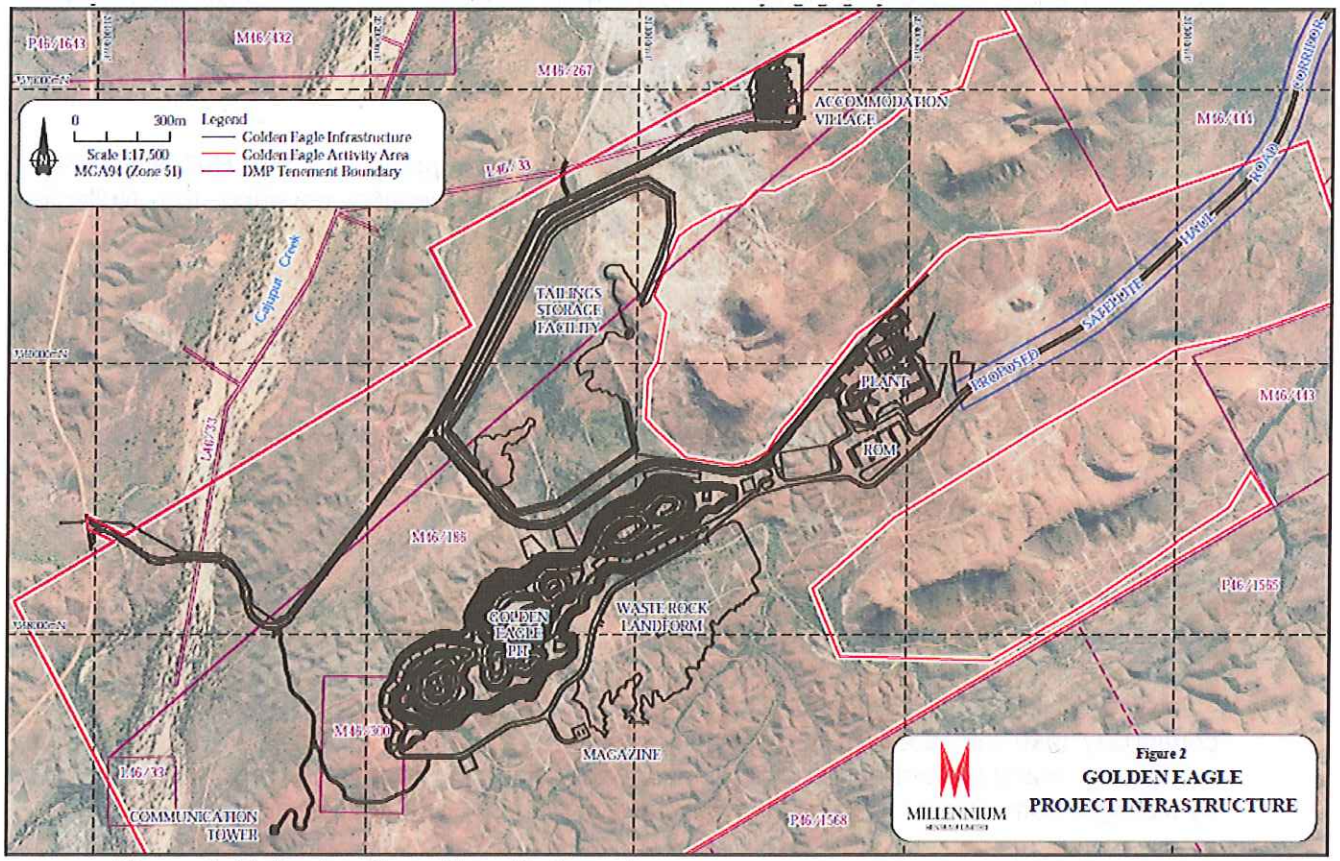


Figure 1: Nullagine Operation site layout

Crushing and Processing Plant

Figure 2 shows the process at the Nullagine Operation. The plant infrastructure includes:

- conveyors;
- primary jaw crusher;
- 4 000 kW SAG mill;
- cyclones;
- nine CIL tanks (up to 890 $m^3$ in capacity);
- 120 $m^3$ lime silo;
- elution column;
- gravity circuit;
- oxygen plant;
- 2.7 kW carbon regeneration kiln;
- tails thickener; and
- miscellaneous tanks for electrowinning, storage, solutions and reagent dosage systems.

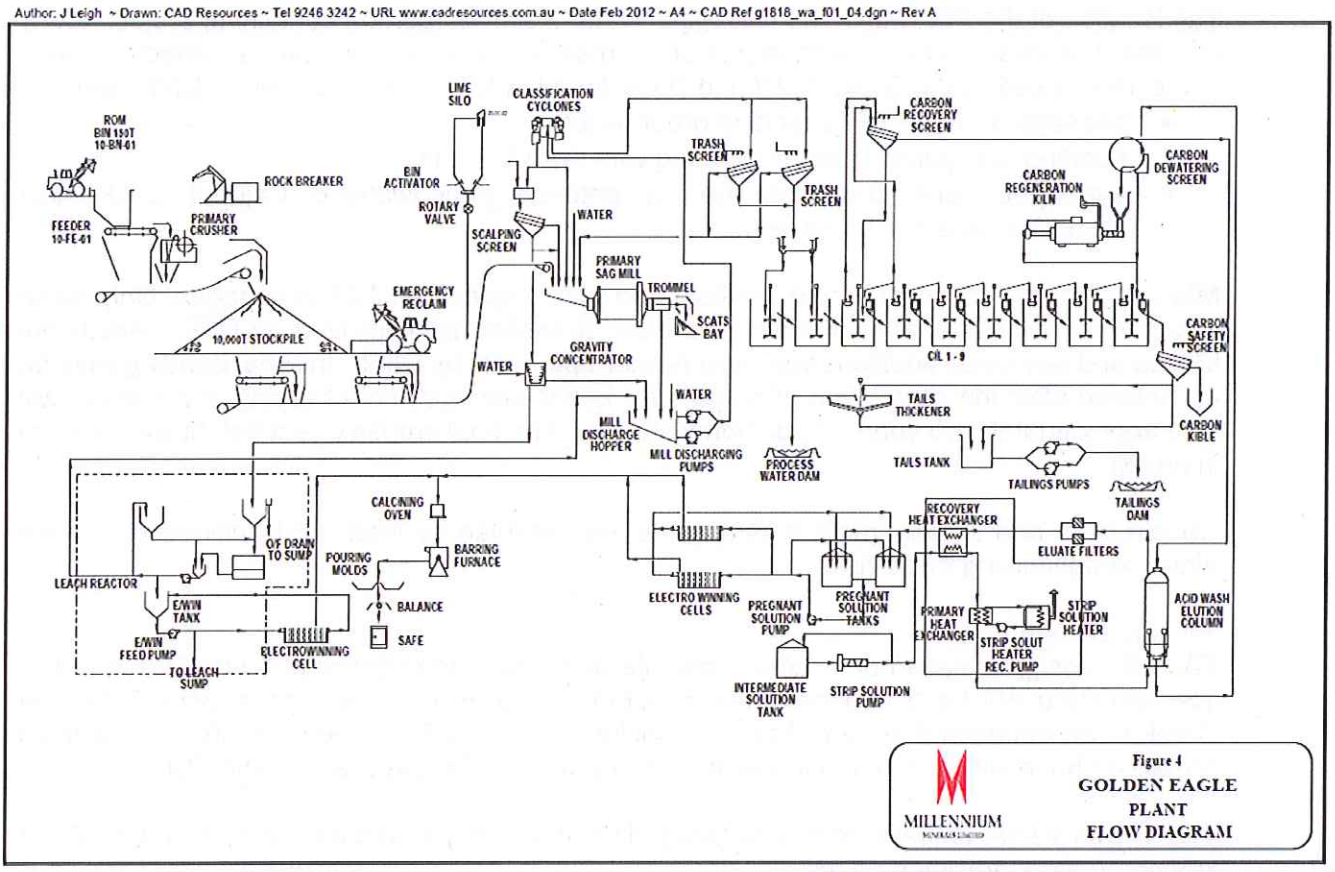


Figure 2: Golden Eagle Plant Flow Diagram.

TSF

*Location*

On 28 February 2012 an amendment to works approval W4248/2006/1 was submitted for a change in location and design. The TSF is now proposed to be constructed in five stages. The works approval (amended 2012) only assessed and approved stage 1 of the new TSF design and location.

The TSF is located entirely within M46/186, approximately 400 m north west of the main ore body (Figure 1). The site slopes from north to south in excess of a 1% gradient and comprises sand and rock outcrop covered by sparse spinifex grassland below patchy low shrubs. The subsoil is described as being silty/clayey sands overlying clayey siltstones and sandstones. The Cajuput Creek drainage system is located approximately 500 m to the west of the proposed TSF and groundwater is approximately 20 m below the natural surface. Groundwater quality in the region of the Nullagine Operation is potable to brackish.

The TSF is located in the 1 in 100 year flood zone. A flood protection bund was been included in the design of the TSF.

*Process*

Tailings is pumped to a TSF to provide secure storage for the waste materials to promote solids settlement and recovery of water for reuse. The design objectives for the TSF are:

- permanent and secure confinement of all solid waste materials;
- maximisation of tailings densities using subaerial deposition;
- minimisation of storage catchment area; and
- maximum removal of free water for re-use at the plant.

The location of the TSF within the Nullagine Water Reserve (portion containing project now a P3 area) had raised concern with regulatory bodies. The main environmental impacts relating to the TSF raised by the DER, DOW and Department of Mines and Petroleum (DMP) were:

- seepage from the TSF reaching groundwater;
- flooding of Cajuput Creek interacting with the TSF; and
- overtopping and runoff from the TSF entering groundwater or Cajuput Creek (Acid Rock Drainage (ARD) issues).

MML revised the TSF design and location, and will complete the TSF in 5 stages. Only stage 1, which is the starter embankment, has been assessed an approved by DER. Additional stages and any other additions will need further approvals by DER. Internal bunding may be considered after the completion of stage 1 for better management of drying. Each stage will give approximately 1.5 years of additional storage. The final embankment height will be 14 m in height.

Construction and management mechanisms implemented by MML and outlined below are aimed at minimising these risks.

*Tailings Design*

The TSF design is based on a seven year life and designed capacity of 1 500 000 $m^3$. The TSF structure will be a paddock impoundment based on centreline construction. Cajuput Creek is an ephemeral stream that is downslope from the TSF given the proximity a flood protection bund will be constructed along the northern and western wall of the TSF.

The overall starter embankment area (stage 1) of the facility is approximately 42.6 ha. Other key parameters are listed below:

| **Parameter** | **Details** |
|---|---|
| Starter embankment | RL 396.0 m |
| Final embankment level | Unknown |
| Footprint surface area | 42.6 ha |
| Additional height of embankment lifts | 6 m |
| No. of lifts | 4 |
| Individual lift heights | 1.5 m |
| Additional Storage life | 2 years |
| Embankment fill – starter | unknown |
| Embankment fill lifts | unknown |
| Total fill | unknown |

The initial embankments will be constructed using compacted and oxidised non acid-forming (NAF) waste material from the open pit to the height of zero to seven metres, with four 1.5 m lifts (to be assessed in future applications to DER) in subsequent years utilising stockpiled NAF material with oxidised rock armouring as required. The TSF has a decant pond against the centre of the southern wall of the facility. Reclaim water is pumped back to the Process Pond at the processing plant via a bunded high-density polyethylene (HDPE) pipeline for reuse in the process.

*Tailings Characteristics*

Thickening of the tailings slurry is to a nominal density of 55% prior to its discharge to the TSF. The tailings are comprised of silt sized material that settle quickly and achieve a high density. The tailings have a permeability of 2.2 x $10^{-6}$ m/s. A tailings-slurry sample was geochemically characterized by Graeme Campbell and Associates Pty Ltd. The results indicate that the tailings consist mainly of quartz, plagioclase and muscovite, with traces of pyrite and chlorite. Tailings liquor from bench scale tests had pH 10.4 and total dissolved

solids (TDS) of 2 700 mg/L. The salts in the liquor are mainly NaCl, with concentrations of most minor elements below or close to detection limits (GCA, 2005). The tailings were classified as potentially acid-forming (PAF) with trace to accessory amounts of pyrite. As the tailings material are kept wet by continual overlays of beaching, and then capped immediately following trafficable desiccation at closure, the short lag PAF material is not considered to be an issue as exposure to atmospheric conditions are restricted. The tailings solids were also enriched in the following elements:

- Arsenic (As) 1.5 mg/kg;
- Boron (B) 10 mg/kg;
- Antinomy (Sb) 0.2 mg/kg;
- Selenium (Se) 0.05 mg/kg; and
- Total Sulphur 0.97%.

A concern with many TSFs, as documented in the Environment Australia document entitled "Best Practise Environmental Management in Mining: Cyanide Management", is the cyanide concentration in ponded surface water. This has been documented as causing faunal deaths particularly to birds. Industry standards aim to keep the concentration of weak acid-dissociable (WAD) cyanide in the ponded water below 50 mg/L. Although the concentration of WAD cyanide in the tailings slurry is approximately 100 mg/L, dilution and the rapid break down of cyanide will result in levels below the 50 mg/L level. MML have indicated in their mining proposal that the ponded water in the TSF will have a WAD cyanide concentration below 50 mg/L (equivalent to water quality in decant return water). Recycling of the water via the decant, also minimises exposure to ponded water.

*Monitoring*

As part of the operation of the TSF, monitoring of all aspects of the operation are undertaken. This monitoring falls into three basic types:

- short term daily operational monitoring, including visual inspections of pipelines, bund integrity, off take location, integrity of pipe joints, etc., to ensure that the facility is operating smoothly;
- compliance monitoring, including:
  (a) checking starter embankments;
  (b) monitoring bores to check for contamination; and
  (c) operation monitoring, to ensure that the project is meeting all its commitments in regard to a safe secure operation; and
- longer term performance monitoring, including residue level surveys and water flow measurements, to monitor the long term performance of the facility and refine future lift levels.

Water quality in the region of the TSF is potable to brackish and water monitoring is routinely carried out to ensure that operation of the TSF is not impacting on the groundwater resource or the Nullagine Water Reserve. There are six groundwater monitoring bores in the vicinity of the TSF placed around the periphery of the TSF. The TSF monitoring bores are nested bores with deep and shallow bores. Monitoring is undertaken quarterly.

*Seepage Collection*

A seepage recovery system is present to contain any seepage from the TSF. Inception trenches have been constructed so the water flow accumulates in the underdrainage system and toe drain sump. The TSF design incorporates an underdrainage system comprising a finger drain that is placed to the upstream toe of the embankment. The underdrainage system drains evenly into a concrete sump. Seepage is returned into the TSF by pumps.

Sewage Treatment Plant (STP)

The STP was designed for 160 personnel giving it a design capacity of 50 $m^3$/day. The proposed plant is a "MAK 50 – Membrane Bioreactor". The effluent is treated in the bioreactor (aerobic and anaerobic treatment) prior to polishing with Ultra Filtration (UF) membranes. The expected water quality performance standards for the STP are outlined in Table 2.

The Membrane bioreactor plant includes:

- five x U860 membrane cartridges;
- feed and backflush pumps;
- feed, air and backflush pressure gauges;
- product flow meter;
- air-scouring blower;
- stainless steel or galvanised steel support frame;
- PVC piping, houses and quick couplings;
- electrical control panel with programmable logic controller (PLC);
- bio-reactor tank; and
- two submersed aerators.

**Table 2: STP Performance standards for water quality**

| Parameter | Expected performance standard | Results from 12 Aug 2013 | Results from 9 Sep 2013 | Australian Guidelines* |
|---|---|---|---|---|
| Biochemical Oxygen Demand (mg/L) | <1.5 - 5 | <5 | <5 | 20-30 mg/L |
| Total Nitrogen (mg/L) | <10 | 37 | 58 | 25-40 mg/L |
| Total Phosphorus (mg/L) | <2 | 0.65 | 8.7 | 20-50 mg/L |
| Total Suspended Solids (mg/L) | <5 | 5 | 20 | 6-12 mg/L |
| *E.coli* (cfu/100 mL) | <1 | <1 | 10 | $10^5$-$10^6$ |

*Australian Guidelines for Sewerage Systems – Effluent Management

A 30 $m^3$ Polyurethane Surge/Balance Tank has also been installed prior to the containerised plant to cope with an average maximum peak load of 20 $m^3$. The plant also contains an enclosed stainless steel parabolic primary screen to remove any unwanted non biodegradable materials. This screen transfers the unwanted waste to a plastic bag held within a relocatable bin for removal to a landfill.

The system and effluent is closely monitored as part of the water monitoring program to ensure input and output parameters are achieved. The STP has monthly maintenance checks conducted by the suppliers of the unit (MAK Water). The STP has inspections by operational staff daily. MML have committed to monitoring pH, BOD, TSS, TN, TP and *E.coli* twice a month.

RO plant

The RO plant is a containerised plant which uses energy to force water particles through a semi-permeable membrane, leaving higher concentration of solutes behind as waste. The waste is discharged into the process water dam and returned to the processing plant for reuse. The RO plant has a capacity of 75 $m^3$ per day.

Putrescible landfill

The landfill capacity is 100 tonnes per annum and has been designed to accept putrescible and inert wastes. Approximately eight tonnes of waste report to the landfill each month (approximately 100 tonnes annually). The facility is sited in the waste rock landform (WRL),

south west of the processing plant (Figure 3). The site is seen as appropriate due to the following:

- types of waste to be accepted (see below);
- subsurface geology (the groundwater aquifer is structurally separated from the Cajuput Creek which connects into the water reserve);
- earthen bunding of trench;
- abundant cover material (waste rock);
- buffer zones to the accommodation village and offices;
- fencing of the mine-site;
- diversion of runoff around active tipping areas;
- distance from surface drainage (site is more than 100 metres from surface waters and outside flood area); and
- proposed construction and operation of the site.

Due to these factors the landfill poses minimal risk to the environment, in particular the Nullagine Water Reserve.

The following waste types will to report to the landfill:

- Clean fill from building or associated excavations;
- Inert Type 1 wastes including building and demolition waste such as bricks, concrete and non recyclable glass, paper, metal and timber;
- Inert Type 2 wastes including non recyclable plastics, poly pipe and rubber; and
- Putrescible waste including camp and site food waste, office and packaging waste, clean drums and containers.

The following waste types are not disposed of into the landfill:

- hydrocarbons;
- used tyres (recycled or removed off site);
- hazardous waste such as explosives and detonators, cyanide boxes and bulk bags, waste chemicals, batteries, poisons and other dangerous goods;
- intractable waste including radioactive materials and contaminated soils; and
- Special Type 1 and 2 wastes such as asbestos and biomedical wastes.

Due to the nature of the material being accepted and the location of the facility, lining of the facility was deemed not necessary.

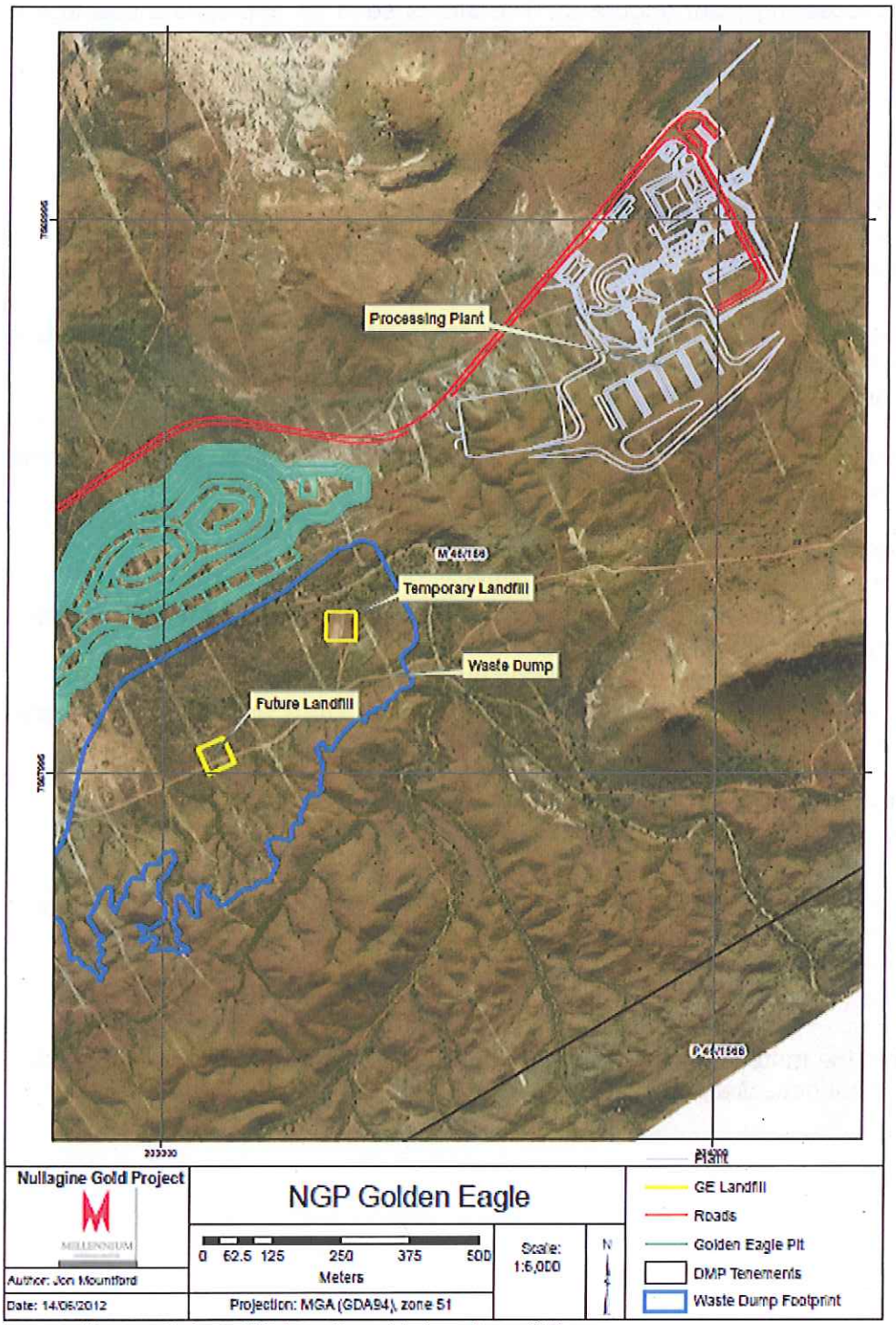


Figure 3: Landfill location (Future Landfill).

A site specific Environmental Management Plan (EMP) has been developed for the Nullagine Operation. The plan includes:

- site Environmental Policy;
- details of current approvals, permits and licenses;
- environmental responsibilities of site personnel;
- proposed environmental monitoring and reporting requirements;
- proposed inspection and audit process and management of incidents; and
- preparation of procedures and work instructions.

## 1.4 REGULATORY CONTEXT

### 1.4.1 Part IV *Environmental Protection Act 1986*, Environmental Impact Assessment

The proposal to develop the Nullagine Operation was referred to the Office of the Environmental Protection Authority (OEPA) on 26 April 2006. The OEPA advised the proponent on 29 May 2006 that the project would not be formally assessed and that any issues could be managed by Part V of the *Environmental Protection Act 1986* (works approval and licence) and other assessments.

### 1.4.2 Part V *Environmental Protection Act 1986*, Environmental Management

The Nullagine Operation has been assessed as a "prescribed premises" under the Environmental Protection Regulations 1987 for categories 5, 7, 85 and 89.

MML submitted partial compliance documents for works approval W4248/2006/1 for the STP on 4 July 2012. Final compliance documentation for the remaining infrastructure was provided on 20 June 2013.

Nullagine Operations also has a registration R2324/2012/1, on the same premises, for a Category 89 – Landfill. This landfill has been replaced by another which constructed under works approval W4248/2006/1. This licence will replace the registration.

DER will also administer the following legislation:

- *Environmental Protection Act 1986*;
- Environmental Protection Regulations 1987;
- Environmental Protection (Unauthorised Discharges) Regulations 2004; and
- Environmental Protection (Controlled Waste) Regulations 2004.

### 1.4.3 Other Decision Making Authorities' Legislation which applies

**Department of Mines and Petroleum (DMP)**

The revised mining proposal was resubmitted to DMP and subsequently approved on the 13 October 2006. For the 2012 design change a revised TSF Design Report was submitted to DMP and stage 1 – starter embankment was subsequently approved (staged approval) on 3 July 2012, subject to conditions.

**Department of Health**

The proposal to temporarily dispose of treated effluent to the irrigation field was referred to the Department of Health. No objections were received.

**Department of Parks and Wildlife**

The revised mining proposal was resubmitted and subsequently approved on 13 October 2006 by DMP after consultation with DER. No changes were made for the 2012 amendment which were required to be submitted to the Department of Parks and Wildlife (DPaW).

**Department of Water (Water Quality Protection Branch)**

Due to the project's location in the Nullagine Water Reserve the Water Quality Protection Branch of the DoW has a role in approving the project. The mining proposal has been submitted to ensure that on site activities will have no impacts on the water reserve.

### 1.4.4 Rights in Water Irrigation Act 1914

The property owners hold a Groundwater Licence (GWL) under the Rights in Water Irrigation Act 1914. Licence number GWL161702 allocates groundwater to the property per year.

### 1.4.5 Local Government Authority

The premises is located within the Shire of East Pilbara.

# 2.0 STAKEHOLDER AND COMMUNITY CONSULTATION

**SUBMISSIONS RECEIVED DURING 21 DAY PUBLIC COMMENT PERIOD**

The application for licence details for this facility was advertised in The West Australian newspaper on 24 September 2012 as a means of advising stakeholders and to seek public comments. No submissions were received.

# 3.0 EMISSIONS AND DISCHARGES RISK ASSESSMENT

DER considers that conditions should focus on regulating emissions and discharges of significance. Where appropriate, emissions and discharges that are not significant should be managed and regulated by other legislative tools or management mechanisms.

The following section assesses the environmental risk of emissions from the Nullagine Operation. In order to determine the site's appropriate environmental regulation, an emissions and discharges risk assessment was conducted of the facilities using the environmental risk matrix outlined in Appendix A. The results of this are summarised in Table 3.

## Table 3: Risk assessment and management response summary table.

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| Air emissions (point source). | Power Station:<br>**Emission significance of 3 (NOx).**<br>MML operates a power station comprising of 9 diesel generators. 7 are operated at a time with 2 as reserves. Maximum capacity of all generators is 7.6 MW. As the power station is under 10 MW it was not formally assessed in this licence.<br><br>Operation of the Power Station generates CO, $NO_2$, particulates ($PM_{10}$), $SO_2$ and Pb emissions that could affect sensitive receptors such as the mine camp. The NOx emissions do not meet the current NSW Protection of Environment Operations (Clean Air) Regulation 2010 guideline. However, this guideline is for systems with capacity of 30 MW or more. The power station has 9 diesel generators with a combined capacity of only 7.6 MW, well below the guideline. NOx is 1027 $mg/m^3$. This is 1141% of guideline when assessed as group 6 and 41% of the guideline when assessed for Group 1 to 4. | No level of socio-political concern. | D - EIPs, other management mechanisms/licence conditions. | LIC – No licence conditions. No conditions due to diesel generators being located apart and having a small capacity individually. Also only 7 are operated at a time reducing total emissions. | N/A. | General provisions of the *Environmental Protection Act 1986.* |
| Dust emissions. | Dust emissions should not be significant as the impacts from dust are minimal (mainly localised impacts) and there is sufficient management.<br><br>Dust produced during operations by crushing, screening and general mining activities.<br><br>Management includes minimising surface clearing and vehicle speeds, using water carts on roads and installing dust mitigation infrastructure such as conveyor covers and sprinklers.<br><br>The site Environmental Management Plan includes dust management.<br><br>Impacts are unlikely as the facility is located approximately 500 m from the camp and the town of Nullagine is approximately 10 km away. | No level of socio-political concern. | E- No regulation, other management mechanisms. | LIC – Includes standards conditions relating to dust emissions. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Unauthorised Discharges) Regulations 2004.<br><br>*Occupational Safety and Health Act 1984.*<br><br>Mines Safety and Inspection Regulations 1995.<br><br>Site inspections.<br><br>Environmental Management Plan. |
| Odour emissions. | Odour emissions during the operation of the STP should not be significant as the new STP does not require evaporation ponds so the potential for odour emissions to be emitted are further reduced.<br><br>Impacts are unlikely as the facility is located approximately 500 m | No level of socio-political concern.<br><br>This is an isolated site which is | E- No regulation, other management mechanisms. | LIC – Standard condition relating to odour. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>*Occupational Safety and Health Act 1984.* |

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| | from the camp and is located a significant distance from any other residences. | approximately 10 km from Nullagine. | | | | Shire of East Pilbara.<br><br>Department of Health. |
| Noise emissions. | There is the potential for noise emissions from mineral processing and other mining activities. The impacts should not be significant as the plant and mine is located approximately 1.2 km from the camp and a significant distance from any other residences.<br><br>MML have committed to complying with the Environmental Protection (Noise) Regulations 1997. | No level of socio-political concern. | E- No regulation, other management mechanisms. | LIC – No conditions. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Noise) Regulations 1997. |
| Light emissions | Light emissions should not be significant during the construction and operation of the facilities. | No level of socio-political concern. | E – No regulation, other management mechanisms. | LIC – No conditions. | N/A. | General provisions of the *Environmental Protection Act 1986.* |
| Discharges to water | There should be no discharges to water associated with the operation of the facilities.<br><br>The Cajuput Creek drainage system is located approximately 500 m to the west of the proposed TSF and groundwater is approximately 20 m below the natural surface. The TSF is located within the 1 in 100 year flood level for Cajuput Creek. MML has constructed a flood protection bund along the downstream toe of northern and western embankment of the TSF. The TSF has been designed to accommodate a 1 in 100 year, 72 hour rainfall event. The rainfall event would generate 345 mm of stormwater in the TSF. MML committed to maintaining a total freeboard of 900 mm (operational freeboard 300 mm, beach freeboard 200 mm and stormwater freeboard 400 mm).<br><br>Water quality in the region of the Nullagine Operation is potable to brackish and water monitoring is routinely carried out to ensure that operation is not impacting on the groundwater resource or the Nullagine Water Reserve. There are 6 TSF monitoring bores placed around the periphery of the tailings facility. Bores are checked regularly (quarterly).<br><br>Dewatering may be undertaken with water used in the processing plant and also for some dust suppression.<br><br><u>Landfill</u><br>The landfill is has been constructed on the waste rock dump with trenches constructed to a depth, above the natural ground level. | No level of socio-political concern. | E – No regulation, other management mechanisms. | LIC – Standard conditions relating to stormwater management.<br><br>Condition relating to maintaining a freeboard on the TSF.<br><br>Conditions relating to the management of the landfill facility. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Unauthorised Discharges) Regulations 2004. |

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| | The groundwater is 3.9 m to 18.5 m below ground level. The height between the bottom of the trench and the groundwater is greater than 3 m. Groundwater quality is potable to brackish. | | | | | |
| Discharges to land | TSF<br>The environmental risk associated with discharges to land is low, due to management controls proposed by MML and the following factors:<br>• appropriate design of the TSF;<br>• installation of a TSF seepage recovery system;<br>• installation and implementation of groundwater monitoring; and<br>• closed system for the sewage facility.<br><br>The TSF location within the Nullagine Water Reserve (portion containing project now a Priority 3 area) has caused concern with regulatory bodies. The main environmental impacts relating to the TSF raised by the DER, DoW and DMP are:<br>• seepage from the TSF reaching groundwater;<br>• flooding of Cajuput Creek interacting with the TSF; and<br>• overtopping and runoff from the TSF entering groundwater or Cajuput Creek.<br><br>MML indicated in their mining proposal that the ponded water in the TSF will have a WAD cyanide concentration below 50 mg/L (equivalent to water quality in decant return water). This is verified on a quarterly basis in accordance with the Tailings Verification Plan. Recycling of the water via the decant minimises exposure to ponded water.<br><br>As part of the operation of the TSF, monitoring of all aspects of the operation is undertaken. This monitoring falls into three basic types:<br>• short term daily operational monitoring, including visual inspections of pipelines, bund integrity, off take location, integrity of pipe joints, etc., to ensure that the facility is operating smoothly;<br>• compliance monitoring, including:<br>(a) checking starter embankments;<br>(b) monitoring bores to check for contamination;<br>(c) operation monitoring to ensure that the project is meeting all its commitments in regard to a safe secure operation; and<br>• longer term performance monitoring including residue level | Medium level of socio-political concern, due to the proximity to Priority 3 water reserve. | D - EIPs, other management mechanisms/licence conditions. | LIC – Standard monitoring conditions to ensure that effluent quality is maintained including targets and reporting conditions.<br><br>Conditions relating to the management of the TSF.<br><br>Groundwater monitoring and reporting conditions.<br><br>Condition requiring the development of alternative disposal method for treated effluent. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Unauthorised Discharges) Regulations 2004.<br><br>Mines Safety and Inspection Regulations 1995.<br><br>Department of Commerce.<br><br>Department of Mines and Petroleum – Safe Design and Operating Standards for Tailings Storage.<br><br>Tailings Operating Manual.<br><br>Tailings Verification Plan. |

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| | surveys and water flow measurements, to monitor the long term performance of the facility and refine future lift levels.<br><br>The TSF has been designed to minimise the amount of ponded water, by making use of the naturally high evaporation rates and by pumping excess water to be recycled in plant processing. In the event that seepage occurs, water is collected by a toe drain system around the perimeter of the TSF and directed concrete sump. It is then be pumped back into the TSF.<br><br>MML has committed to excavate all TSF foundations to rock. The near surface materials do not have a suitable permeability rating to prevent seepage. The rock underneath is rated at $1.0 \times 10^{-9}$.<br><br>There is the potential for ARD forming, however, tailings disposal is carried out to limit subaerial exposure. Additionally, tailings runoff is contained by the design and by maintaining a freeboard of 900 mm.<br><br><u>STP</u><br>Treated effluent is currently discharged to the TSF and effluent discharge quality is consistent with "Australian Guidelines for Sewerage Systems: Effluent Management" for secondary treated wastewater.<br><br>Parameter significance:<br>**BOD – 1** (16% of guidelines)<br>**TN – 1** (20% of guidelines)<br>**TP – 1**(16% of guidelines)<br>**TSS – 1** (12.4% of guidelines)<br>**E.coli – 1** (<1of guidelines)<br><br>Treated effluent is currently discharging to a 0.35 ha, fenced and signposted, spray irrigation field. Due to the location of the WWTP within a P3 drinking water source area, disposal via spray irrigation is not supported. A condition has been placed on the licensee requiring MML to investigate alternatives means of disposing of treated effluent. Disposal to the irrigation field will not be allowed under the licence beyond 31 December 2013.<br><br>Water quality in the region of the Nullagine Operation is potable to brackish and water monitoring is routinely carried out to ensure | | | | | |

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| | that operation is not impacting on the groundwater resource or the Nullagine Water Reserve.<br><br>MML committed to groundwater monitoring prior to operations to collect baseline data for the site. As this monitoring has commenced it has been included in the conditions of this licence and will allow a comparison of results through ongoing operation. | | | | | |
| Solid / liquid wastes | Solid and liquid waste generated during the operation of the facilities should not be significant, due to the following factors:<br>• relatively small size of the landfill and sewage facilities;<br>• closed system for the sewage facility;<br>• design and operation of the landfill;<br>• location of the facilities- the landfill is greater then 300 m from natural drainage lines; and<br>• no hydrogeological connection to the Cajuput Creek and the Nullagine Water Reserve.<br><br>Sewage sludge is removed from the facility and transported offsite to an approved waste disposal facility.<br>The following waste types are anticipated to report to the landfill:<br>• clean fill from building or associated excavations;<br>• inert Type 1 wastes including building and demolition waste such as bricks, concrete and non recyclable glass, paper, metal and timber;<br>• inert Type 2 wastes including non recyclable plastics, poly pipe and rubber; and<br>• putrescible waste including camp and site food waste, office and packaging waste, clean drums and containers.<br><br>The following waste types will not be disposed of into the landfill:<br>• hydrocarbons;<br>• used tyres (recycled or removed off site);<br>• hazardous waste such as explosives and detonators, cyanide boxes and bulk bags, waste chemicals, batteries, poisons and other dangerous goods;<br>• intractable waste including radioactive materials and contaminated soils; and<br>• Special Type 1 and 2 wastes such as asbestos and biomedical wastes. | Medium level of socio-political concern, due to the proximity to Priority 3 water reserve. | D - EIPs, other management mechanisms/licence conditions. | LIC – Includes conditions relating to management of the landfill facility. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Unauthorised Discharges) Regulations 2004.<br><br>Environmental Protection (Controlled Waste) Regulations 2004.<br><br>Department of Health.<br><br>Shire of East Pilbara.<br><br>Landfill Management Plan. |

| Risk factor | Significance of emissions | Socio-Political Context of Each Regulated Emission | Risk Assessment | DER Regulation (EP Act - Part V) | EAR Reference | Other management (legislation, tools, agencies) |
|---|---|---|---|---|---|---|
| Hydrocarbon/ chemical storage | Bulk diesel (55 000 L in self bunded tanks) and chemicals are used and stored onsite. Chemicals/reagents used onsite include hydrochloric acid, LPG, diesel, caustic soda, carbon, cyanide and quicklime. MML has committed to complying with the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 and Australian Standards 1940-2004 The Storage and Handling of Flammable and Combustible Liquids.<br><br>Hydrocarbon/chemical spills or leaks are managed using spill kits. Oil spills on site are reported and remediation action taken. Hydrocarbon contaminated soils are disposed of at an approved waste facility.<br><br>Any hydrocarbons/chemicals are stored as per the DoW - Water Quality Protection Notes relating to Public Drinking Water Source Areas and tenement conditions as developed by the Department of Mines and Petroleum. | No level of socio-political concern. | E – No regulation, other management mechanisms. | LIC – Standard hydrocarbon/ chemical conditions. | N/A. | General provisions of the *Environmental Protection Act 1986.*<br><br>Environmental Protection (Unauthorised Discharges) Regulations 2004.<br><br>Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007.<br><br>Australian Standards 1940-2004 The Storage and Handling of Flammable and Combustible Liquids.<br><br>Dangerous Goods Licenses (DMP).<br><br>Hydrocarbon Management Plan.<br><br>Cyanide Management Plan. |

# 4.0 GENERAL SUMMARY AND COMMENTS

As shown in Table 3, emissions related to the operation of the Nullagine Operation should pose minimal risk to the environment if managed appropriately. The licence conditions relate to the management of emissions and discharges from the premises which are contaminated stormwater, groundwater monitoring, STP monitoring and STP management. Standard conditions including hydrocarbon storage, dust and reporting have been included. Due to the sensitive location of the site, a condition has also been included requiring MML to develop an alternative method for disposing of treated effluent from the STP as disposal to the irrigation field is not supported.

The operation of the TSF poses the most significant risk to the Nullagine Water Reserve and DER needs to ensure that during mining and processing, the proponent is vigilant in managing and monitoring potential impacts. The proponent has developed an Environmental Management Plan and Tailings Operating Manual.

The premises will be subject to site inspections following construction and during operation, and the proponent will need to demonstrate that the operation is continually having no significant impact on the environment, particularly on the Nullagine Water Reserve. Information to demonstrate the likely environmental risks will need to be provided to the DER in MML's Annual Environmental Reports.

The facilities are subject to the general provisions of the *Environmental Protection Act 1986* relating to the causing and reporting of pollution. In the event of discharge outside normal operating parameters from the processing operations, landfill or sewage facility, the Environmental Protection (Unauthorised Discharges) Regulations 2004 could be applied, as well as other regulatory tools such as Environmental Protection Notices.

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# APPENDIX A: EMISSIONS AND DISCHARGES RISK ASSESSMENT MATRIX

## Table 4: Measures of Significance of Emissions

| Emissions as a percentage of the relevant emission or ambient standard | | Worst Case Operating Conditions (95th Percentile) | | | |
|---|---|---|---|---|---|
| | | >100% | 50 – 100% | 20 – 50% | <20%* |
| Normal Operating Conditions (50th Percentile) | >100% | 5 | N/A | N/A | N/A |
| | 50 – 100% | 4 | 3 | N/A | N/A |
| | 20 – 50% | 4 | 3 | 2 | N/A |
| | <20%* | 3 | 3 | 2 | 1 |

*For reliable technology, this figure could increase to 30%

## Table 5: Socio-Political Context of Each Regulated Emission

| | | Relative proximity of the interested party with regards to the emission | | | | |
|---|---|---|---|---|---|---|
| | | Immediately Adjacent | Adjacent | Nearby | Distant | Isolated |
| Level of Community Interest or Concern* | 5 | High | High | Medium High | Medium | Low |
| | 4 | High | High | Medium High | Medium | Low |
| | 3 | Medium High | Medium High | Medium | Low | No |
| | 2 | Low | Low | Low | Low | No |
| | 1 | No | No | No | No | No |

Note: These examples are not exclusive and professional judgement is needed to evaluate each specific case

## Table 6: Emissions Risk Reduction Matrix

| | | Significance of Emissions | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| Socio-Political Context | High | A | A | B | C | D |
| | Medium High | A | A | B | C | D |
| | Medium | A | B | B | D | E |
| | Low | A | B | C | D | E |
| | No | B | C | D | E | E |

PRIORITY MATRIX ACTION DESCRIPTORS
A = Do not allow (fix)
B = licence condition (setting limits + EMPs - short timeframes)(setting targets optional)
C = licence condition (setting targets + EMPs - longer timeframes)
D= EIPs, other management mechanisms/licence conditions (monitoring/reporting)/other regulatory tools
E = No regulation, other management mechanisms