ILOVICA-SHTUKA ESIA

Environmental and Social Impact Assessment

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Abbreviations and Glossary

%  percent
%ile  percentile
<  less than
>  greater than
≤  less than or equal to
≥  greater than or equal to
µg/m³  micrograms per cubic metre
µm  micrometre
34N  section 34N based on the UTM system
AADT  annual average daily traffic flows
AD MEPSO  Macedonian Electricity Transmission System Operator of Macedonia
ADM  air dispersion modelling
Al  aluminium
ANFO  ammonium nitrate/fuel oil explosive
AOI  area of influence
APELL  Awareness and Preparedness for Emergencies at Local Level
AQS  air quality standard
ARD  acid rock drainage
AREC  Agency for Real Estate Cadastre
As  arsenic
BAT  best available technology
BMP  biodiversity management plan
BOD  biological oxygen demand
BREF  best available technology reference documents
Ca  calcium
Cd  cadmium
CEC  cation exchange capacity
CIL  carbon in leach
cm  centimetre
cmol  centimole
CO  carbon monoxide
Cr  chromium
CRTN  Calculation of Road Traffic Noise
Cu  copper
dB  decibel
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>dB(A)</td>
<td>The sound measurement equipment weighting which correlates best with the human response to noise is the A-weighting.</td>
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<tr>
<td>DBE</td>
<td>design base earthquake</td>
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<tr>
<td>dBL</td>
<td>linear decibels</td>
</tr>
<tr>
<td>dBLAeq,period</td>
<td>The period-averaged ambient noise level.</td>
</tr>
<tr>
<td>DMRB</td>
<td>Design Manual for Roads and Bridges</td>
</tr>
<tr>
<td>DO</td>
<td>dissolved oxygen</td>
</tr>
<tr>
<td>DWS</td>
<td>drinking water standard</td>
</tr>
<tr>
<td>e.g.</td>
<td>for example (Latin, abbreviation of exempli gratia)</td>
</tr>
<tr>
<td>EARM</td>
<td>Energy Agency of Republic of Macedonia</td>
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<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
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<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EDC</td>
<td>environmental design criteria</td>
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<tr>
<td>EIA</td>
<td>environmental impact assessment</td>
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<tr>
<td>EMP</td>
<td>environmental management plan</td>
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<tr>
<td>ESIA</td>
<td>environmental and social impact assessment</td>
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<tr>
<td>et al.</td>
<td>and others</td>
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<td>EU</td>
<td>European Union</td>
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<tr>
<td>EUNIS</td>
<td>European Nature Information System</td>
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<tr>
<td>FAO56</td>
<td>Food and Agriculture Organisation Irrigation and Drainage Paper No 56</td>
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<tr>
<td>FFP</td>
<td>Fast opening filter press</td>
</tr>
<tr>
<td>FS</td>
<td>feasibility study</td>
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<tr>
<td>FTE</td>
<td>full time equivalent (2,080 hours of employment per annum)</td>
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<tr>
<td>g</td>
<td>gram</td>
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<tr>
<td>g/m²</td>
<td>grams per square metre</td>
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<tr>
<td>g/m²/yr</td>
<td>grams per square metre per year</td>
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<tr>
<td>g/s</td>
<td>grams per second</td>
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<tr>
<td>g/s/m²</td>
<td>grams per second per square metre</td>
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<tr>
<td>g/VKT</td>
<td>grams per vehicle kilometre travelled</td>
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<tr>
<td>GA</td>
<td>Geoscience Australia</td>
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<tr>
<td>GDP</td>
<td>gross domestic product</td>
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<tr>
<td>GIS</td>
<td>geographic information system</td>
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<tr>
<td>GPS</td>
<td>global positioning system</td>
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<tr>
<td>ha</td>
<td>hectare</td>
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<tr>
<td>HDPE</td>
<td>High Density Polyethylene</td>
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<td>HDV</td>
<td>heavy duty vehicle</td>
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<tr>
<td>HEC-HMS</td>
<td>The USGS Corp of Engineers Hydraulic Engineering Center Hydraulic Modelling System</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>HEC-RAS</td>
<td>The USGS Corp of Engineers Hydraulic Engineering Center River Analysis System</td>
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<tr>
<td>Hg</td>
<td>mercury</td>
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<tr>
<td>HGV</td>
<td>heavy goods vehicle</td>
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<td>i.e.</td>
<td>that is (Latin, abbreviation for id est)</td>
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<tr>
<td>IAQM</td>
<td>Institute for Air Quality Management</td>
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<td>ICI</td>
<td>Imperial Chemical Industries</td>
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<td>ICME</td>
<td>International Council on Metals and the Environment</td>
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<td>ICMM</td>
<td>International Council on Mining and Metals</td>
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<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
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<tr>
<td>IFC EHS</td>
<td>International Finance Corporation's Environmental Health and Safety Guidelines</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<tr>
<td>K</td>
<td>potassium</td>
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<tr>
<td>keq/ha/yr</td>
<td>kilo-equivalents per hectare per year</td>
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<tr>
<td>kg</td>
<td>kilogram</td>
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<td>kg/blast</td>
<td>kilograms per blast</td>
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<td>kg/ha/day</td>
<td>kilograms per hectare per day</td>
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<td>kilograms per hectare per year</td>
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<td>kilograms per hole</td>
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<td>kg/hr</td>
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<td>kg/t</td>
<td>kilograms per tonne</td>
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<td>kg/VKT</td>
<td>kilograms per vehicle kilometre travelled</td>
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<tr>
<td>km</td>
<td>kilometre</td>
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<tr>
<td>km/hr</td>
<td>kilometres per hour</td>
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<td>km2</td>
<td>square kilometre</td>
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<tr>
<td>kN/m3</td>
<td>kilonewton per cubic metre</td>
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<tr>
<td>kPa</td>
<td>kilopascal</td>
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<td>kV</td>
<td>kilovolt</td>
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<tr>
<td>kVA</td>
<td>kilovolt-amps</td>
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<tr>
<td>kW</td>
<td>kilowatt</td>
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<tr>
<td>L</td>
<td>water level</td>
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<tr>
<td>l</td>
<td>litre</td>
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<tr>
<td>LAeq</td>
<td>equivalent continuous A-weighted sound pressure level, expressed in decibels</td>
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<tr>
<td>LCA</td>
<td>landscape character area</td>
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<tr>
<td>LOM</td>
<td>life of mine</td>
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<tr>
<td>LSA</td>
<td>local study area</td>
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<tr>
<td>m</td>
<td>metre</td>
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</tbody>
</table>
SPR  source pathway receptor
SPWMC  Strumichko Pole Water Management Company
sq km  square kilometre
SW  southwest
SWL  sound power level
SWS  Schlumberger Water Services
t/ha/yr  tonnes per hectare per year
t/month  tonnes per month
the Project  the proposed Ilovica Gold-Copper Project
TMF  tailings management facility
 tonnes/year  tonnes per year
TSP  total suspended particles
TSS  total suspended solids
UNEP  United Nations Environment Programme
US SCS  United States Soil Conservation Service
US$  United States dollar
USEPA  United States Environmental Protection Agency
USGS  United States Geological Survey
UTM  Universal Trans Mercator
VKT  vehicle kilometre travelled
VMRO – DPMNE  Internal Macedonian Revolutionary Organisation – Democratic Party for Macedonian National Unity
VP  viewpoint
w/w%  percent by weight (concentration of solution)
WAD-CN  weak acid dissociable cyanide
WFD  Water Framework Directive
WMF  waste management facility
WTW  water treatment works
yr  year
Zn  zinc
ZTV  zone of theoretical visibility
Glossary

alluvial  
Describes granular material that has been deposited by running water, as in a riverbed, floodplain, or delta.

base cations  
A positively charged ion held on or near the surface of a solid particle by a negative surface and which may be replaced by other positively charged ions in the soil solution, largely Calcium, Magnesium, Potassium and Sodium. Usually expressed in centimoles (cmol) or millimoles (mmol) of charge per kilogram.

bedrock  
The body of rock that underlies gravel, soil or other surficial material.

biodiversity  
The variety of life at the genetic, individual organism, species, population, community, ecosystem and landscape levels, and all the ecological and biological processes through which they are connected.

coarse fragment  
Rock fragments greater than 2.0 mm in diameter and include: gravel 0.2 to 7.5 cm and cobbles 7.5 to 25.0 cm.

coarse textured soil  
The texture exhibited by sands, loamy sands, and sandy loams but not including very fine sandy loam. A soil containing large quantities of these textural classes.

colluvial  
An adjective describing soil, debris or rocks that have been moved by gravity (see colluvium).

corporate tax  
A percentage of incremental profit, before taxes, paid to the national government.

direct effect (economics and employment)  
Effect resulting from direct Project construction or operations activities.

erosion  
The process by which material, such as rock or soil, is worn away or removed by wind or water.

excise tax  
Taxes, less subsidies, on products, and net product taxes.

expatriate  
Non-resident filling Project employment position.

geohazard  
Geological or environmental conditions which may lead to widespread damage or risk.

geology  
The study of the Earth’s crust, its structure, and the chemical composition and physical properties of its components.

geomorphology  
The study of landforms, their origins, and the processes by which they are formed or altered.

gulley  
Describes a land surface with parallel and sub-parallel long, narrow ravines, usually produced by erosion from running water.

indirect effect (economics and employment)  
Effect occurring in industries supplying the Project with goods or services.

induced effect (economics and employment)  
Effect created by consumer spending of indirect and induced employment incomes.
landslide  A slope or mass movement where a shear failure occurs along a specific surface.

leaching  The removal by water of soluble matter from a solid material (e.g., from soil, alluvium, or bedrock).

lentic  Still water ecosystem e.g. pond.

lotic  Dynamic (flowing) aquatic habitat e.g. river.

lowland  The plains (< 400 masl) surrounding the relatively higher elevations of the mountains.

nutrient  An environmental substance (element or compound), such as nitrogen or phosphorus, that is necessary for the growth and development of plants and animals.

organic matter  Plant and animal materials that are in various stages of decomposition.

personal income tax  A percentage of income earned through employment or other income sources paid to the national government.

pH  The negative logarithm of the hydrogen ion activity of a soil. The pH is the measurement of the degree of acidity or alkalinity of a soil.

phyto-remediation  Processes by which contaminants are removed from soil through the uptake by photosynthesising organisms such as cyanobacteria, non-vascular and vascular plants.

rapid drainage  Water is removed from the soil profile rapidly.

reclamation  The restoration of disturbed land to a state of useful capability. Reclamation may include the construction of stable landforms, drainage systems, wetlands, soil reconstruction, addition of nutrients and revegetation.

resource royalty  A percentage of net smelter return paid to government annually.

rill erosion  The removal of soil by running water through streamlets or headcuts.

sand  A soil particle 2.00 to 0.05 mm in diameter.

sediment  Mineral particles such as sand, silt and clay that are transported by water.

sheet wash  Material flow that occurs at a fairly uniform depth over an area where there are no defined channels.

silt  A soil particle 0.05 to 0.002 mm in diameter.

soil quality  The ability of a soil to support unrestricted growth of vegetation due as a function of its inherent physical, chemical and biological properties.

soil salvage  The process of physically removing soil from the pre-disturbance landscape for use in reclamation activities.

subsoil  The middle lower layer of the soil profile, usually the B horizon, which has been weathered.

tailings  The waste material left over from the ore processing.

tailings management facility  The location of tailings impoundment – for the deposit of the tailings from the mineral processing plant.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>terrain</td>
<td>The physical shape and dimensions of a land surface.</td>
</tr>
<tr>
<td>topography</td>
<td>The surface features of a region, such as hills, valleys, or rivers.</td>
</tr>
<tr>
<td>topsoil</td>
<td>For the purposes of this report, topsoil is defined as the upper portion of a soil that is more or less equivalent to the upper A horizon.</td>
</tr>
<tr>
<td>total organic carbon</td>
<td>A measure of the percentage of a sample mass of carbon which originates from organic compounds.</td>
</tr>
<tr>
<td>toxicity</td>
<td>The inherent potential or capacity of a material to cause adverse effects in a living organism.</td>
</tr>
<tr>
<td>understory</td>
<td>Trees or other vegetation in a forest below the main canopy level.</td>
</tr>
<tr>
<td>waste rock</td>
<td>Rock moved and discarded in order to access iron ore resources.</td>
</tr>
<tr>
<td>well drained</td>
<td>Water is removed from the soil profile readily but not rapidly.</td>
</tr>
</tbody>
</table>
Ilovica-Shtuka Environmental and Social Impact Assessment
Non-Technical Summary

This document is the non-technical summary of the Environmental and Social Impact Assessment (the ESIA) for the Ilovica – Shtuka Project (the Project). It describes the main features of the Project, presents the current environmental and social conditions in the area and discusses the potential environmental and social impacts associated with the Project. Mitigation, management and benefit enhancement measures to avoid and minimise adverse impacts and maximise positive impacts are then presented.

Background

The Ilovica – Shtuka Project (the Project) is a proposed copper and gold mine with supporting facilities. The location of the proposed mine is within the Municipalities of Bosilovo and Novo Selo in south-eastern Macedonia (Figure 1). The mine is situated approximately 130 km southeast of Skopje and 18 km east of Strumica. The region is characterised by forested hills up to 1,400 m with the broad valley of the Strumica and Turija rivers to the south of the site. The surrounding land area is sufficient to support the proposed mining operations and facilities and the site is well connected to services and markets by paved roads. The Project will cover an area of approximately 500 hectares (ha) within a concession area of approximately 1,500 ha.

![Figure 1: Regional setting of the Ilovica Shtuka Project and concession area](image-url)

The Project will include an open pit mine, areas of ancillary facilities and warehouses and a tailings management facility (TMF) into which mine waste will be deposited. The mine will operate as an open pit, from which the ore will be extracted and crushed, then transported by a conveyor to the processing plant. The crushed ore will undergo flotation to remove the copper- and gold-bearing minerals. Leaching in a series of
ILOVICA ESIA

tanks will be used to extract gold from a portion of the rest of the ore. The gold leachate will be processed on-site to produce doré bars.

The copper concentrate will be transported from the site in trucks to an existing smelter in Bulgaria. An access road will be constructed to connect the site to the main road.

Construction of the Ilovica-Shtuka Project is expected to take 18 months - 2 years. Construction is scheduled to commence in 2017/2018, subject to financing, and production will continue for 20 years.

Total construction workforce requirements are estimated at about 1,200 Full Time Equivalents (FTE). During operations the average number of FTEs will be approximately 487 per annum. In addition there will be indirect employment opportunities through local contractors and sub-contractors.

The Project will contribute to the local economy through its policy of seeking to maximise the procurement of goods and services from local suppliers through transparent and equitable purchasing procedures. These purchases affect the creation and development of local businesses that provide relevant products, inputs, and services to the Project.

A state royalty will be paid which has been estimated to be approximately US$3.6 million per annum at full production from the mine. According to the Minerals Law, royalties will be distributed between the national government (receiving 22% of the royalty) and the municipalities in which the concession activity is performed (receiving 78% of the royalty). As a result, the Municipalities of Bosilovo and Novo Selo will both have significant economic injections to their budgets: the Project will contribute approximately US$72 million over the life of mine, with approximately US$56 million to the municipalities.

Legal and permitting

Early geological exploration of the Ilovica resource was carried out by the Macedonian Bureau of Geology in 1973. An Environmental Impact Assessment (EIA) was approved for a smaller concession area by the Macedonian Government in November 2011 based on a Conceptual Study.

Subsequently, the exploration licence for the two concession areas (Ilovica village locality concession area, Municipality of Bosilovo; and Ilovica locality concession area, Municipality of Bosilovo and Municipality of Novo Selo) transferred to Euromax Resources DOO Skopje, who have conducted further geological, engineering and environmental studies between 2013 and 2015.

In April 2016 a nationally compliant EIA was undertaken in accordance with the requirements of the Law on the Environment and all relevant secondary regulation. The Project Description assessed in the Macedonian EIA was based on a draft of the NI 43-101 Feasibility Study Technical Report dated 2 October 2015. At the time of writing no written feedback has been received from the Macedonian EIA review process, however stakeholder engagement activities completed by Golder throughout the Macedonian EIA process and feedback provided during the Public Enquiry has been incorporated and responded to within this (internationally compliant) ESIA.
Stakeholder Engagement and Information Disclosure

Stakeholder engagement is important to gain an understanding of how the Project will affect stakeholders and to gather their ideas on how the impacts should be mitigated and managed. Feedback from stakeholders provides an important input to project design. Stakeholder engagement also provides an early opportunity for stakeholders to become informed about planned Project activities and the process followed to refine the project design to maximise benefits while minimising adverse impacts.

Stakeholders include national and municipal government (who are interested and affected parties by virtue of their roles in the approval process, as well as their responsibilities for populations under their jurisdiction) and people living in the communities of Ilovica, Shtuka and Strumica due to their proximity to the Project site and their higher potential to benefit from the Project and be affected by any environmental changes. Other communities may also experience effects (e.g. visual, noise, traffic).

The results of stakeholder engagement for the ESIA showed that people are generally supportive of the Project and would like to see it move ahead for the economic and employment benefits that it will bring to the region and Macedonia as a whole. A lack of employment opportunity was cited in many discussions as being a primary cause for the out-migration of young, educated people from the southeastern region to the EU to pursue employment. While being generally supportive, a number of concerns and questions were raised regarding environmental and social effects of the Project. Aside from employment opportunities, the most common questions related to:

- **Impacts to water**: Stakeholders are concerned that mining activities will result in negative impacts to water quality and availability, with surface water and groundwater currently being used for human consumption and irrigation of gardens and agriculture.

- **Noise and vibration**: Noise generated by mining activity and heavy transport can be a disturbance, while some stakeholders are concerned that vibration associated with blasting and other activities could cause damage to houses.

- **Soil and agriculture**: There is concern that mining activity will result in air pollution and that this could impact upon soils, reducing agricultural productivity.

- **Perceptions of harm**: People are concerned that having a mine so close to farmland will have a negative effect on sales of agricultural products.

The results of stakeholder engagement activities were provided to the ESIA team so that the issues and questions could be addressed in the appropriate section of the ESIA. Each section of the ESIA lists the relevant environmental and/or social issues that were raised during consultations and how they have been addressed through the impact assessment process.
Information Disclosure

This non-technical summary has been prepared for the purposes of information disclosure and to enable a wide range of stakeholders to participate in the decision-making process. More detailed information is available in the ESIA.

Information disclosure has been conducted in accordance with the requirements of the Macedonian Law on the Environment, in line with international good practice and IFC Performance Standard 1 (2012). This non-technical summary and the ESIA are available in the Sustainability section of the Euromax Resources website: [http://www.euromaxresources.com/](http://www.euromaxresources.com/)

View towards Ilovica and the Project location from the Strumica Valley
Project Design and Consideration of Alternatives

The design of the Ilovica - Shtuka Project has been refined over a number of years as the result of studies on the engineering feasibility and the potential environmental and social impacts of the Project. The engineering studies included a Preliminary Economic Assessment, various trade-off studies (tailings and waste rock, process plant location, process flowsheet), the Pre-Feasibility Study (PFS) and the Feasibility Study (FS).

These studies applied a number of criteria to determine the best project design, including:

- The health and safety of workers and residents in surrounding communities;
- The significance of potential social, health and environmental impacts and the ability to mitigate adverse impacts through evaluation of alternative options;
- The economic extraction and production of copper concentrate and gold to meet market specifications;
- Minimising the number of residents that would be disadvantaged economically and physically;
- The availability of infrastructure and labour, including the integration of local skills base;
- Compliance with all applicable laws and regulations in the Republic of Macedonia and the international standards which the Project is committed to meeting; and
- Cost-benefit analyses to enhance Project benefits to surrounding communities, workers, investors, and the Macedonian government (through tax revenue and social investment).

Project alternatives were examined throughout the development of the Ilovica-Shtuka Project, including the Preliminary Economic Assessment (PEA; TetraTech, 2012), various trade-off studies (TetraTech, 2013; AFW, 2015a, 2015b), the Pre-Feasibility Study (PFS; Euromax, 2014) and the Feasibility Study (FS; Euromax, 2015a), and some preliminary detailed design work.

The alternatives that have been considered during the project design included:

- Mine design and infrastructure;
- Logistics and transport;
- Water supply;
- Employee accommodation;
- Non-mining waste management;
- Closure alternatives; and
- The ‘No Project’ alternative.

Project description for the Ilovica – Shtuka Project

The ESIA assesses the potential environmental and social impacts of the Ilovica - Shtuka Project based upon a design freeze on the preliminary design work established in November 2016 (layout shown in Figure 2). The ESIA assesses impacts associated with three phases of the life of mine:

- Construction: an 18 to 24 month period during which mine facilities are constructed and the pit area is stripped in preparation for mining;
- Operations: a 20 year period of open pit mining, processing of the ore, production and export of copper concentrate and gold doré, and deposition of the tailings; and
Closure: a 2 year period during which mining infrastructure is decommissioned and removed (where possible) and land is rehabilitated and revegetated.

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**Open Pit**

The proposed method of mining is by conventional open pit methods using drilling and blasting, loading with excavators and shovels, and hauling with rigid dump trucks. Ore will be deposited to the ROM pad for primary crushing and then transported to the process plant by conveyor.

During the construction phase, the open pit area will be stripped in preparation for mining. Stripping will involve blasting and earth moving to excavate covering materials, including waste rock which will be used in construction of the tailings management facility and in a buttress against the downstream face of the embankment. Any soils which can be stripped and recovered will be stockpiled for future use in rehabilitation and revegetation of the site. Around 2 to 3 blasts per week are anticipated during the construction phase.

During operations, the pit will operate 24 hours per day. Blasting will occur in the daytime only, with on average 1 blast per day. Prior notification of blasting will be provided to police and local authorities. Communities are usually notified of blasting by the municipalities or emergency response institutions, such as the Crisis Management Centre, via the media.

**Plant Site**

Following extraction from the open pit, the mined ore will be delivered to the primary crusher where it will be crushed and fed onto a conveyor which transports the crushed ore to the process plant (a distance of approximately 1.6 km). At the process plant, ore will be milled to smaller sizes before being fed into the flotation circuit. The flotation circuit consists of a number of processes which result in a copper concentrate. Another product of the flotation circuit is a solution ('cleaner scavenger tails') which is then fed into a carbon-in-leach
circuit, during which cyanide is added. This is then followed by cyanide destruction, elution and electrowinning to produce gold doré. Waste materials (tailings) are treated, and some of the water removed for reuse, prior to release to the tailings management facility.

The process plant is designed to process 10 million tonnes of ore per year. During mine operations, the process plant will operate 24 hours per day, with the exception of the crusher and conveyor which will only operate 16 hours per day.

**Tailings Management Facility**

The tailings management facility (TMF) will be a dam within the Shtuka Valley which is designed to contain the mine waste, which results from the processing of ore. The tailings in the facility will be contained along the northern, eastern and southern sides by the natural contours of the valley, and on the western side by the TMF wall.

Prior to construction of the TMF, vegetation clearance and site preparation will occur within the footprint of the starter embankment (a subsection of the TMF which is designed to hold tailings for the first years of operation). Any salvaged soils will be stockpiled for future use in rehabilitation and revegetation of the site. During construction, waste rock from the open pit area will be used to construct the TMF starter wall. The TMF embankment will be constructed using the downstream method and will be raised a number of times throughout the life of mine to a final height of 776 masl. The remainder of the footprint of the TMF will be cleared progressively as the tailings level rises.

Throughout the operations phase, approximately 7 million cubic metres (Mm³) of tailings will be produced each year. Tailings will be gravity-fed or pumped from the plant to the TMF and deposited via pipeline and spigots. Surplus water from the TMF will be returned to the process plant where it will be reused.

At the end of operations, the TMF embankment will have a closure elevation of approximately 776 metres above sea level (masl) (approximately 2 m higher than the final tailings elevation). At closure, the TMF will have a surface area of approximately 191 Ha.

At the conclusion of mining, the TMF will be closed and revegetated. At closure, it will be necessary to construct a closure spillway for the TMF to enable rainfall run-off to spill from the TMF surface. The closure surface of the TMF will be shaped to direct water towards the south of the facility.

A Seepage Control Facility (SCF) will be constructed on the Shtuka River directly downstream of the TMF to capture seepage from the TMF and runoff from both the TMF embankment and waste rock buttress during operations. The SCF is provided to mitigate the potential impact of seepage from the TMF on water quality in the Shtuka River.

A Storm Water Dam (SWD) will be constructed early in the construction phase on the Shtuka River downstream of the TMF and the SCF. The SWD will attenuate high flows and allow settlement of sediment-heavy runoff. Normal flows will be allowed to discharge through the porous dam of the SWD, to maintain ecological flows downstream, and high flows will be attenuated to ensure that flood risk is not increased downstream.

A diversion dam and diversion channel will be constructed to divert the Shtuka River around the TMF and discharge the flows downstream into the SWD.

**Other facilities**

The mining and administration complex will be located to the south of the pit. The mine workshop area will consist of buildings and workshops (offices, workshops, component stores, control room and gate houses and sewage treatment plants). There will be two sewage treatment plants: one at the plant site and one at the mine workshop.

Disposal of non-mineralised waste and general waste will be to a licenced facility off site. However, there will be a waste transition yard, storage facility and salvage yard on-site. Waste will be segregated and sorted at site and stored until sufficient quantities are available for removal to another facility.
A new off-site access road is planned to connect the Project to the existing M6 highway which runs between Strumica and the Bulgarian border. The new off-site access road will be developed in two stages (Figure 3) to serve mine construction and mine operations:

- The temporary off-site access road (shown in green), to be used during construction, is located along the eastern bank of the Shtuka river and through agricultural land.
- The permanent off site access road (shown in purple) will be a new paved road between the concession and the M-6 to a new junction between Serkirnik and Turnovo.

Figure 3: Ilovica – Shtuka Project access roads

Haul roads will be constructed from the pit to the TMF embankment and the mine workshop area. The roads will be 25 m wide and be surfaced with crushed aggregate. Haul roads will be in use 24 hours per day. The speed limit within the concession area is 50 km/h.

All surface water run-off from project infrastructure within the concession area will be diverted to sedimentation ponds, to meet Euromax’s zero discharge policy for surface water.

Construction staff will be accommodated off-site at existing facilities (hotels or existing (commercial) buildings appropriately refurbished), most likely in Strumica.

During operations, all workers will live in nearby towns and villages with site visitors being accommodated in existing refurbished hotels or guest houses.

Temporary diesel generators will be used during construction until the Project is connected to the Macedonian high voltage (110kV) electricity transmission network (permanent power supply). Electricity for the operations phase (permanent power supply) will be provided via a 110 kV connection to the national high voltage transmission network owned and operated by the Macedonian transmission network operator MEPSO.
The permanent power supply connection comprises a new 110/10 kV substation at the plant site ("Ilovica-Shtuka substation"), a new 10.5 km overhead transmission line (OHL) from the Ilovica-Shtuka substation to the existing MEPSO Sushica substation ("Sushica OHTL"), and a new 27 km OHL from the Ilovica-Shtuka substation to the existing MEPSO Berovo substation ("Berovo OHL"). Construction of the Sushica OHTL is expected to be completed first being a shorter line, with Berovo OHL to follow within a few months due to longer permitting and construction timeframes. A separate EIA in accordance with the Macedonian legislation will be prepared to address permitting requirements for the construction of the Berovo overhead transmission line, and an Environmental Elaborate for the Sushica overhead transmission line.

Water Supply

Two major sources of water will supply the mine:

- Conserved on-site sources of water (reclaim from the TMF, including pumped water from the SCF; pit water; and treated wastewater); and
- External sources of fresh water (Ilovica Reservoir and Turija Reservoir).

The major potential source of water supply assessed in the ESIA is from the Turija Reservoir via a pipeline constructed to the Ilovica Reservoir. Water from Turija reservoir and other external sources will be pumped into Ilovica Reservoir in order to support Euromax's abstraction and maintain the reliability of water supplies of the other users. Euromax currently plans to use Ilovica Reservoir as a holding reservoir for water from Turija Reservoir. Water for mine supply will be pumped from Ilovica reservoir to the raw water storage facility at the process plant.

Euromax plans to share the reservoir with existing users – Strumichko Pole Water Management Company (SPWMC; which supplies irrigation water to Ilovica and Shtuka villages) and Ogražđen Public Utility Enterprise (PUE; which supplies seven villages in Bosilovo Municipality with treated water for domestic purposes).

Transport

The majority of construction personnel will be housed in Strumica or local villages. All construction personnel will be bussed from accommodation to site on a daily basis; 30 - 40 trips per day are estimated. The vast majority of operations personnel are expected to live in the surrounding areas with 24 – 28 (offsite) and 50 (onsite) bus trips anticipated on a daily basis.

During construction, between 152 and 190 trucks per month are expected to arrive at the site for the delivery of materials. In addition, throughout construction between 2 and 4 diesel fuel tankers per day and between 2 and 5 food delivery trucks per week are expected. Delivery of reagents and fuel will form a large portion of truck activity during operations, totalling between 136 and 180 vehicles per month.

Copper concentrate will be exported from site to the Bulgarian border (and on to the smelter in Bulgaria), with the haulage contractor expected to use 30 tonne articulated trucks with an estimated 210 to 270 trucks traveling each way per month.

Capital and Operating Expenditures

The total capital cost of Project construction is preliminarily estimated at between €425 and €450 million. The procurement of construction and mining equipment is expected to account for the majority of this expenditure. Labour, fuel and light vehicles will represent smaller, but still significant, capital costs during construction.

Operational expenditures are expected to be approximately €95 to €100 million per annum. Mine operation, including equipment and labour, will account for nearly a third (€30 million) of total annual operational expenditures. Reagents and power represent a further third (€36 million) of annual operational costs, while consumables, maintenance materials, equipment and laboratory costs are anticipated to cost €16 million.
Employment

During construction, peak workforce requirements will amount to about 1200 Full Time Equivalents (FTEs), 1046 (87%) of which are expected to be filled by Macedonian workers. Approximately 55 managerial and technical construction FTEs will be filled by expatriates as needed.

Similarly, the majority of operations phase FTEs are expected to be filled by Macedonians (469 positions or 96% of total), with a small number (18) of managerial roles being filled by expatriates during early mining activities. Expatriate managers will gradually be replaced by local managers mentored and trained during the early years of Project operation.

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1 A Full Time Equivalent (FTE) is the hours worked by a full-time employee, and is calculated based on Macedonian labour conventions, which suggest an eight hour work day, with five days of work per week. This amounts to a FTE of 2,080 hours per annum.
Existing Environmental Conditions

Environmental and social baseline data gathering was completed as part of the ESIA. Baseline data provides a characterisation of the existing environmental and social conditions. This characterisation provides a baseline from which the ESIA can be used to predict potential environmental and social changes as a result of the Project. The baseline also provides a benchmark against which any future changes can be monitored and managed.

Baseline data gathering for all technical areas except water commenced in October 2013 and was completed in September 2015. Water baseline data gathering extended to July 2016.

Local study areas (LSAs) and regional study areas (RSAs) were established for the baseline study. For the biological and physical disciplines, the areas are generally delineated based upon natural geographic boundaries (e.g. river catchments) or a polygon based upon a set radius from the site (e.g. 10 km from the centre of the site). For the socio-economic discipline, studies focussed on the communities which are most likely to feel the positive and adverse effects of the Project, namely the villages in the municipalities of Bosilovo and Novo Selo and the town of Strumica.

Geology

The Ilovica copper-gold deposit is situated at the southern margin of a northwest-southeast striking Cenozoic magmatic arc, which covers part of central Romania, Serbia, Macedonia, southern Bulgaria, northern Greece and western Turkey. The deposit is situated on the northern border of the Strumica half-graben and Ograždhen granite massif, which is one of a number of Neogene-age sedimentary basins in Macedonia.

The Ilovica copper-gold deposit is one of several porphyry systems in eastern Macedonia and northern Greece. The Ilovica deposit sits within a mineralised section of a porphyry system, which is approximately 1.5 km in diameter. There is clear evidence of active faulting along the southern and western borders of the Strumica half-graben. Earthquakes have been reported in the northwest part of the Strumica half-graben.

Geomorphology, Soils and Land Use Capability

The majority of the LSA is dominated by rugged low altitude mountains which contrast with the lowland agricultural zone of the Strumica valley. The highest summit in the LSA is Anovi at 878 masl (part of Mount Ograždhen); the lowest elevation is located in the southwest corner of the LSA along the Shtuka River at about 256 masl. Slope gradients on the mountains range from moderately steep (30% to 60%) to very steep (>60%). In lowland areas, slope gradients are mostly <15%.

The geomorphology of the LSA is dominated by complex colluvial deposits (soil, debris or rocks that have been moved by gravity) and weathered bedrock in the mountains and alluvial deposits (material that has been deposited by running water) in the lowland plains. Colluvial soils are well- to rapidly-drained soils on moderately steep to very steep slopes. Weathered bedrock is decomposed or disintegrated rock in situ, broken down by the process of mechanical and/or chemical weathering in the absence of downslope movement. Alluvial materials are associated with floodplains, terraces, fans and deltas. In the LSA, they are characterised by well- to poorly-drained, coarse- to medium-textured soil s with rounded to sub-rounded coarse fragments.

The most common soil map units in the LSA are those derived from colluvial deposits. These soils are located in the highland zone (mountainous regions) and are characterised by moderately well to rapidly drained soils of variable texture and coarse fragment contents (primarily angular to subangular). These soils developed on high relief (i.e., moderately steep to very steep) slopes, dominated by Regosols and Cambisols, occupying about 50% of the total LSA (about 64% of the highland zone).

The LSA is prone to geohazards due to the mountainous landscape, intense rainfalls, aridity and highly erodible soils. Geohazards can include mass movements (e.g. landslides, debris flows, mudslides, rockfalls),
liquefaction, or seismic events (i.e. earthquakes). The Project is in an area of increased seismic hazard and this has been taken into account in the design of structures and facilities. The majority of mass movement features in the LSA were recorded as inactive (not recently moving) and relic (historical) landslides.

**Climate**

Key meteorological parameters were recorded between 2013 and 2015 to characterise local climate conditions. The area has a mildly continental climate with typical seasonality, although some effects on measured conditions, such as higher wind speed, may be attributed to the elevation and position of the monitoring station.

The following key trends were identified:

- Temperature is highest during the months of June to September with peak temperatures generally recorded in August and the lowest temperatures recorded during the winter months, particularly December and January. The same trends are seen in the solar radiation data.

- Relative humidity displays the same seasonal variation as temperature, but with lower relative humidity during the summer months (approximately May to September) and higher relative humidity during the autumn and winter months (approximately October to March).

- Precipitation data for the EOX station suggests that there are a large number of low intensity rainfall days in the spring and winter, with shorter duration high intensity rainfall days tending to occur during the summer months. Monthly precipitation levels in the region tend to be consistent throughout the year with slight increases in June and towards the end of the year.

- The wind direction at the EOX meteorological station is predominantly south-easterly in direction. The wind direction for the most relevant regional station at Sandanski station showed predominantly north to north-westerly.

- The location of the EOX monitoring station within the Ograždhen mountain range is likely to influence the wind direction due to channelling of the wind. The same effect is potentially also observed in the wind speed data where the average monthly wind speeds at the EOX station are greater than those recorded at the Strumica station. Wind speeds in the area are generally greater during the spring and early summer and are slightly lower for the remainder of the year.

**Water Quantity**

The baseline report on water quantity described the baseline conditions of surface water and groundwater in the local study area in qualitative and quantitative terms.

The proposed mine site is located in the upper Jazga and Shtuka catchments. Ilovica and Shtuka villages with their water supply systems, including the Ilovica Reservoir, are situated downstream of the proposed site. Further downstream, the Jazga and Shtuka catchments discharge surface water and groundwater into the Strumica valley where they contribute to the flow in the Turija and Strumica Rivers and from where groundwater is abstracted for agricultural production.

**Groundwater**

Baseline groundwater data was collected through testing conducted in 2015. The testing found that the geology of the deposit/open pit area has higher permeability (a measure of the ability for water to move through rock) near the surface and lower permeability near the base of the pit.

Observations during drilling indicated that the granite underlying the TMF is weathered and highly fractured. Permeability values were higher than those in the deposit. The weathered and fractured upper surface of the granite underlying the TMF appears to form a minor aquifer that is in hydraulic continuity with the Shtuka River.

Groundwater underlies Ilovica and Shtuka villages at a relatively shallow depth. The depth to water correlates closely with proximity to the Jazga and Shtuka Rivers, with wells located close to rivers showing the shallowest depth to water and those further away from the river showing greater depths to water. A survey undertaken in
2013 identified approximately 60 wells and boreholes and two springs that are used for water supply purposes in the two villages.

The northern side of the Strumica Plain is underlain by a substantial thickness of alluvial deposits. The alluvial deposits support only a very few public or industrial water supply boreholes in the vicinity of the local study area (the public supply source for Sushica village and the dairy at Radovo). However, groundwater is a major source of water supply for agriculture on the Strumica Plain. Approximately 350 irrigation boreholes were identified in a survey of the area around Radovo, Turnovo and Sekirnik.

**Surface Water-Groundwater Interaction**

Baseline studies found that the Jazga River loses small volumes of water to the groundwater system as the river passes the proposed open pit.

In the Shtuka valley, there is a complex system of interaction between groundwater and surface water. Studies showed that approximately 30% of surface water flow was lost within the proposed TMF footprint. Immediately downstream of the TMF, surface water flow increases due to inflow from groundwater in alluvial gravels.

**Jazga River**

Flows in the upstream reaches of the Jazga River were observed year round during baseline monitoring.

Immediately downstream of the Ilovica Reservoir, flows are very low and are mainly fed by minor seepage through the reservoir embankment, supplemented by spills from the reservoir when it is full. Under dry weather conditions, flows increase slightly to the south of Ilovica as a result of inflow from the groundwater system.

The Jazga River is used for public water supply system to Ilovica and is used for domestic purposes (other than drinking) and for irrigation of plots and gardens. The water abstracted at the intake has been adequate to meet the (non-potable) needs of the residents of Ilovica.

The Ilovica Reservoir supplies agriculture and public water supply for Bosilovo, Sekirnik, Turnovo, Radovo, Borievo, Ednokukevo and Robovo, plus intermittent supplies to Shtuka and Ilovica. Peak demand occurs in the summer months (between July and September) when agricultural and domestic water demand increases. Information provided by SPWMC indicates that people in Ilovica and Shtuka use the water from Ilovica reservoir for irrigation.

**Shtuka River**

Flow in the upstream reaches of the Shtuka River were observed to flow year round during baseline monitoring. The river has been observed to dry up and become seasonal between the upper village intake and the lower village intake (both upstream of Shtuka village). Under dry weather conditions, the river channel through Shtuka village and further downstream has been observed to be mainly dry with occasional pools.

Two intakes on the Shtuka River are used for public water supply system to Shtuka. Water is used for domestic purposes (including drinking) and irrigation of plots and gardens. The water abstracted at the intake has not been adequate to meet the needs of the residents of Shtuka and is augmented by treated water supply from the Ilovica water treatment works for an average of 39 days each year during summer months.
Water Quality
The majority of waterbodies monitored during the baseline campaign present relatively clean, unimpacted waters dominated by calcium, magnesium and bicarbonate. There has been little evidence of seasonal variation.

Several surface water and groundwater monitoring points showed different water chemistry, generally believed to be influenced by water draining from mineralised zones. These monitoring points showed higher concentrations of sulphate, iron and copper and lower alkalinitities and pH.

A minor tributary to the Jazga River passes in close proximity to the deposit. Water quality in this tributary shows significant alkalinity towards the top of the tributary, but as the stream flowed past the mineralised zone alkalinity and pH decreased.

Shallow groundwater in the vicinity of Ilovica, Shtuka and Sushica, as well as surface waters downgradient, has been impacted by anthropogenic activities such as wastewater discharges and agricultural practices, as indicated by elevated nitrate and ammonia, sometimes exceeding drinking water guidelines. Surface waters and groundwaters in the Strumica Plain had higher alkalinitities and thus a more neutral pH. One of the exceptions to this trend was the piped spring Bela Voda (JZSP10) in the Jazga catchment. The major ions, as well as parameters like strontium, were elevated at this spring, which suggested an older or deeper groundwater source than other springs in the upper catchment.

Sediment
Suspended sediment sampling was undertaken at three locations: one in the Jazga River (at the village intake location) and two in the Shtuka River (one at the village intake location and one at an undisturbed upstream location). The baseline study concludes that, prior to any mining exploration influences, baseline TSS concentrations in the Shtuka and Jazga Rivers are considered to be approximately 250 mg/l for 95% of the time, which means the natural state exceeds the IFC guideline.

Chemical analyses of sediments collected from the Jazga and Shtuka Rivers showed that aluminium and iron were the most abundant elements in the stream sediments. Concentrations for major ions such as Al, Ca, K, Mg and Fe were higher in samples taken in the Jazga catchment than in the Shtuka catchment. Copper, iron and sulphur levels were elevated at a stream sampling point close to the deposit (within the Jazga catchment). Lead was also elevated at this sampling location, with levels more than double that recorded at other sites.

Noise
Measured noise levels at the majority of receptors in the study area were found to be predominantly influenced by natural noise sources. These included wildlife, such as birds and insects and also domesticated animals including chickens, cows, dogs and pigs, as well as wind-induced noise from rustling vegetation. This is consistent with the rural nature of the study area, in which industrial and commercial mechanized noise sources are largely absent. At monitoring locations with significant vegetative cover, such as Sekirnik, wind-induced rustling of vegetation was a significant contributor to the ambient noise environment.

The primary anthropogenic noise source in the study area is the M6 highway from Strumica to Bulgaria. Traffic flows on the road are typically low, however, there is a significant component of articulated HGVs. Villages through which the M6 passes typically exhibited higher noise levels, with the highest ambient noise levels recorded at monitoring locations in Novo Konjarevo, Samuilovo and Novo Selo.

In villages close to the M6 where the monitoring locations were sited away from the road, including Sekirnik and Turnovo, noise levels were comparable with villages remote from major roads. This suggests that traffic noise alone is the dominant factor in the higher noise levels in villages close to the road, rather than additional anthropogenic noise associated with settlements on a major transport route.

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2 This value differs from the value of 50mg/l presented in the Macedonian EIA. Further data gathering in 2016 has provided an adjusted value
Air Quality

Overall, the baseline monitoring indicates that ambient air quality within the study area is good and that sources of local atmospheric pollution are limited.

Ambient nitrogen dioxide (NO\textsubscript{2}) concentrations were relatively consistent across the study area (slightly lower in more rural locations and higher at locations closer to roads or combustion sources in villages). Concentrations were substantially below project limits\textsuperscript{3} for the protection of human health and for the protection of habitats/vegetation.

Sulphur dioxide (SO\textsubscript{2}) concentrations were consistent across the study area. Concentrations were substantially below limits for the protection of human health and for the protection of habitats/vegetation.

Ozone (O\textsubscript{3}) concentrations were high across the study area, with maximum concentrations exceeding the limit for the protection of human health. This reflects the situation throughout Macedonia, with monitoring conducted by the Ministry of Environment and Physical Planning recording exceedances at Skopje and the eastern and western zones. The MOEPP report states that the highest ozone concentrations occur in rural areas far away from the emission sources. Ozone will react with NO\textsubscript{X} in air to form NO\textsubscript{2}, which explains why higher concentrations would typically be found where lower concentrations of NO\textsubscript{X} are present.

Measured levels of deposited dust were typically higher closer to roadside locations than in other parts of the villages or in rural locations. The levels of measured deposited dust are influenced by meteorological conditions, with higher concentrations measured during dry summer periods.

Monitoring of particulate matter (PM\textsubscript{10} and PM\textsubscript{2.5}) indicates that annual average levels were substantially below the project limits, however short term periods of elevated concentrations were observed in the data.

Biodiversity and Ecology

Habitat diversity in the vicinity of the Project includes intensive arable production in the Strumica valley which contrasts with the unimproved pastures that become more species-rich with greater altitude toward the sources of the Jazga and Shtuka streams. Forest communities are represented by broadleaved riverine fringes, boreo-alpine riparian galleries and continental forests. Many of the forest communities are subject to licenced and un-licenced felling which in many cases has resulted in large areas of coppice regeneration growth rather than standard trees in evidence. Habitat quality within the LSA is underlined, to some extent, by the presence of species such as the Large Blue butterfly (\textit{Phengaris arion}) a species listed as endangered at the European scale by the IUCN. Much of the LSA is designated by Butterfly Conservation Europe as a Prime Butterfly Area (PBA).

Anthropogenic pressure at the lower altitudes of the LSA has resulted in natural habitats becoming at best semi-natural and more likely modified habitat. In contrast, some forest communities at higher altitudes can be considered more natural owing to the lack of access and associated lower harvesting pressure. Grasslands above 800 masl are generally more species rich as a result of lower nutrient contribution from grazing animals. The diversity of flora that has developed in these areas appears to be of value to insects.

\textsuperscript{3} Project-specific limits were established for air quality, noise, water quality and soils in the Environmental Design Criteria (included in Annex 1D to the ESIA). The EDC limits were established as a result of a review of limit values established in Macedonian and European Union regulations and other relevant international guidelines and standards.
Biodiversity, especially species richness, has been evaluated within the LSA over a number of years. A total of 271 of the most prominent vascular plant species were recorded within the LSA during baseline surveys. Furthermore, 138 species of fungi were recorded within the LSA with widespread distribution including in pasture, oak and beech forest and pine plantations. Species of conservation concern (SoCC) include bladder campion (*Silene vulgaris*), *Boletus quelletii*, and Caesar's mushroom (*Amanita caesarea*).

A high level of faunal species richness has been recorded within the LSA, with approximately 40% of the butterfly species known to occur in Macedonia, over 50% of herpetofauna (reptiles and amphibians) and 36% of bird species. Coleopterans, dragonflies and other insect groups were collected widely throughout the LSA. Special attention was given to saproxylic beetles due to their conservation status. Numerous faunal species of conservation concern (SoCC) were recorded, with designations including national protection, the European Habitats Directive and the IUCN Red List.

Aquatic habitat surveys targeted communities of aquatic, emergent and marginal vegetation. Four habitat types were recorded: reed bed, willow (*Salix*) woodland, small permanent streams, and ephemeral streams. For aquatic fauna, nine species of fish were captured, all of which were common and widespread with no SoCC noted. Stone crayfish were recorded at numerous sites within the LSA and freshwater crab at one site on the Shtuka River. Stone crayfish is a protected species in Macedonia, listed on Habitats Directive-III and Bern I & III, but has not been evaluated by IUCN.

**Ecosystem Services**

Ecosystem services are the direct and indirect contributions made by ecosystems to human well-being and also to Project performance. Despite considerable anthropogenic pressure being applied to many of the forest and grassland communities within the LSA, ecosystem value is noted.

The following provides a summary of the ecosystem services identified, listed under their ecosystem service categories:

- **Provisioning**
  - Livestock (raised for meat and milk);
  - Apiculture (bee keeping);
  - Arable, fruit and vegetable production;
  - Capture fisheries;
  - Wild foods (fungi/snails);
  - Hunting (e.g. partridge, wolf and boar);
  - Biomass fuel and timber;
  - Public water supplies obtained from the Jazga and Shtuka Rivers and from groundwater sources; and
  - Natural medicines, perfumes and pharmaceuticals (60 species of medicinal herb, e.g. chamomile, Bigroot cranesbill, Oak moss).

- **Regulating**
  - Mountains affecting local rainfall patterns;
- Hydrological catchments regulating run-off, ground water recharge and water storage and providing water supplies;
- Vegetative cover providing soil retention, managing scour and erosion; and
- Wildflowers used by local bee colonies and to support crop pollination e.g. orchards.

**Cultural**
- Recreational pleasure people derive from natural or cultivated ecosystems e.g. arable, water bodies, forestry and grasslands;
- People learn how to hunt, fish and forage in the natural environment; and
- Sacred sites and intangible cultural heritage are linked with natural ecosystems e.g. wetlands, rivers, lakes and forests.

**Supporting**
- Providing habitat for a large number of species, including some nationally protected or endangered at the European scale e.g. large blue butterfly;
- An area is important for timber production; and
- The area plays a part in sustainable water cycling.

**Cultural Heritage**

The cultural heritage findings were classified into three types of cultural heritage: ‘living’ cultural heritage, intangible cultural heritage and archaeology. An historic structure at Novo Selo is the only nationally designated site within the LSA.

**Living Cultural Heritage**

Fifty-three potential ‘living’ cultural heritage receptors were recorded during the baseline study in the LSA. A brief summary of these is presented in the table below.

<table>
<thead>
<tr>
<th>Location/associated settlement</th>
<th>Cultural heritage receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project footprint</td>
<td>Two receptors were recorded: a spring site with an inscribed memorial stone and a waterfall that is a focal point for collecting Bigroot Cranesbill (<em>Geranium macrorrhizum</em>), a plant which is used to decorate homes at Easter.</td>
</tr>
<tr>
<td>Ilovica</td>
<td>Fourteen receptors were recorded: two cemeteries, a church, a mosque, three sites of religious/ritual significance, five springs, a communal feature (Ilovica Cultural Centre) and the site of an historic event.</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Nine receptors were recorded: two cemeteries, two churches, a site of religious/ritual significance, two springs, a communal feature (Shtuka Cultural Centre) and the site of an historic event.</td>
</tr>
<tr>
<td>Turnovo</td>
<td>Two receptors were recorded: a cemetery and a church.</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Five receptors were recorded: a cemetery, two churches, a communal feature (Sekirnik Park) and a structure of architectural significance.</td>
</tr>
<tr>
<td>Sushica</td>
<td>Six receptors were recorded: a cemetery, a church, a communal feature (the Sushica Cultural Centre), a former mosque and two springs.</td>
</tr>
<tr>
<td>En-route to Bulgarian border</td>
<td>Six receptors were recorded: four churches, a monastery and a site of religious/ritual significance.</td>
</tr>
<tr>
<td>Wider region</td>
<td>Nine receptors were recorded: eight churches and a monastery.</td>
</tr>
</tbody>
</table>
Intangible Cultural Heritage

The following three elements of intangible cultural heritage were recorded during the baseline study: Religious beliefs and practices, traditional music and dance, and a traditional agricultural way of life.

- Orthodox Christianity and Islam are prominent faiths in the region, with Catholicism also practiced by a minority of the population. These religious beliefs are sincerely held and actively practiced throughout the region. Religious holidays and festivals are an important aspect of the cultural heritage of the population.
- Traditional music and dance, relating in particular to the Rusalii tradition, is preserved and commemorated in a number of the settlements, with an annual meeting of Rusalii dance groups held in Sekirnik.
- The traditional agricultural way of life is widespread and is observable in the landscape.

Archaeology

Seventy-six potential archaeological receptors were recorded during the baseline study, with a total of twelve located within, or in close proximity to, the proposed project footprint. These 12 receptors comprise a variety of archaeological site types, including settlements, burials and sites of historical industry. Varnica and Crkviste are the only receptors in proximity to the project footprint which have been ascribed a date, with both believed to be Late Antiquity period sites (4th – 6th century AD).

Landscape and Visual

The landscape within and surrounding the concession area is not designated or protected. It is attractive, yet reasonably commonplace within the wider region. The project footprint extends into three landscape types: Mountain Forest, Flat Agricultural Land, and Undulating Pasture/Scrub.

Baseline analysis showed that inhabitants located in the Strumica valley to the south, southwest and west of the concession area may be afforded views of the proposed mine (or part of it).

Socio-economics

The populations of Ilovica (1,907) and Shtuka (781) have similar demographics. Ilovica has a younger population (median age 35.0) than Shtuka (median age 36.0), and more even gender ratio of males to females (51:49 in Ilovica, compared to 54:46 in Shtuka). Ethnically, both communities are predominantly Macedonian, though small Turkish, Roma and Bulgarian populations do exist in Ilovica.

Agriculture dominates economic activity in Ilovica and Shtuka. Most households (72%) maintain arable land, and receive an average net agricultural income of €2,690 annually. Some households (34%) also maintain vineyards for personal consumption, or pasturable land (40% of households) for grazing livestock. In terms of crop production, potatoes are grown by most households, while tobacco, peppers and grapes are other common crops. Corn (maize) is grown in the fields around the villages for fodder.

Few households in Ilovica and Shtuka raise livestock for sale, with cows and goats being kept in small numbers for milk, chickens for meat and eggs, and pigs for meat alone. A few households keep flocks of sheep, and there are several small-scale (i.e. 50 head) cattle ranching operations run out of the villages. Supplementing incomes from agricultural activity, some villagers harvest mushrooms on the forested slopes of Ogražden Mountain for sale at local markets and collection centres, and a few keep bees for small-scale honey production.

Mining has not been a major industry in the Southeast Region, with only a small feldspar mine on Ogražden Mountain and the Buchim Copper and Gold Mine near the town of Radovish.

Incomes in the Southeast Region are lower than any other regions in Macedonia, with average monthly wage incomes of 16,500 denars (€269) at the regional level (influenced by the industrial, manufacturing and service sectors) and 15,600 denars (€256) at the local level (influenced by the greater reliance on agricultural and seasonal employment). Average monthly incomes for local agricultural producers (i.e. not influenced by the waged economy) are lower still at 13,700 denars (€224).
With no access to a shipping port, 93% of Macedonia’s freight was transported via roads in 2014. The country’s public enterprise rail system extends geographically from north to south and east to west, and across national borders with Kosovo, Serbia and Greece. There are, however, no rail lines that extend into the municipalities of Strumica, Bosilovo or Novo Selo. The Southeast Region is connected by regional highways and roadways and local access roads. The M6 highway is used to access the Southeast Region, and runs through Strumica to the Bulgarian border. Local roads connect adjacent villages (e.g. Ilovica and Shtuka). Traffic on the M6 east of Strumica is mixed, including large trucks, personal vehicles (e.g. pick-ups, cars), motorcycles, tractors, bicycles, horse and cart, and pedestrians.
Environmental and Social Impacts

The following section presents the predicted environmental and social impacts associated with Project activities. These impacts are predicted based upon spatial analysis and qualitative and quantitative modelling. In most cases, the impact assessments have taken a conservative approach by adopting a ‘worst case’ scenario. The impacts presented below include the application of mitigation measures to avoid, minimise, restore or offset the impacts presented above. With the application of these mitigation measures, the majority of residual impacts are reduced to low or negligible impact classification.

The approach to evaluating environmental and social impacts comprised the following steps:

- Establish baseline conditions;
- Establish the project description;
- Evaluate stakeholder engagement information to feed into the impact assessment;
- Confirm the key receptors and their sensitivity or importance;
- Characterise the potential effects of the project by modelling or qualitative analysis;
- Determine the nature and scale of impact, combined with the importance/sensitivity of receptors. The magnitude of the effect is determined by taking into account: magnitude of change, geographic extent of change, duration of change, and its frequency;
- Consider the need for mitigation measures should impacts be considered unacceptable;
- Assess the significance of residual impacts after mitigation;
- Consider other operating or planned projects in the region (the cumulative impact assessment);
- Assess environmental risks and accidents by evaluating hazards, probability and management of risks; and
- Develop monitoring and management plans.

Geomorphology, soils and land use capability

The Project will result in the permanent loss of forested land in the Shtuka Valley for the TMF and the loss of forested land in the mine pit area. Due to the requirement to prevent deep rooting trees from establishing on the closed TMF (due to the material contained within the TMF), 284 ha of land previously suitable for forestry will not be returned to forestry after the closure of the mine. Instead, the TMF will be capped with a layer of material (e.g. rock, soil) that will enable vegetation growth. Vegetation on the TMF will include grassland and scrub which is suitable for grazing, subject to long-term monitoring of soil quality, including ecological health and risk assessment.

Effects to agricultural land use are minor as the only agricultural land lost is due to the construction of the off-site access roads.

Access to grazing land within the concession area will be restricted during the lifetime of the Project. Upon closure of the mine, restoration and revegetation of the site will return grazing land and the addition of suitable grazing land on the TMF results in a low impact classification overall.

Erosion is predicted to occur during the construction phase due to the exposure of soil surfaces to erosive forces during the construction of the haul road, access road, the pre-strip area of the open pit, the TMF starter embankment and deforestation of the TMF starter area. Installation of erosion controls (e.g. silt fences,
ditches, rock check dams, temporary surface water diversions, soakaways and small sediment ponds) during the construction phase will limit the magnitude of erosion across the site. The Storm Water Dam (SWD) will ultimately control the discharge of eroded materials in the Shtuka catchment.

Additional mitigation measures include the stockpiling of soils for reclamation of the site, with stockpiles to be seeded with native plant species to establish vegetation cover and minimise erosion. Waste rock to be used for reclamation of the TMF will be stockpiled at or above the elevation of the final tailings level to minimise double handling and transportation at closure.

Through the application of these mitigation measures, all impacts related to geomorphology, soils and land use capability are rated as low.

**Water quantity**

**Jazga River**

In the Jazga River, the Ilovica Reservoir acts as a control to flow, so effects of the Project were assessed on three sections of the river: upstream of the Ilovica Reservoir (at the Jazga intake), the reservoir itself and downstream of the Ilovica Reservoir.

During construction, negligible changes to flow were predicted upstream of the Ilovica Reservoir. However, the Ilovica Reservoir would supply water for mine construction and continues to provide public water supply. The level of water in the Ilovica Reservoir would therefore, be much lower than at baseline and is predicted to empty more than once every year, until the supply from Turija Reservoir is commissioned at the start of Project operations. This effect on Ilovica Reservoir leads to high negative effects on low and median flows downstream, which rely on spills and seepage from the reservoir.

During operations and following closure, and until a lake forms in the pit (in year 110), upstream of the Ilovica Reservoir low flows are almost completely lost to the pit (median flows are only partially lost). This reduction in low and median flows is predicted to start in Year 5, when the base of the pit is excavated below the Jazga River bed elevation. From this time baseflows would be lost to the pit through underground flowpaths. This would have an impact on water supplies provided by the Jazga intake and flow contributions to the Ilovica Reservoir until year 110 at which time the baseflow will return to the Jazga and impacts will be negligible.

During operations, effects on the Ilovica Reservoir will be negligible as abstraction from the Turija reservoir will maintain the Ilovica Reservoir at a higher than baseline water level. Downstream of the Ilovica Reservoir, the low flows would be increased, but the median flows would decrease as the seepage through the dam wall increases. The reservoir would no longer spill in its managed state.

Following closure, when water supply contributions from Turija cease, and until year 110 when baseflow returns to the Jazga and treated spill water from the pit lake will be discharged to the Ilovica Reservoir, water levels in the Ilovica Reservoir, and flows downstream, will be reduced. Following year 110, these impacts will be negligible.

To mitigate potential impacts to village water supplies from the Jazga River (intake), Euromax Resources has committed to assisting Bosilovo Municipality (PUE) and Strumichko Pole Water Management Company (SPWMC), including provision of sufficient funds, to design, construct and commission:

- A water supply pipeline to Ilovica WTW from the refurbished Turija irrigation pipeline;
- A new potable water distribution network to all households in Ilovica, to be operated by PUE;
- A permanent connection between Ilovica WTW and the new distribution networks;
- An extension of the existing agricultural water distribution network to unserved households from Ilovica Reservoir, operated by SPWMC; and
- Decommissioning of Ilovica intake on the Jazga River.
In addition, Euromax commits to the following:

- Minimising abstraction of water from Ilovica Reservoir for construction purposes and developing alternative sources of water supply for construction;
- During mine operations, establish a fund that will provide financial resources for the capital replacement of infrastructure to augment Ilovica Reservoir from the Turija pipeline during closure and post-closure, including provision of power for pumping;
- At closure, maintain operational water supply infrastructure linking the Turija pipeline with Ilovica Reservoir and Ilovica WTW;
- Agree with SPWMC a limited number of releases of water from Ilovica Reservoir during operations, via its low level outlet, to mimic artificial floods that overflow the spillway; and
- Following closure, to design the provision of storage and attenuation for flood waters during extreme events within the closed pit by modifying the drainage outlet from the restored pit.

With the application of these mitigation measures, residual impacts on water quantity in the Jazga are negligible, except for the impact on low flows in the Jazga upstream of the Ilovica Reservoir which is evaluated further under the aquatic biodiversity study.

**Shtuka River**

During construction and operations only negligible changes in flows are anticipated for the Shtuka River at the village intake and further downstream.

The physical changes to the Shtuka catchment will alter the rainfall-runoff relationship; however, the design of the TMF (which will be located in the Shtuka catchment) will incorporate engineering solutions to manage effects on water quantity. A Stormwater Dam (SWD) will be installed downstream of the TMF to manage flow and sediment heavy runoff so impacts are negligible on median to high flows.

Post closure, the diversion channel is assumed to fall into disrepair, therefore, low flows generated in the section of the catchment upstream of the TMF will be lost to evaporation and infiltration on the surface of the TMF. These flows will not be able to discharge downstream and low flows will be lost downstream.

Mitigation will be applied in the form of engineered water management of the TMF to ensure low flows downstream. One of the following will be applied:

1) The diversion channel will be maintained and convey the Shtuka River in perpetuity;
2) The upper Shtuka River will be routed across the surface of the tailings in an engineered channel and low and median flows will be able to discharge downstream; or
3) Shallow groundwater in the TMF cap will be discharged under control to maintain low and median flows downstream.

With the application of this mitigation measure, the residual impacts to water quantity in the Shtuka River are predicted to be minor.

**Groundwater**

Modelling was conducted of potential impacts to groundwater resources in Ilovica, Shtuka and the Strumica Plain (between Ilovica and Turnovo). The modelling found that there would be no discernible change from baseline levels during mine life and post-closure.

**Water quality**

**Jazga River**

Effects of the Project on water quality were assessed on the same three sections of the river as for water quantity.
During construction and operations, active management of discharges means that there are no impacts on water quality which exceed a low classification in the Jazga, despite the reductions in water quantity for dilution.

Following closure there will be no direct or indirect discharges to the Jazga River from the closed pit until the formation of the pit lake is complete. The pit lake is predicted to overflow approximately 90 years after the cessation of pit dewatering (i.e. at LOM year 110). Should spilling from the pit lake occur it would lead to unacceptable levels of metals and sulphate, low pH and predicted precipitation of iron hydroxides which could cause smothering in the stream bed. Major impacts would extend down the Jazga and into the Ilovica Reservoir until discharge into, and dilution from, the Turija River.

Mitigation described above under water quantity (decommissioning and replacement of intake water supply), would be added to by post closure installation of preferably passive treatment (e.g. wetlands and settling/aeration ponds), but possibly active treatment of pit lake discharge to neutralise the pH and remove metals and sulphate to acceptable discharge limits. This treatment process would be in place prior to pit lake spilling and treated water would discharge back into the Jazga.

As a result of these mitigation measures, residual impacts to water quality in the Jazga River and Ilovica Reservoir are classified as negligible.

**Shtuka River**

Contaminated water discharging from the SCF following closure, when recycling of SCF water ceases, will require active treatment. In addition, the following mitigation will also be required:

- Construction of a grout or gel curtain at the SCF to reduce the flow of contaminated groundwater under the SCF. The curtain must capture 95% of the groundwater flow;
- Active treatment in a treatment plant of seepage captured in the SCF that is not suitable for discharge. The plant should ideally be situated relatively close to the SCF, and the treated water should be discharged back into the Shtuka River channel;
- Assessment of encapsulating acid generating material in the TMF embankment;
- Assessment of hydroseeding or otherwise revegetating the TMF embankment for stabilizing and reducing infiltration and runoff; and
- Sizing the SCF to ensure that, following closure, overflows due to storm events will be adequately diluted to comply with project water quality standards.

During the construction period no direct discharges to the Shtuka River will occur as a result of the mine project. The SWD will manage sediment heavy runoff.

During operations, as a result of contaminated seepage entering the Shtuka River, the predicted effect of the mine at the Shtuka river intake is high. The predicted water quality here and downstream includes depressed pH, elevated metals, sulphate and total cyanide.

Following closure, the change in water quality as a result of contaminated seepage entering the Shtuka River downstream of the Seepage Collection Facility (SCF), without considering potential discharge from the SCF, is classified as high. The pH of the water is predicted to decrease and there will be elevated levels of metals and sulphate.

Major impacts during operations and following closure would extend down the Shtuka until it discharges into the Strumica River, where the impact reduces due to dilution.

To mitigate potential impacts to village water supplies from the Shtuka River (intakes), Euromax Resources has committed to assisting Bosilovo Municipality (PUE) and Strumichko Pole Water Management Company (SPWMC), plus provision of sufficient funds to design, construct and commission:

- Provision of funds to design, construct and commission a water supply pipeline to Ilovica WTW from the refurbished Turija irrigation pipeline;
ILOVICA ESIA

- A new potable water distribution network to all households in Ilovica, to be operated by PUE;
- A permanent connection between Ilovica WTW and the new distribution networks;
- An extension of the existing agricultural water distribution network to unserved households from Ilovica Reservoir, operated by SPWMC; and
- Decommissioning of Shtuka intakes on the Shtuka River.

With the application of these mitigation measures, the residual impacts to water quality in the Shtuka River are low or negligible.

**Sushica River**

The Sushica River was considered as a receptor in the ESIA due to stakeholder concerns around impacts to the Sushica River associated with groundwater contamination from the TMF. However, the potential risk of thoughtflow occurring from the TMF to the Sushica River is likely to be negligible.

**Groundwater**

Potential water quality impacts to groundwater were assessed at community water supplies in Ilovica and Shtuka and at irrigation wells between Ilovica and Turnovo. Water quality modelling predicted that no significant change will occur to groundwater quality at any community water supply receptors in Ilovica or Shtuka villages.

**Sediment**

The primary source of sediment entering the Jazga River will be the preparation of the pit area during construction. During operations, the mine site will operate on a zero discharge basis, consequently erosion within the site will not affect the Jazga River and TSS in the watercourse will remain similar to baseline levels. During closure, the site will be revegetated to minimise erosion.

The pre-strip area of the pit is situated on the steep slopes along the ridge line between the Jazga and Shtuka catchments. Exposed surfaces will lead to increased erosion within the catchment, though the natural catchment between the stripping area and watercourse will act as a “buffer strip” or natural sediment trap. Exposed surfaces will lead to minor impacts in the Jazga River between the site and Ilovica Reservoir. Best practice will be adopted to minimise erosion and control discharge of sediment. This includes the installation of sediment dams, water management infrastructure and erosion control measures, phased removal of vegetation, and the maintenance or establishment of a vegetated buffer around watercourses.

The primary source of sediment entering the Shtuka River will be from stripping of the TMF area during construction; direct rainfall on this area could lead to sediment-laden surface water runoff entering the Shtuka River. To manage sediment from the TMF area, silt fences will be installed on contours within the cleared area of the TMF starter dam and also around the downslope boundaries.

To capture remaining eroded material, the SWD downstream of the TMF will be developed prior to stripping of the upstream catchment. To minimise the discharge from the SWD of clays and any fine silts remaining in the water, the storage may be flocculated as required based on sampling.

During operations, the SWD will be in place and will retain sediment-heavy runoff from the TMF embankment and infrastructure within its catchment. The SWD will allow settlement of sediment prior to discharge to the environment. The mine site will operate on a zero discharge basis.

During closure, the site will be revegetated to minimise erosion and act as a natural sediment trap. Runoff/sediment ponds including the SWD will be decommissioned following closure, once monitoring identifies that discharge water quality is acceptable for discharge to the environment.

With the application of the design considerations and additional mitigation measures, the residual impacts from sediment are low in both the Jazga and Shtuka Rivers.
Noise and vibration

Potential impacts were identified at Shtuka and Sekirnik, primarily related to construction and operation of the off site access road. A number of mitigation measures are required to minimise these impacts.

The short duration of the access road construction works will limit the scale of the noise impacts at individual receptor villages and sensitive timing of noisy works will aid in reducing annoyance. Good community relations and the selection of low-noise plant during the construction works will further assist in minimising impacts. During the programming of access road construction works, the proposed schedule will be discussed with the municipalities and local residents. Actions will then be put in place to minimise noise impacts.

A permanent acoustic barrier prior to construction of the road itself will not be feasible at Shtuka, however dependent on consultation with local communities, temporary noise protection will be considered. Euromax will consider the use of additional noise protection for properties within 50 m of the access road if the impacts of the road construction are deemed unacceptable by residents.

Mitigation for noise impacts from use of the permanent off-site access road includes an acoustic barrier at Shtuka during mine construction and throughout operations and at Sekirnik throughout operations. The cut-fill profile of the road will be used to maximise screening.

With the application of these mitigation measures, moderate residual impacts remain at Shtuka and Sekirnik associated with construction of the off-site access road. All other residual noise impacts are classified as minor or negligible.

The assessment of potential vibration impacts considered ground-borne vibrations and air overpressure associated with the mining operations and potential impacts on nearby villages. The assessment found that during both the construction and operations phases, vibration impacts will be minor or negligible at all receptors.

Good practice will be adopted to minimise any concerns related to blasting. Blasts will occur during the daytime period only and the proposed blasting schedule will be clearly communicated to neighbouring communities in advance and vibration monitoring will be undertaken in the event that complaints arise. In response to stakeholder concerns, Euromax will undertake a condition survey of all properties in Ilovica and Shtuka prior to commencement of any blasting and will monitor them throughout operations for any change in condition due to blasting.

Air quality

The air quality impact assessment looked at the Project’s contribution to air quality parameters (NO₂, NOx, SO₂, CO, TSP, particulate matter, dust, odour) associated with a number of project activities (including earthworks, drilling and blasting, traffic on unpaved haul roads, material transfer, ore processing, carbon regeneration, combustion emissions from vehicles and mobile equipment, emergency generators, sewage treatment plant).

Impacts to human health were assessed at surrounding villages (Ilovica, Shtuka, Turnovo, Sekirnik and Sushica) with relation to the Project’s emissions (including baseline) and the results were below the project limits for human health. In addition, at all locations, the predicted dust deposition fell below the limit values for loss of amenity.

The assessment for impacts to habitats (vegetation) were assessed and the overall environmental concentration will be below the limit value for the protection of habitats. As all air quality impacts were classified as low, no additional mitigation measures are required.

Biodiversity

Terrestrial Habitat and Species

Impacts to terrestrial habitats and species vary by habitat type and quality. Of most concern are impacts to natural habitat and flora and fauna SoCC. However, the more natural forest communities and most
species-rich grassland occur at higher elevations and are impacted less than the average loss across all habitats.

At its maximum extent, the project footprint will result in approximately 508 hectares of habitat loss. The bulk of this habitat loss is from turkey oak forest (approximately 243 hectares), which is widespread across the LSA. Other areas of habitat loss include sessile oak forest (90 hectares), oak and hornbeam forest (102 hectares) and pastures (49 hectares). The complete avoidance of impacts to beech and beech/pine forest reduces the overall impact to natural forest communities. However, some SoCC are associated with modified forest habitats, including fauna such as bats, and fungi which are associated with oak and hornbeam forest.

Some forest clearance will be permanent due to the construction of the pit and the TMF. Therefore permanent loss of forested habitat associated with the TMF is classified as a moderate residual impact.

The conceptual revegetation plan proposes that much of the site (excluding the TMF footprint) be rehabilitated with forest species which reflect baseline conditions. Flora SoCC will be salvaged during site clearance for use in progressive ecological restoration, revegetation trials will be undertaken during operations, mandatory environmental training will be undertaken by all workers and contractors, and potential bat roosting locations will be surveyed prior to construction. These mitigations reduce the residual impact to forested habitat to minor.

Due to the materials contained within the TMF, the closure surface of the TMF will be unsuitable for deep-rooted vegetation such as trees. Instead, the surface of the TMF will be revegetated to scrub and grassland which are suitable for Large Blue butterfly and other invertebrates. This will result in a positive residual impact to the pastures habitat type, with a gain of approximately 234 hectares.

Additional mitigations for terrestrial fauna SoCC include:

- Pre-clearing rapid surveys plus selective SoCC salvage and relocation;
- Where possible clearing will be in a direction that would push mobile species away from the Project area;
- Undertake progressive ecological restoration to minimise impacts to wildlife;
- Develop and apply species action plans for SoCC;
- Placement of artificial bat roosting habitat;
- Implement invasive flora and fauna mitigations;
- Seasonal constraints applied to earthworks (where practicable) and hibernacula active searches during spring, summer and autumn; and
- Removal of bird nesting habitat outside of the nesting season. Bird scaring techniques used to prevent ground nesting species from using the construction footprint.

As a result of the mitigations presented above, residual impacts to terrestrial flora and fauna SoCC are classified as minor.

**Critical Habitat**

The focus of critical habitat recognition has been generating an understanding of the biodiversity features of the Prime Butterfly Area (PBA) and associated designating species such as the Large Blue butterfly. The quality of habitat varies across the PBA and the Project footprint avoids much of the best quality habitat.

Although the critical habitat is essentially avoided, the predicted impact to the moderate biodiversity zone and broader PBA will have a major consequence. However, given that the high biodiversity zone was avoided and the Large Blue butterfly was also observed outside the PBA, it is possible that impacts would be classed as low if a fuller understanding of species regional distribution and habitat use was obtained.

Post closure, a focus on re-vegetation to pasture will allow for the creation of habitat suitable for the Large Blue butterfly, as well as numerous other invertebrates which naturally occur on the site. The Large Blue
butterfly becomes the main faunal focus of the re-vegetation strategy. Aside from creation of Large Blue habitat, the strategy is to return areas to the pre-existing vegetation type, where feasible. The conceptual revegetation strategy includes:

- Creation of a grassland and scrub mosaic suitable for grazing on the surface of the TMF; and
- Planting native forest species to achieve a scrub and forest mosaic on restored footprint of haul roads, conveyor, upper benches of the open pit, plant site and the workshop site.

Based upon this conceptual revegetation strategy, the residual change in land cover would be lessened for the forest community and there would be a positive impact on the pasture land cover which is of value to invertebrates, including the Large Blue butterfly, plus flora SoCC.

**Aquatic Habitat and Species**

The Jazga River upstream of the Ilovica reservoir will lose low flows during operations and closure (from year 5 to year 110) to such an extent that the aquatic habitat will be entirely degraded. As such, the mitigation strategy must focus on fish and decapod rescue and translocation. A sample of released individuals will be marked to enable success of relocations to be determined. Site options for release will be planned in congruence with reclamation planning.

Unmitigated effects on water quantity and quality in the Ilovica Reservoir and downstream on the Jazga would lead to effects during construction and post closure (prior to year 110). However, no species of conservation concern are explicitly linked to an exact water level or the requirement for the level to seasonally fluctuate in Ilovica Reservoir. In addition, there is limited ecological value to the Jazga downstream of the reservoir, due to the existing flow regime (restricted to seepage from and overflows from the Ilovica Reservoir) and the baseline nutrient loading associated with surrounding agriculture and other human activities. Therefore proposed mitigation ensuring water levels are maintained in the reservoir and regular flushing of the Jazga downstream will lead to negligible impacts on Ilovica Reservoir and downstream.

In the Shtuka River, the main impact to aquatic habitat and species is from the loss of 4 km of natural aquatic habitat when the Shtuka is diverted into the diversion channel around the TMF. As a permanent impact, this results in a major impact consequence. Mitigation for aquatic ecology on the Shtuka include undertaking fish and decapod rescue and translocation prior to diversion of the Shtuka River. The successful execution of this mitigation would reduce the residual impact classification to moderate.

Impacts and mitigation of impacts are managed by the mitigation presented in the water quality and quantity assessments. The design of the gel or grout curtain at the SCF and the discharge of treated water from the SCF post closure must be driven by not only drinking water standards for human and livestock consumption, but consideration for aquatic habitats downstream of the TMF.

**Ecosystem Services**

The ecosystem services assessment has identified that the Project will affect beneficiaries of priority ecosystem services, including: raising livestock; bee-keeping; arable farming; hunting and gathering foodstuffs; collection of biomass fuels and timber; freshwater supplies and the gathering of medicinal plants. Freshwater is also an example of a priority service necessary for both the operational performance of the Project as well as for the livelihood of the local population.

A water pipeline will be constructed between Turija reservoir and Ilovica WTW, preserving the reliability and quality of water entering the WTW for treatment and supply to villages; this plus other water management control measures reduce residual impacts.

The project could lead to economic effects and/or displacement or impacts on livelihoods of herding communities, loss of grazing and arable land, foraging communities, sustainable farming, eco/sustainable hunting tourism or other activities that provide alternative food sources and income. These impacts will be mitigated by the delivery of community engagement action planning and associated management plans including delivery of livelihood restoration assistance (LRP) within the Land Acquisition and Resettlement Framework (LARF).
Mitigation measures including slope stabilization, prompt revegetation and controls such as silt fences, berms and mats will result in minor residual effects from site clearance/Project footprint upon soil quantity and quality, limiting exposure to dust and weathering.

The presence of Project infrastructure will also change physical characteristics of the landscape associated with intangible ecosystem values, in a spiritual and cultural context. Sites such as Shtuchki Vodopad are natural features which offer belief in fertility, spiritual fulfilment and wellbeing. Mitigation in the form of (participatory) site relocation and site preservation will reduce effects on ethical and spiritual values.

With the proposed mitigation measures and management in place the residual impact on ecosystem services are reduced to minor.

**Cultural heritage**

The cultural heritage assessment considered the potential for impacts to 19 ‘living’ cultural heritage sites, intangible cultural heritage and 8 archaeological sites. The assessment included consideration of ground disturbance through earthmoving or excavation and the effects of noise, vibration, dust or visual changes.

Mitigation for impacts on Living cultural heritage included relocation of Preslop Spring Memorial Stone, Photographic recording of Shtuchki Vodopad and provision of enhanced access to other collection sites. Mitigation of impacts on intangible cultural heritage includes noise mitigation and sympathetic scheduling of construction activities and blasting regime, thereby reducing residual impacts on living and intangible cultural heritage to minor.

At archaeological sites, photographic recording, sympathetic blasting regime and vibration monitoring, archaeological watching brief and archaeological evaluation and excavation reduce residual impacts to minor at the Adit tunnel, Crkviste, Domus Gaber and Old Mill. Residual impacts following Archaeological evaluation and excavation will be reduced to moderate at Anovi, Preslop, Krvavichevo and Golemata Niva and Gradishte.

**Landscape and Visual**

The Project will be visible throughout the LSA. The Project will have an effect on the mountain forest landscape, given the removal of forested areas and the presence of an open pit mine, the tailings management facility (TMF), and associated Project infrastructure. Reclamation to pasture and scrub will be the favoured end use for the TMF.

The Project’s effect on the landscape of the agricultural plains in the Strumica Valley and undulating pastures/scrubland in the hills approaching the Ograzhdene Mountains is expected to be low, with the only changes to the landscape being the addition of the off-site access road.

Visual disturbance will vary by the viewer’s location, with some villages affected by permanent changes in the skyline associated with the TMF or pit. Visual disturbance decreases with distance, so villages that are closer and affected by permanent changes will have a greater degree of disturbance.

Mitigation will include planting of trees around the periphery of the mine workshop area to reduce the prominence of the elevated buildings/plant from Shtuka and the Monastery of St George; Project lighting will be located away from the prominent summit and southern faces of Ćukar; elsewhere ‘cut-off’ lighting (directional lights) will be used to minimise light pollution. The outer face of the TMF embankment will be revegetated at closure to minimise the extent of bare ground visible from the surrounding areas.

**Socio-economics**

The Project is expected to have a highly positive effect on the economies of Macedonia, the city of Strumica, and the Municipalities of Bosilovo and Novo Selo. The Project’s effects on national GDP, national government revenue, and the growth of the mining sector will be of high magnitude and will continue for the life of the Project. The same is true of the Project’s effects on municipal government revenues and business development. Consumer spending of employee incomes, while a less pronounced effect, is expected to result in a moderate positive effect on local economic activity over the life of the Project.
As with economic effects, the Project's employment effects are positive. Nationally, the impact of Project employment is positive but low in magnitude, given that most employment is expected to accrue locally. In the local area, the Project's effect on employment is expected to result in a high positive impact, representing a substantial increase in the availability of high-quality, permanent employment. The effect of consumer spending by employees is expected to generate induced employment growth locally, but at a lower magnitude. All of the Project's impacts on employment will be realised over the life of the Project.

The Project is not expected to influence wages in sectors outside of mining. As a result, the impact of national indirect and induced incomes is expected to be low. Locally, the relatively high incomes paid to direct employees are expected to have a high impact, given the Project's maximisation of local employment and high direct wages paid. Changes to project-related indirect and induced employment incomes are expected to be less prominent, but still of moderate magnitude. As all income effects are related to Project-generated employment, the impact of incomes will persist over the life of the Project.

The Project's ability to influence population increase or decrease in the local area is limited: most of the workforce is expected to already reside locally. The Project will not result in substantial in-migration that would offset the current trend of out-migration from the region. The Project's effect of slowing out-migration through the provision of employment opportunities is expected to have a negligible impact on population, but one that is permanent.

The Project's effects on community health, safety and security are mixed in direction. The small amount of in-migration will result in continued demand for healthcare services. This is of negligible magnitude given the Project's negligible population impact. The effect of potential accidental injuries on the demand for healthcare services could be considered adverse given their unplanned nature and unknown severity and extent. The impact on healthcare services is, however, expected to be low given the capacity of the system and presence of an on-site medical clinic. This on-site clinic could potentially result in a positive effect on local healthcare services, providing for the medical needs of employees. Given the number of people employed by the Project, this would be a moderate positive impact.

Effects to quality of life as a result of the Project are similarly mixed in direction. The Project's positive effects on community investment and income generation are moderate to high (respectively) and will persist throughout the life of the Project. The Project's adverse effects of increased noise and heavy truck traffic, alteration of the visual environment, and generation of perceptions of harm are expected to be of high impact when taken together, given that they have the potential to alter peoples' day-to-day lives and that they cannot be fully mitigated. The impact of increased noise in communities beyond guideline values will persist into the medium-term, but not at unacceptable levels given the mitigation/management applied in the noise impact assessment. Perceptions of harm may extend beyond operations into the long-term due to perception that the environment is contaminated, and some people may not accept that reclamation has addressed any potential environmental issues. The impact of the alteration of the visual environment for those in the viewshed of the mine (particularly the TMF) is expected to be permanent.

The Project's effect on transport infrastructure and utilities is expected to be of low impact, not substantially changing current conditions. The replacement of the water reticulation system in Ilovica and Shtuka has the potential to have a moderately positive impact on water distribution and treatment systems in both villages, and a negligible adverse impact on the cost of water for users.

Project effects on land use in the local area are expected to have a negative impact on agriculture, forestry, and other land uses. The removal of arable and grazing land due to Project land-take is expected to have a high impact on those who currently use that land, given the relative lack of suitable alternative grazing land with access to water in the area. The removal of forestry land base for the TMF is expected to have high impact on users. Although the Forestry Management Company and other users (e.g. fuel wood collectors) will be able to continue operating in other forested parts of the Ográzhdhen Mountains, the land over the TMF will no longer produce forestry resources, effectively removing forestry land base permanently. The Project's land take will also temporarily displace other land users (e.g. recreational hunters in the concession area, beekeepers on the slopes of the Ográzhdhen Mountains, and mushroom harvesters in the forested areas). The number of individuals affected by these displacements is small and in most cases they are not primary
livelihood activities; bee hives will be relocated and harvesters of special crops will be consulted and suitable mitigation considered.

Overall, the Project is expected to have substantial economic benefits to the Republic of Macedonia, representing a major contributor to national economic activity and government revenues. It will also benefit the local economy through procurement of goods and services, payment of municipal royalties, employment, and associated incomes. The Project is not expected to result in important population or demographic change in local communities, or the associated changes in demand for and pressure on public infrastructure and community services. Project-related impacts on community health, safety and security, and on the quality of life for residents of nearby communities (primarily in Ilovica, Shtuka and Strumica), have the potential to be both positive (e.g. community development, increased incomes, medical services on site) and negative (e.g. noise along roads, changes to the visual environment, increased traffic). Positive effects will be supported by benefit enhancement measures, while negative effects will be minimised to the greatest extent possible through mitigation. The Project’s effects on land use will be mitigated through the implementation of a Land Acquisition and Resettlement Framework and Livelihood Restoration Plan.
Environmental and Social Management Plans

Environmental and social management plans will provide a framework for the implementation of mitigation measures and monitoring required to help avoid or minimise adverse impacts and to optimise beneficial effects of the Project. These management plans will be developed by Euromax and implemented throughout the life of the Project to form live management plans and company policies which will be updated on a regular basis.

The plans will be aligned with relevant international good practice guidelines including the EBRD Environmental and Social Policy (2014) including Performance Requirements, IFC Performance Standards (2012), International Cyanide Management Code, Equator Principles and Sustainable Development Policies of ICMM, as well as meet Macedonian Legislation.

Contractors working on the Project will be required to adhere to the obligations of the environmental and social management plans. Where appropriate, major contractors will be required to submit health, safety and environment plans and evidence of their own environmental and health and safety management systems to the HSEC Manager for approval prior to commencing work.

The following environmental and social management plans will be developed for the Project:

- Compliance Monitoring Plan;
- Water Management Plan;
- Soils, Rehabilitation and Reclamation Management Plan;
- Air Quality, Noise and Vibration Management Plan;
- Construction Environmental Management Plan (CEMP);
- Biodiversity Action Plan;
- Cultural Heritage Management Plan;
- Social Management Plan:
  - Workers Health and Safety Plan;
  - Livelihood Restoration Plan;
  - Community Health, Safety and Security Management Plan;
  - Human Resources Plan;
  - Local Content and Procurement Plan; and
  - Community Investment Plan.
- Closure Plan;
- Traffic Management Plan
- Hazardous and Non-hazardous Waste Management Plan;
- Hazardous Materials Management Plan;
- Mine Waste Plan;
- Resource Efficiency Plan;
- Emergency Preparedness and Response Plan; and
- Stakeholder Engagement Plan.
Conclusion

The ESIA presents how positive effects of the Project will be supported by benefit enhancement measures, while negative effects will be minimised to the greatest extent possible through management and mitigation measures. The ESIA presents that, with the successful implementation of the mitigation measures and management plans, any adverse residual environmental and social impacts identified are considered acceptable throughout the life of the Project.

All residual impacts identified for geomorphology, soils and land use capability, water quality and quantity, sediment and vibration, are low or negligible. A summary of residual impacts for the Project is presented in Table 1 below.

The following residual impacts were identified as moderate or high and warrant reference in this conclusion:

- Noise in Shtuka and Šekirnik during access road construction has potential to present a moderate residual impact. Mitigation has been presented, but may not fully mitigate the impacts. Community consultation and sensitive working will be maintained throughout the construction period;
- Noise during religious practices at Ilovica Muslim cemetery, Ilovica Christian cemetery, Shtuka Christian cemetery and Sts. Cyril and Methodius Church during construction has potential to present a minor to moderate residual impact. Mitigation has been presented, but may not fully mitigate the impacts. Community consultation and sensitive working will be maintained throughout the construction period;
- Land take of habitats supporting endangered species in the Ogražden Prime Butterfly Area has the potential to have a moderate residual impact. However Euromax has committed to maintain the existing grazing regime (or replicate), avoid disturbance to high quality pasture at higher elevations and revegetate the TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates;
- The placement of the TMF within Shtuka River will result in the loss of 4 km of natural aquatic habitat which has the potential to have a high impact. In addition the loss of baseflow in the Jazga upstream of the Ilovica Reservoir will lead to the derogation of aquatic habitats. The decapods will be translocated reducing this impact;
- The uncertainty associated with the effectiveness of the grout curtain and the residual impact on aquatic habitats and species has led to a requirement for design criteria for grout curtain and SCF design to ensure protection of aquatic habitats and species;
- Despite archaeological evaluation, excavation and recording implemented as mitigation at directly impacted archaeological sites, a moderate residual impact may result where sites are permanently lost. Strumica Museum has been engaged by Euromax to implement mitigation;
- Project components altering the visual character of the landscape will present a residual impact. Revegetation and restoration will partially mitigate this, however a permanent moderate visual impact will remain; and
- The Project will result in the permanent loss of productive forestry land-use over the reclaimed TMF, which results in a high residual impact on forest land use. Euromax has committed to revegetation of the TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates, which has the potential to have a net positive impact on biodiversity at closure.

Despite these residual impacts, the Project is expected to have substantial economic benefits to the Republic of Macedonia, representing a major contributor to national economic activity and government revenues and benefits to the local economy. In addition, positive impacts on the quality of life for residents of nearby
communities (primarily in the Municipalities of Bosilovo and Novo Selo and more broadly in the Strumica region) will include community development, increased incomes and improved infrastructure and services.
Table 1: Summary of Residual Impacts

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geomorphology, terrain and soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Control of erosion/sediment loading</td>
<td>Moderate</td>
<td>Erosion control measures incorporated into the Project design.</td>
<td>Low</td>
</tr>
<tr>
<td>Construction, operations, closure, Post-closure</td>
<td>Agricultural land use</td>
<td>Moderate</td>
<td>Road will be routed to minimise loss of productive agricultural land.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Grazing land use</td>
<td>Moderate</td>
<td>Reclamation, monitoring of soil quality.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Forestry land use (fuel, timber)</td>
<td>Major</td>
<td>Capping of TMF with soil or waste rock. Long-term monitoring.</td>
<td>Low</td>
</tr>
<tr>
<td>Water Quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations (Yr 20) and Closure (Yr 27)</td>
<td>Jazga River at Ilovica water supply intake</td>
<td>Major</td>
<td>Facilitating new village water supply systems for Ilovica and Shtuka and decommissioning Ilovica and Shtuka intakes on the Jazga and Shtuka rivers.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Year 20) and Closure (Yr 27)</td>
<td>Jazga River upstream, of Ilovica Reservoir</td>
<td>Major</td>
<td>None</td>
<td>Major (see aquatic biodiversity)</td>
</tr>
<tr>
<td>Construction (Yr -1)</td>
<td>Ilovica reservoir</td>
<td>Moderate</td>
<td>Euromax to minimise abstraction of water from Ilovica Reservoir for construction purposes. Develop alternative sources of water supply for mine construction.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Yr 20) and Closure (Yr 27 onwards)</td>
<td></td>
<td>Major</td>
<td>Euromax to work with SPWMC and others to design, construct and operate supply from Tuirja Reservoir. At closure, the water supply infrastructure, power supply and pumps will be maintained, linking the Tuirja pipeline with Ilovica Reservoir and Ilovica WTW. Euromax to work with SPWMC and others to pump water into Ilovica Reservoir from Tuirja Reservoir to augment river inflows prior to the pit lake spilling.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Yr 20)</td>
<td>Jazga River downstream of Ilovica reservoir</td>
<td>Major</td>
<td>Euromax to agree with SPWMC that they will make a limited number of releases of water from Ilovica Reservoir of agreed magnitude (flow) and duration (a few days).</td>
<td>Negligible</td>
</tr>
<tr>
<td>Post Closure (Yr 110+)</td>
<td>Jazga River through Ilovica</td>
<td>Moderate</td>
<td>Euromax to design provision of storage and attenuation for flood waters.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Post Closure (Yr 27+)</td>
<td>Shtuka River at the intake</td>
<td>Major</td>
<td>Euromax will develop engineering designs for water management on the TMF to maintain low flow downstream.</td>
<td>Minor</td>
</tr>
</tbody>
</table>
**Project Phase/s** | **Receptor** | **Impact before mitigation** | **Mitigation** | **Residual impact classification**
--- | --- | --- | --- | ---
**Operations Years 1 and 2-20** | Turija irrigation area | Moderate | Euromax to agree with SPWMC to operate abstraction from the proposed refurbished Turija pipeline to ensure flow remains in the Turija pipeline downstream of Euromax's abstraction point. | Minor

**Post pit lake (Yr 110)** | Jazga River at Ilovica water supply intake | Major | Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, plus decommission Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. | Negligible

Ilovica reservoir | Major | Euromax will collect the pit lake overflow and pipe to a passive or active treatment system where the pH will be neutralised and metal concentrations will be reduced (as described in Table 6-1). | Negligible

Jazga River at Radovo | Moderate | | | Negligible

**Water Quality**

**Operations (Yr 20)** | Shtuka River at Shtuka water supply intakes | Major (all phases) | Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, and decommission Ilovica and Shtuka intakes on the Jazga and Shtuka rivers.

Euromax will construct a grout or gel curtain at the SCF to capture 95% of the flow of contaminated groundwater under the SCF, encapsulate acid generating material in the TMF embankment and develop methods for stabilizing and reducing infiltration into and runoff from the TMF embankment surface using vegetation.

Euromax will treat seepage captured in the SCF that is not suitable for discharge in a treatment plant.

The SCF will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted and comply with project water quality standards. | Negligible (water supply security)

**Low (other receptors)**

**Shtuka River at Sekirnik road bridge** | Moderate | As above for Shtuka River at Shtuka water supply intakes. | Negligible

**Low**

**Sediment**

**Construction** | Shtuka River - downstream of TMF and diversion | High | SWD will be constructed prior to TMF stripping and construction, flocculation in SWD. | Low

**Noise & Vibration**

**Construction** | Shtuka | Moderate | Sensitive timing of works, screening of noisy activities. | Moderate

Acoustic barrier adjacent to access road. | Negligible
### Project Phase/s

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sekirnik</td>
<td>Moderate</td>
<td>Sensitive timing of works and screening of noisy activities.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Operations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shtuka</td>
<td>Major</td>
<td>Acoustic barrier adjacent to access road.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Major</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Biodiversity

<table>
<thead>
<tr>
<th>Phase</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction and operations</td>
<td>Terrestrial habitats – forest communities (excluding the TMF)</td>
<td>Moderate</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Revegetate project footprint to forest and scrub mosaic which reflects baseline conditions.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Terrestrial habitats – forest communities (TMF)</td>
<td>Major</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Revegetate TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates.</td>
<td>Major</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Critical Habitat - Habitats supporting endangered species – Ograzden Prime Butterfly Area</td>
<td>Major</td>
<td>Deliver BMP and biodiversity offset feasibility study in consultation with local and regional experts. Avoid disturbance to high quality pasture at higher elevations. Fences to be installed to prevent access. Maintain the existing access and grazing regime (or replicate through artificial means) for the higher elevation grasslands. Compensatory habitat creation will be undertaken by revegetating the TMF to pasture and scrub mosaic at closure plus offsetting feasibility study delivery.</td>
<td>Moderate (potentially moderate positive post-closure)</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Flora SoCC</td>
<td>Moderate</td>
<td>As feasible, salvage flora SoCC during site clearance Revegetate project footprint (except TMF) to forest and scrub mosaic. Revegetate TMF to pasture and scrub mosaic at closure. Avoid disturbance to high quality pasture at higher elevations. Fences to be installed to prevent access.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Terrestrial fauna SoCC (non-butterfly)</td>
<td>Moderate</td>
<td>Pre-clearing rapid surveys plus selective SoCC salvage and relocation. Undertake progressive ecological restoration to minimise impacts to wildlife. Placement of artificial bat roosting habitat. Implement invasive fauna mitigations. Seasonal constraints applied to earth works. Removal of bird nesting habitat outside of the nesting season. Prior to construction activities, carry out an assessment of amphibian and reptile migration corridors.</td>
<td>Minor</td>
</tr>
<tr>
<td>Project Phase/s</td>
<td>Receptor</td>
<td>Impact before mitigation</td>
<td>Mitigation</td>
<td>Residual impact classification</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
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<td>----------------------------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Operations, closure</td>
<td>Aquatic habitat and species – Upstream of Ilovica Reservoir</td>
<td>Moderate</td>
<td>Undertake fish and decapod rescue prior to operations.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post-closure</td>
<td>Aquatic habitat and species – Shtuka River upstream of SWD</td>
<td>Major</td>
<td>Undertake fish and decapod rescue prior to diversion of the Shtuka River.</td>
<td>Major</td>
</tr>
<tr>
<td>Post-closure</td>
<td>Aquatic habitat and species – Shtuka River downstream of TMF</td>
<td>Moderate</td>
<td>Define design criteria for grout curtain and SCF design to ensure protection of aquatic habitats and species.</td>
<td>Minor</td>
</tr>
<tr>
<td>Ecosystem Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations, closure, post-closure</td>
<td>Freshwater Type 1</td>
<td>Major</td>
<td>Euromax to work with SPWMC and others to ensure the supply of water to the WTW will be switched from Ilovica reservoir to Turija reservoir. Water intakes on both Jazga and Shtuka to be decommissioned.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Euromax to agree with SPWMC to ensure a prescribed flow remains in the Turija pipeline downstream of Euromax's abstraction point.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Active and or passive treatment of water discharge from the TMF following closure, plus active treatment of discharge form the pit lake once formed following closure.</td>
<td></td>
</tr>
<tr>
<td>Operations, closure, post-closure</td>
<td>Freshwater Type 2</td>
<td>Major</td>
<td>A water pipeline will be constructed between Turija reservoir and Ilovica WTW to preserve the reliability and quality of water entering the WTW.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction and operation</td>
<td>Erosion Control type 1 and 2</td>
<td>Moderate</td>
<td>Development of stable embankment slopes, mechanical stabilisation and installation of erosion control features, and prompt revegetation of appropriate areas. Installation of physical erosion control features.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operation, closure, and post closure</td>
<td>Regulation of Water and Slowing of the water cycle (Including Filtering water and slowing of the water cycle)</td>
<td>Moderate</td>
<td>Construction of SWD. Zero surface water discharge from the site during construction and operations phases. Passive and active treatment and closure and post closure.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operation, closure and post closure</td>
<td>Ethical and Spiritual Values</td>
<td>Moderate</td>
<td>Relocation of receptors and photographic logging and preservation of sites.</td>
<td>Minor</td>
</tr>
</tbody>
</table>
### ILOVICA ESIA

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cultural Heritage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preslop Spring Memorial Stone</td>
<td>Moderate</td>
<td>Relocation of receptor.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Shtuchki Vodopad</td>
<td>Moderate</td>
<td>Photographic recording and enhanced access.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Religious beliefs and practices</td>
<td>Moderate</td>
<td>Sympathetic construction schedule.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Adit/Tunnel Site</td>
<td>Moderate</td>
<td>Photographic recording.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Domus Gaber</td>
<td>Moderate</td>
<td>Archaeological watching brief.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Preslop</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Krvavichevo and Golemata Niva</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Gradishte</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Old Mill</td>
<td>Moderate</td>
<td>Archaeological evaluation and excavation.</td>
<td>Minor</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anovi (AR-06)</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religious beliefs and practices</td>
<td>Major</td>
<td>Sympathetic blasting regime.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Crkvishte (AR-04)</td>
<td>Moderate</td>
<td>Sympathetic blasting regime and visual inspection and vibration monitoring.</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Socio-economic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction, operation</td>
<td>Economy</td>
<td>High (positive)</td>
<td>None Required.</td>
<td>High (positive)</td>
</tr>
<tr>
<td>Construction, operation</td>
<td>Employment</td>
<td>High (positive)</td>
<td>None Required.</td>
<td>High (positive)</td>
</tr>
<tr>
<td>Construction, operation</td>
<td>Incomes</td>
<td>High (positive)</td>
<td>None Required.</td>
<td>High (positive)</td>
</tr>
<tr>
<td>Construction and operation</td>
<td>Population and health</td>
<td>Moderate</td>
<td>Euromax will assist in improving the Ilovica clinic.</td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td></td>
<td>Noise for local communities</td>
<td>Moderate</td>
<td>Considered above.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Visual for local communities</td>
<td>Moderate - High</td>
<td>None practical.</td>
<td>Moderate to High</td>
</tr>
<tr>
<td>Project Phase/s</td>
<td>Receptor</td>
<td>Impact before mitigation</td>
<td>Mitigation</td>
<td>Residual impact classification</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>--------------------------------</td>
</tr>
<tr>
<td></td>
<td>Perception of harm by local communities</td>
<td>High</td>
<td>Public education of environmental effects.</td>
<td>Low</td>
</tr>
<tr>
<td>Operation, post-closure</td>
<td>Physical infrastructure</td>
<td>Moderate (positive)</td>
<td>None required.</td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td>All phases</td>
<td></td>
<td>Moderate (positive)</td>
<td></td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td>Construction, operation</td>
<td>Land use – grazing and forestry</td>
<td>Moderate - High</td>
<td>Addressed through LRP.</td>
<td>Negligible – Low</td>
</tr>
<tr>
<td>All phases, post-closure</td>
<td>Land use – forestry land over TMF</td>
<td>High</td>
<td>None. TMF will be restored to scrub, there is net positive impact on biodiversity at closure, but forest users remain impacted through all phases.</td>
<td>High</td>
</tr>
</tbody>
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# Table of Contents

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1.0 INTRODUCTION

This report presents the environmental and social impact assessment (ESIA) for the proposed Ilovica-Shtuka Project (the Project).

The Project is a proposed open pit gold and copper mine located in the Municipalities of Bosilovo and Novo Selo, in south-eastern Macedonia. The ESIA has been developed using data collected during a series of physical and biological environment studies and social studies conducted between 2013 and 2016.

The ESIA assesses potential effects of the Project based on the project description presented in Section 4 and covers all activities and infrastructure associated with the construction, operation and closure of the proposed mine.

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments by comparison to the ESIA baseline and Project environmental design criteria. Where identified as necessary, the ESIA will identify potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits to Macedonia, local communities and other stakeholders.

1.1 Background

Early geological exploration of the Ilovica resource was carried out by the Macedonian Bureau of Geology in 1973 and identified areas of significant mineralisation which were suitable for further exploration. From 2004 to 2011, “Phelps Dodge Vardar” DOOEL, Skopje, undertook comprehensive exploration activities on a concession area of around 15 km². The resulting Conceptual Study confirmed that the Ilovica area hosted a porphyry copper and gold deposit.

An earlier version of an Environmental Impact Assessment (EIA) for the original concession area, and which was based on the Conceptual Study, was approved by the Macedonian Government in November 2011.

Subsequently, the exploration licence for the two concession areas (Ilovica village locality concession area, Municipality of Bosilovo; and Ilovica locality concession area, Municipality of Bosilovo and Municipality of Novo Selo) were transferred to Euromax Resources DOO Skopje, who have conducted further geological, engineering and environmental studies between 2013 and 2016. An earlier version of this document (the Macedonian EIA) was presented to the Macedonian Government in May 2016; this report was the outcome of environmental and social studies completed up to February 2016 and provided supplementary information to that which was presented in the 2011 EIA. The primary objective of the Macedonian EIA was to assess the Feasibility Study engineering design and meet Macedonian regulatory requirements and therefore did not necessarily cover all requirements for international investors, including the European Bank for Reconstruction and Development (EBRD).

This report presents the analysis of environmental and social impacts of the activities and infrastructure proposed in order to develop the mine within the two concession areas. Although there are two concession areas, for simplicity this ESIA refers to ‘the concession’ which is the full extent of both concessions. The concession areas are described further in Section 4 and shown in Figure 1-1.

The land acquired to accommodate Project infrastructure is a subset of the concession area. The land which will be acquired for the Project is presented in Figure 1-2. It has been designed to avoid areas of privately owned land as far as possible.

The objective of this ESIA is to assess an updated engineering design (Section 4) and meet international investor requirements.
Figure 1-1: Ilovica-Shtuka Project - Concession Area and Municipality Boundaries
1.2 Legal Framework

Euromax Resources is committed to adhering to the national laws and regulations of the Republic of Macedonia. In addition to meeting the relevant national legislative and regulatory requirements in the May 2016 EIA, this ESIA has been completed to meet the EBRD Performance Requirements and has taken into account various other international standards and guidelines for good international industry practice.

1.2.1 Context

The Constitution of the Republic of Macedonia, which was amended several times between 1991 and 2011 (Republic of Macedonia, 2011), establishes the rights and obligations of citizens and government, and sets out the fundamental values of the Republic. The constitution is organised under the following headings:

- **Basic Provisions**: establishes the sovereignty of the Republic, rules of citizenship, the state symbols, the official language(s), and the fundamental values.

- **Basic Freedoms and Rights of the Individual and Citizen**: sets out civil and political freedoms and rights, economic, social and cultural rights, guarantees of basic freedoms and rights, and foundations for economic relations.

- **The Organization of State Authority**: describes the structure, authority and responsibilities of the Assembly of the Republic of Macedonia, the President of the Republic of Macedonia, the Government of the Republic of Macedonia, the Judiciary, and the Public Prosecutor’s Office.

- **The Constitutional Court of the Republic of Macedonia**: describes the structure, authority and responsibilities of the Constitutional Court.
Local Self-Government: establishes the rights of citizens to local self-government at the municipal level, the division of which is defined by law.

International Relations: describes how international agreements or associations are ratified or established.

The Defence of the Republic and States of War and Emergency: defines a state of war or state of emergency and allows the issuing of decrees with the force of law.

Changes in the Constitution: describes the process for amendments to the constitution.

The Macedonian Government has three distinct political branches: the Executive, Legislative and Judicial branches. The Executive branch includes an elected President, who serves as the head of state, the Prime Minister, who serves as the head of government, and the Government itself (i.e., ministries). Ministries are headed either by a Deputy Prime Minister (Finance, Economic Affairs, Framework Agreement Implementation and European Integration), or by a Minister (all other departments). Other representatives of institutions include the Governor of the National Bank of the Republic of Macedonia, the Attorney General, the Chief of Staff of the Armed Forces, and the Special Envoy and Chief Negotiator of the Macedonia name dispute. The President fills a largely ceremonial role, while the Prime Minister leads the nation politically (International Parliamentary Union, 2015). The current Government of the Republic of Macedonia is formed by the Internal Macedonian Revolutionary Organisation – Democratic Party for Macedonian National Unity (or VMRO – DPMNE) (RoMSEC, 2011).

The Republic of Macedonia is divided into 84 municipalities, ten of which collectively form the nation’s capital, the City of Skopje (RoMSEC, 2011). Each municipality is an administrative unit of self-government responsible for local matters. Municipalities may work in cooperation with one another and may be influenced by national government departments, such as the Ministry of Agriculture, Forestry and Water Management. Communities within municipalities may set local policy and priorities, but have limited autonomy from the municipality. Individual villages do not maintain separate budgets and are financially tied to the municipal government (Focus Groups, 2015).

1.2.2 Macedonian Policy and Legislative Requirements

The legislation most relevant to the Project is summarised below.

1.2.2.1 Law on Mineral Resources

The Law on Mineral Resources (Official Gazette of the Republic of Macedonia No. 136/12, 25/13, 93/13, 44/14, 160/14, 129/2015, 192/2015, 39/16, 53/16, 120/16 и 189/16) is the basic law which governs the exploration for and extraction of mineral resources. The Law sets out the conditions and methods of exploration and mining of minerals both underground and on the surface, the concessions on detailed geological exploration and mining concession, the design, use and maintenance of mining and mineral processing facilities, machines, and instruments, and requirements for occupational safety, environmental protection, mining measurements and plans.

1.2.2.2 Law on the Environment

The Law on the Environment (Official Gazette of the Republic of Macedonia no. 53/2005, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14, 44/15, 129/15, 192/15, 39/16) is the fundamental piece of legislation for environmental protection and management in the Republic of Macedonia. The Law specifies the rights and obligations of the Republic of Macedonia in securing the basic conditions on environmental and nature protection in order to provide the achievement of the constitutionally guaranteed rights of citizens to live in a healthy environment. Section XI of the Law on the Environment requires that an EIA be undertaken for certain projects ‘which due to their character, scope or location of their implementation, may have significant impact on the environment.’ Under Article 77 of Section XI, a decree was issued specifying the types of projects for which an environmental impact assessment is required and the list includes ‘Quarries and open-cast mining where the site area exceeds 25 hectares...’ Under this decree, an EIA is required for the Ilovica-Shtuka Project as the proposed project footprint extends over an area of approximately 500 hectares, within a concession area of approximately 1,500 hectares.
Under Section XI of the Law on Environment (Environmental Impact Assessment of Certain Projects; Articles 76 to 94), the EIA should include:

- Screening, scoping, assessment and evaluation;
- Direct and indirect impacts;
- Impacts from project implementation or non-implementation;
- Project preparation (construction), execution, implementation (together operations), and termination (closure); and
- Normal functioning of the project plus the likelihood of an accident.

The Law establishes processes and timeframes for the procedures associated with the EIA, including screening and scoping decisions, review of the EIA and delivery of a report on the adequacy of the study, and issuing of the decision approving or rejecting the application. The Law transposes EIA Directive requirements regarding rights of legal review, access to information for members of the public, and transboundary effects.

Impacts shall be assessed based on the status of the environment “at the time of submission of the notification on the intention to carry out the project.” This notification process triggers the MOEPP to make the screening decision.

Article 83, paragraph 2, of the Law requires that the project proponent engage at least one person from the Macedonian List of Experts (as defined in Article 85) to sign the study as responsible person with regard to the quality of the study. For the Macedonian EIA, Dragi Peltechki, In-Country Project Manager for Euromax, undertook this role.

Article 91 of the Law establishes a requirement for a public hearing during the review of the EIA.
The EIA proceeds through a number of phases, presented below:

1. Notification on the intention to implement the project and Request to determine the scope of the project environmental impact assessment (responsibility of the investor)

2. Procedure for establishing the need for project environmental impact assessment (responsibility of MOEPP)

3. Establishing the scope of the project environmental impact assessment (responsibility of MOEPP)

4. Development of the EIA (expert team)

5. Report on the relevance of the project environmental impact assessment study (responsibility of MOEPP or of authorized individuals from the List of EIA experts selected by MOEPP)

6. Decision consenting to or rejecting the request for implementation of the project (responsibility of MOEPP)

According to the “Regulation on the Content of the Requirements to be Met in a Project Environmental Impact Assessment Study” (Official Gazette of the Republic of Macedonia no. 33/2006) issued under the Law on the Environment, the EIA must contain the following information:

- A description of the project along with information about the location, the character and the size of the project and the required land area;
- A description of the environment and its location media;
- A description of natural, cultural and historic heritage and the landscape;
- A description of the type and amount of expected emissions, particularly air emissions and wastewater, solid waste, as well as other information required for evaluation of larger project environmental impact;
A description of measures to prevent, reduce and eliminate the environmental impact, as well as measures for restoring into previous condition;

A description of the project environmental impact regarding the level of development of science and accepted evaluation methods;

A description of the characteristics of the applied technology;

A description of alternative solutions for project implementation the investor considered and the main reasons for selecting the proposed alternatives; zero alternative is always included;

A summary of the submitted study, technical details excluded;

An analysis of difficulties (technical deficiencies or lack of knowledge) experienced by the investor or expert during the preparation of the study; and

A proposal for the size and characteristics of the change for which it is required to update the Environmental Impact Assessment Study.

### Other relevant legislation and policy

Table 1-1 provides a summary of other Macedonian legislation which is applicable to the ESIA. A comprehensive list of secondary legislation is provided in Annex 1D. As Macedonia is a candidate for accession to the European Union (EU), new Macedonian legislation and regulation is aligned with the policies and requirements of the EU (refer to Section 1.2.4 for further information).

<table>
<thead>
<tr>
<th>Name of Legislation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law on Waters (Official Gazette of the Republic of Macedonia 87/08, 6/09, 161/09, 83/10, 51/11, 44/12, 23/2013, 163/13, 180/14, 146/15, 52/16) and the pertinent secondary legislation</td>
<td>This Law sets out the legislative framework governing surface waters, including permanent watercourses or watercourses where the water flows occasionally, lakes, accumulations and springs, groundwater, waterside land and water habitats and their management, including the distribution of waters, protection and conservation of waters, as well as protection against harmful effects of waters; water resources management facilities and services; organizational set up and financing of water resources management, as well as the conditions and the procedures under which the waters can be used and discharged.</td>
</tr>
<tr>
<td>Law on Forests (Official Gazette of Republic of Macedonia, no. 64/2009, 24/11, 53/11, 25/13, 79/13, 147/13, 43/14, 160/14, 33/15, 44/15, 147/15, 7/16, 39/16) and the pertinent secondary legislation</td>
<td>This Law sets out the legislative framework governing the management, use and protection of forests. It provides for the adoption of a national plan on forest management to be implemented for a period of 20 years. Specific provisions deal with afforestation and reforestation, felling in forests and related authorisations, collection of forest products, prohibitions aimed at protecting forests, penalties for infringements, prevention of forest fires, and adoption of plans for forest management.</td>
</tr>
<tr>
<td>Law on Protection from Noise in the Environment (Official Gazette of the Republic of Macedonia no. 79/07, 124/10, 47/11, 163/13, 146/15) and the pertinent secondary legislation</td>
<td>This law sets out that environmental noise is unwanted or harmful outdoor sound created by human activities, which is imposed on the nearby environment causing nuisance and disturbance. Noise emission in the environment is related to the development of technology, industry and transport. Noise limits for different areas are established in the Rulebook for limit values of noise in the environment (Official Gazette of the Republic of Macedonia No. 147/08).</td>
</tr>
<tr>
<td>Law on Protection of Cultural Heritage (Official Gazette of the Republic of Macedonia 20/04, 71/04, 115/07,18/11, 148/11, 23/13, 137/13, 164/13, 8/14, 44/14, 199/14, 104/15, 154/15, 192/15, 39/16) and the pertinent secondary legislation</td>
<td>This Law specifies the processes for identifying, protecting and managing cultural heritage in Macedonia. It defines cultural heritage, establishes the goals for protection of cultural heritage, and establishes the roles and responsibilities of individuals, experts and archaeologists, and government bodies/authorities.</td>
</tr>
<tr>
<td>Name of Legislation</td>
<td>Description</td>
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<tr>
<td>------------------------------------------------------------------------------------</td>
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<tr>
<td>Law on Nature Protection (Official Gazette of the Republic of Macedonia no. 67/04, 14/06, 84/07, 35/10, 47/11, 148/11, 59/12, 13/13, 163/13, 41/14, 146/15, 39/16, 63/16) and the pertinent secondary legislation</td>
<td>Defines nature protection as a matter of ‘public interest’ and regulates the protection of biological diversity and landscape diversity. The law is based upon the following principles: high level of protection; integration; sustainable development; precaution; prevention; user pays; public participation; and cooperation. Provides for a number of activities, such as the determination of the components of biological and landscape diversity and the extent to which they are endangered; monitoring and reporting on the state of nature and enabling public participation; and the adoption and implementation of strategies and plans for nature protection.</td>
</tr>
<tr>
<td>Law on the Quality of Ambient Air (Official Gazette of the Republic of Macedonia no. 67/04, 92/07, 35/10, 47/11, 59/12, 163/13, 10/15, 146/15) and the pertinent secondary legislation</td>
<td>With a view to protecting human health and the environment against air pollution, the law regulates the establishment of limit values for ambient air quality and alert thresholds; emission limit values; and ambient air quality monitoring and control.</td>
</tr>
<tr>
<td>Law on Waste Management (Official Gazette of the Republic of Macedonia no. 68/04, 71/04, 107/07, 102/08, 143/08, 124/10, 51/11, 123/12, 147/13, 163/13, 51/15, 146/15, 156/15, 192/15, 39/16, 63/16) and the pertinent secondary legislation</td>
<td>The Law sets out the legislative framework governing plans and programs for waste management; rights and obligations regarding waste management; collecting, transporting, treatment, storage, processing and removal of waste; import, export and transit of waste; monitoring and supervision over waste management.</td>
</tr>
<tr>
<td>Law on protection from explosive materials (Official Gazette of the Republic of Macedonia no. 4/78, 10/78; 51/88, 36/90, 12/93, 66/07, 84/08, 135/11, 148/15)</td>
<td>The Law sets out the legislative framework governing the general conditions for production, transportation, circulation, use and storage of explosives.</td>
</tr>
<tr>
<td>Law on transportation of hazardous substances in the road and railway traffic (Official Gazette of the Republic of Macedonia no. 92/07, 147/08, 161/09, 17/11, 54/11, 13/13, 163/13, 38/14, 166/14, 116/15, 193/15, 31/16) and the pertinent secondary legislation</td>
<td>The Law sets out the terms and conditions for transportation of hazardous substances in the domestic and international road and rail traffic; the conditions that need to be met in terms of packaging and transportation means; the obligations of the participants in the transportation of hazardous substances; the appointment of safety counsellor; supervision over the implementation of the Law.</td>
</tr>
<tr>
<td>Law on storage space and the protection of flammable liquids and gases (Official Gazette of the Republic of Macedonia no. 15/76, 51/88, 19/90, 12/93, 66/07, 130/08, 148/15)</td>
<td>The Law sets out the terms and conditions for storage of flammable liquids and gases and actions related to the storage, processing and transport by means of pipelines in order to protect life and health, environment and material goods.</td>
</tr>
<tr>
<td>Law on Concessions and Public Private Partnership (Official Gazette of the Republic of Macedonia no. 6/12, 144/14, 33/15, 104/15, 215/15)</td>
<td>The Law sets out the terms and conditions for awarding a concession for goods of general interest and a contract for establishment of a public private partnership, the legal protection for any entity that has or had an interest in winning such a contract or that has risked or risks to be damaged in the procedure for awarding such a contract, as well as other issues with regard to the concessions for goods of general interest and the contracts for establishment of a public private partnership.</td>
</tr>
<tr>
<td>Law on Occupational Health and Safety (Official Gazette of the Republic of Macedonia no. 92/07, 136/11, 23/13, 25/13, 137/13, 164/13, 158/14, 15/15, 129/15, 192/15, 30/16) and the pertinent secondary legislation</td>
<td>The Law sets out the measures for safety and health at work, the employer’s obligations and the employees’ rights and obligations in the field of safety and health at work, as well as the preventive measures against occupational risks, the elimination of accident risk factors, the information, consultation, training of employees and their representatives, and their participation in the planning and undertaking of measures for safety and health at work.</td>
</tr>
</tbody>
</table>
1.2.3 Governance and Administrative Structure

The following key administrative agencies regulate mining developments and environmental management in Macedonia and have a key role in the EIA authorisation process.

Regulation of Environmental Impact Assessment

The main environmental authority in Macedonia is the Ministry of Environment and Physical Planning (MOEPP), which is responsible for regulating the EIA process. The MOEPP is divided into three directorates: the Environmental Directorate, Physical Planning Information System and the State Inspectorate. The Environmental Directorate is divided into a number of sectors as follows:

- Environmental Sector
  - Department for EIA
  - Soils Department
  - Environmental Noise Protection Department
  - Database Department
  - Laboratory
- Sector for Industrial Pollution and Risk Management
  - Department for Integrated Pollution Prevention and Control
  - Department for Chemicals and Industrial Hazards
  - Department for Risk Management and the Atmosphere
- Nature Sector
- Water Sector
  - Department for Water Planning and Development
  - Department for Concessions and District Collaboration
  - Department for Water Rights
  - Department for River Basin Management of Vardar River
  - Department for River Basin Management of Crn Drim River
  - Department for River Basin Management of Strumica River
- Waste Management Sector
  - Department for Hazardous and Historic Waste Management
  - Department for Development of Waste Management Plans and Programs
  - Department for Registry and Records of Waste Management
  - Department for Management of Specific Waste Flows

The Environmental Sector within the MOEPP covers a number of areas including the assessment of potential impacts of certain projects, establishing measures for the prevention of pollution, degradation and impacts to the environment (e.g. protection of the ozone layer, prevention of noise pollution and vibration, protection against ionizing and non-ionizing radiation, disposal of wastes), implementing international conventions,
implementing laws and regulations relating to the protection of natural resources (including air, water, and soil), and performing laboratory analysis and testing.

The Department for EIA is responsible for assessing the potential impacts of certain projects on the environment and establishes measures to protect the environment from pollution, degradation and impact on particular areas of the environment. Responsibilities of the department include:

- Establishing the procedure for the assessment of environmental impacts;
- Organising public hearings in the decision-making process for EIA;
- Conducting impact assessments of certain projects; and
- Implementing international requirements for the assessment of environmental impact.

**Regulation of Mining**

The lead government authority responsible for the regulation of mining activities is the Ministry of Economy (MOE). The MOE is responsible for approving the mine design and issuing the exploitation permit.

The MOE’s mission statement reads: “…the creation of conditions for development of the industry, regulation of the internal market, development of the energy sector, creation of conditions for stimulating business and investment climate for growth of the business activities and investments, development of the entrepreneurship and the small and medium enterprises, use of the natural mineral resources, increase and promotion of the export, development of the public private partnership and development of the tourism” (MOE, 2015).

A number of other government bodies are involved in regulating aspects of a mining project:

- The Agency for Real Estate Cadastre (AREC) is responsible for registering usage right over the exploitation area;
- The Ministry of Transport and Communications (MOTC) and the Ministry of Internal Affairs (MOIA) are responsible for approving transport plans and permitting new infrastructure such as the connection of the mine access road to the existing public road; and
- The MOEPP is responsible for the approval of the mine waste management plan and for the permit for use and/or discharge of water.

**1.2.4 International Policy, Guidance and Standards**

In addition to meeting national legislative and regulatory requirements, the Project will also meet a range of international commitments, guidelines and standards. These include relevant EU laws and policies (which are applicable given Macedonia’s status as a candidate for accession and because adherence to EBRD’s Performance Requirements assumes compliance with EU legislation), standards and guidelines from international financial institutions and good industry practice which Euromax is committed to meeting. Further details of these international guidelines and standards are provided in Annex 1D.

**1.2.4.1 European Union legislation and directives**

Macedonia is a candidate for accession to the European Union and is in the process of transposing EU directives and regulations into national law. As such, the following EU Directives are relevant to the Project:

- EIA Directive (85/337/EEC);
- Environmental Liabilities Directive (2004/35/EC);
- Strategic Environmental Assessment Directive (2001/42/EC);
- Integrated Pollution Prevention and Control Directive (2008/1/EC);
- Waste Framework Directive (2008/98/EC);
- Waste from Extractive Industries Directive (2006/21/EC);
- Landfill Directive (1999/31/EC);
- Habitats Directive (92/43/EEC);
- Groundwater Directive (2006/118/EC);
- Water Framework Directive (2000/60/EC);
- Urban Waste Water Treatment Directive (91/271/EEC);
- Directive on the Quality of Water Intended for Human Consumption (98/83/EC); and

The EU has published guidance on best available technology in the form of reference documents (BREFs) for a number of activities associated with mining. These include Emissions from Storage (BREF 07.2006), Energy Efficiency (BREF 02.09), Waste (BREF 08.2006), and Management of Tailings and Waste-rock in Mining Activities (BREF 01.09).

### 1.2.4.2 International conventions

Table 1-2 identifies the relevant international environmental and social development agreements to which Macedonia is party. Being a signatory to such international agreements imposes obligations to address the topics raised in those documents. In many cases, those obligations are directly transposed into national laws. In other cases, implementation may be more complex and require more detailed analysis, prioritisation, capacity building, and/or resource planning. These cases are normally addressed through the establishment of national strategies and action plans.

#### Table 1-2: International treaties to which Macedonia is party

<table>
<thead>
<tr>
<th>Title</th>
<th>Date of Signature/Ratification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convention on Environmental Impact Assessment in a Transboundary Context (Espoo)</td>
<td>31 Aug 1999 A</td>
</tr>
<tr>
<td>Convention on Wetlands of International Importance (the Ramsar Convention)</td>
<td>08 Sept 1991 E</td>
</tr>
<tr>
<td>Montreal Protocol on substances that deplete the ozone layer</td>
<td>10 March 1994 C</td>
</tr>
<tr>
<td>Vienna Convention for the Protection of the Ozone Layer</td>
<td>10 March 1994 C</td>
</tr>
<tr>
<td>Convention concerning the Protection of the World Cultural and Natural Heritage (1972)</td>
<td>30 Apr 1997 C</td>
</tr>
<tr>
<td>Convention on Biological Diversity (1992)</td>
<td>02 Dec 1997 A</td>
</tr>
<tr>
<td>Convention on Long-range Transboundary Air Pollution (Geneva)</td>
<td>30 Dec 1997 C</td>
</tr>
<tr>
<td>United Nations Framework Convention on Climate Change</td>
<td>28 Apr 1998 E</td>
</tr>
<tr>
<td>Agreement on the Conservation of Populations of European Bats (1991)</td>
<td>15 Sept 1999 A</td>
</tr>
<tr>
<td>Convention on the Conservation of European Wildlife and Natural Habitats (Bern)</td>
<td>01 Apr 1999 E</td>
</tr>
<tr>
<td>Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus)</td>
<td>22 Jul 1999 A</td>
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<tr>
<td>Convention on the conservation of migratory species of wild animals (Bonn Convention)</td>
<td>01 Nov 1999 E</td>
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<td>Title</td>
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<td>Cartagena protocol on biosafety to the convention on biological diversity (2000)</td>
<td>12 Sep 2005 E</td>
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<td>European Landscape Convention (Florence)</td>
<td>01 Mar 2004 E</td>
</tr>
<tr>
<td>Kyoto Protocol to the UN Framework Convention on Climate Change</td>
<td>16 Feb 2005 E</td>
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<tr>
<td>Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent (Helsinki)</td>
<td>10 Mar 2010 A</td>
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<tr>
<td>Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes (Sofia)</td>
<td>10 Mar 2010 A</td>
</tr>
<tr>
<td>Protocol concerning the Control of Emissions of Volatile Organic Compounds (Geneva)</td>
<td>10 Mar 2010 A</td>
</tr>
<tr>
<td>Rotterdam Convention on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade</td>
<td>12 Aug 2010 A</td>
</tr>
<tr>
<td>Protocol on Heavy Metals (Arhus)</td>
<td>01 Nov 2010 A</td>
</tr>
<tr>
<td>Protocol on Persistent Organic Pollutants (POPs) (Arhus)</td>
<td>01 Nov 2010 A</td>
</tr>
<tr>
<td>Protocol on Pollutant Release and Transfer Registers (Kiev)</td>
<td>02 Nov 2010 R</td>
</tr>
<tr>
<td>Multilateral agreement among the countries of South-Eastern Europe for implementation of the Convention on Environmental Impact Assessment in a Transboundary Context (Bucharest)</td>
<td>26 Jan 2011 R</td>
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<tr>
<td>Protocol on Strategic Environmental Assessment (Kyiv)</td>
<td>13 Sep 2013 R</td>
</tr>
<tr>
<td>Protocol on Further Reduction of Sulphur Emissions (Oslo)</td>
<td>05 Jun 2014 A</td>
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<tr>
<td>Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg)</td>
<td>05 Jun 2014 A</td>
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<tr>
<td>Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki)</td>
<td>28 Jul 2015 A</td>
</tr>
<tr>
<td>Convention on the Transboundary Effects of Industrial Accidents (Helsinki)</td>
<td>02 Mar 2010 A</td>
</tr>
<tr>
<td>Minamata Convention on Mercury</td>
<td>25 Jul 2014 S</td>
</tr>
<tr>
<td>United Nations Convention to Combat Desertification</td>
<td>06 Mar 2002 R</td>
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**Key Human Rights and Labour Conventions**

<table>
<thead>
<tr>
<th>Title</th>
<th>Date of Signature/Ratification</th>
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<tbody>
<tr>
<td>Convention Relating to the Status of Refugees (1951)</td>
<td>18 Jan 1994 C</td>
</tr>
<tr>
<td>International Covenant on Civil and Political Rights (1966)</td>
<td>18 Jan 1994 C</td>
</tr>
<tr>
<td>United Nations Convention against Corruption</td>
<td>13 Apr 2007 R</td>
</tr>
<tr>
<td>Convention on the Rights of Persons with Disabilities</td>
<td>29 Dec 2011 R</td>
</tr>
<tr>
<td>Forced Labour Convention, 1930 (ILO Convention No. 29)</td>
<td>17 Nov 1991 R</td>
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</tbody>
</table>
Title | Date of Signature/Ratification
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Right to Organise and Collective Bargaining Convention, 1949 (ILO Convention No. 98) | 17 Nov 1991 R
Equal Remuneration Convention, 1951 (ILO Convention No. 100) | 17 Nov 1991 R
Minimum Age Convention, 1973 (ILO Convention No. 138) | 17 Nov 1991 R
Worst Forms of Child Labour Convention, 1999 (ILO Convention No. 182) | 30 May 2002 R
Labour Inspection Convention, 1947 (ILO Convention No. 81) | 17 Nov 1991 R
Employment Policy Convention, 1964 (ILO Convention No. 122) | 17 Nov 1991 R
Tripartite Consultation (International Labour Standards) Convention, 1976 (ILO Convention No. 144) | 08 Dec 2005 R

Notes: S = signature, R = ratification, A = accession, C = succession, E = entry into force.
This list includes only a subset of the 77 ILO conventions to which Macedonia is a party. For a comprehensive list, please refer to: http://www.ilo.org/dyn/normlex/en/f?p=1000:11200:0::NO:11200:P11200_COUNTRY_ID:103555

1.2.5 EBRD Performance Requirements

The following guidance, representing good international best practices and standards relating to sustainable development, will be incorporated in all aspects of the ESIA.

- **EBRD Performance Requirements (PR) and Guidance.**
  - **PR1 Environmental and Social Appraisal and Management.** This PR establishes the importance of integrated assessment to identify the environmental and social impacts and issues associated with projects and the client’s management of environmental and social performance throughout the life of the project.
  - **PR2 Labour and Working Conditions.** This PR recognises that for clients and their business activities, the workforce is a valuable asset, and that good human resources management and a sound worker-management relationship based on respect for workers’ rights, including freedom of association and right to collective bargaining, are key ingredients to the sustainability of business activities.
  - **PR3 Pollution Prevention and Abatement.** This PR recognises that increased economic activity and urbanisation can generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. This PR acknowledges the importance of using best available techniques and good international practice (GIP) to optimise resource use and efficiently prevent and control release of pollutants into the environment.
  - **PR4 Community Health, Safety and Security.** This PR recognises the importance of avoiding or mitigating adverse health and safety impacts and issues associated with project activities on workers, project-affected communities and consumers. Clients have the primary responsibility to provide safe and healthy conditions for their workers and informing, training, supervising and consulting workers on health and safety.
  - **PR5 Land Acquisition, Involuntary Resettlement and Economic Displacement.** Application of this PR supports and is consistent with the universal respect for, and observance of, human rights.
and freedoms and specifically the right to adequate housing and the continuous improvement of living conditions.

- **PR6 Biodiversity, Conservation and Sustainable Management of Living Natural Resources.** This PR recognises that the conservation of biodiversity and sustainable management of living natural resources are fundamental to environmental and social sustainability and recognises the importance of maintaining core ecological functions of ecosystems and the biodiversity they support.

- **PR7 Indigenous Peoples.** This PR recognises that projects can create opportunities for Indigenous Peoples to participate in and benefit from project-related activities that may help them fulfil their aspiration for economic and social development.

- **PR8 Cultural Heritage.** This PR recognises the importance of cultural heritage for present and future generations. The aim is to protect cultural heritage and to guide clients in avoiding or mitigating adverse impacts on cultural heritage in the course of their business operations. In pursuing aims of protection and conservation, this PR is guided by applicable international conventions and other instruments.

- **PR9 Financial Intermediaries.** This PR recognises that Financial Intermediaries (FIs) are a key instrument for promoting sustainable financial markets and provide a vehicle to channel funding to the micro, small and medium-sized enterprise (SME) sector. The nature of intermediated financing means that the FIs will assume delegated responsibility for environmental and social assessment, risk management and monitoring as well as overall portfolio management.

- **PR10 Information Disclosure and Stakeholder Engagement.** This PR recognises the importance of an open and transparent engagement between the client, its workers, local communities directly affected by the project and, where appropriate, other stakeholders as an essential element of good international practice (GIP) and corporate citizenship. This PR identifies GIP relating to ongoing stakeholder engagement as an ongoing process which involves: (i) public disclosure of appropriate information; (ii) meaningful consultation with stakeholders; and (iii) an effective procedure or mechanism by which people can make comments or raise grievances.

EBRD Performance Requirements PR1 to PR6, PR8 and PR10 are considered pertinent to the Project.

### 1.2.6 IFC Guidelines and Performance Standards

The following international guidance, representing international best practices and standards, will be incorporated in all aspects of the ESIA.

- **IFC (2012).** Performance Standards for Environmental and Social Sustainability and accompanying Guidance Notes.

- **Performance Standard 1: Assessment and Management of Environmental and Social Risk and Impacts.** This standard aims to identify and evaluate all environmental and social risks of the Project and to promote improved environmental and social performance through effective use of management systems. The standard also promotes adequate engagement throughout the Project cycle.

- **Performance Standard 2: Labour and Working Conditions.** The objectives of Performance Standard 2 are to promote the fair treatment, non-discrimination and equal opportunity of workers in accordance with national laws and international conventions and instruments, specifically the core conventions of the International Labour Organisation and United Nations conventions related to rights of the child and migrant workers.

- **Performance Standard 3: Resource Efficiency and Pollution Prevention.** The objectives of Performance Standard 3 include avoiding or minimising pollution from project activities in order to avoid or minimise impacts on human health and the environment. This performance standard aims
to promote the sustainable use of resources including energy and water and to reduce project-supplied GHG emissions.

- **Performance Standard 4: Community Health, Safety and Security.** The objectives of Performance Standard 4 include avoiding or minimising risks and impacts relating to the health and safety of the local community during the Project life cycle from both routine and non-routine circumstances. This performance standard aims to ensure that the safeguarding of people and property is conducted in a legitimate way which avoids or minimises risks to the community’s safety and security.

- **Performance Standard 5: Land Acquisition and Involuntary Resettlement.** The objectives of Performance Standard 5 include the avoidance or minimisation of displacement and the avoidance of forced eviction. The responsible party should anticipate and avoid or minimise adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets and ensuring resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected. The performance standard requires the improvement or restoration of the livelihoods and standards of living of the displaced persons. Living conditions among physically displaced persons should be improved through the provision of adequate housing with security of tenure at resettlement sites.

- **Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.** This standard aims to protect and conserve biodiversity. The standard promotes the utilisation of practices which integrate conservation needs and development priorities to promote the sustainable management and use of natural resources.

- **Performance Standard 7: Indigenous Peoples.** The objective of this Performance Standard is to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture and natural resource-based livelihoods of Indigenous Peoples.

- **Performance Standard 8: Cultural Heritage.** This standard aims to protect cultural heritage from adverse impacts of project activities and support its preservation; and also promotes the equitable sharing of benefits from the use of cultural heritage in business activities.

All IFC Performance Standards, apart from PS7: Indigenous Peoples, are pertinent to the Project.

  - **Air Emissions and Ambient Air Quality.** These guidelines apply to facilities or projects that generate emissions to air at any stage of the Project’s life-cycle.
  - **Energy Conservation.** These guidelines complement the industry specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors.
  - **Wastewater and Ambient Water Quality.** These guidelines apply to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment, which may have implications for the Project’s water treatment requirements. The guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. The guidelines also state that if sewage from an industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges is required. In their absence, indicative guideline values are provided by the IFC for sanitary wastewater discharges.
  - **Noise.** These guidelines apply to projects that have noise impacts beyond the property boundary of the facilities. These guidelines establish noise standards that should not be exceeded, and also
stipulates that noise levels should not result in a maximum increase in background levels of 3dB at
the nearest receptor location offsite.

  - These guidelines apply to workers exposed to chemical and physical (i.e. noise) hazards whilst at
    work.
  - These guidelines include information relevant to the operation and maintenance of potable water
    treatment and distribution systems, and collection of sewage in centralised systems, decentralised
    systems, and treatment of collected sewage at centralised facilities.
- IFC (2007a) EHS Guidelines for Mining.
  - These guidelines include information on industry-specific impacts, management performance
    indicators, and monitoring.

Good Practice guidelines which will be referred to throughout the ESIA include but are not limited to the
following:

- Business and Biodiversity Offsets Programme (2012). BBOP Standard on Biodiversity Offsets Guidance;
  the Private Sector in Emerging Markets;
  Weaving ecosystem services into impact assessment: A Step-By-Step Method;
- WHO (2005). Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air,
  in the absence of national guidelines; and

1.2.7 **Euromax Policies**

The following internal Euromax environmental and social policies will also apply to the Project and will be
supplemented by further policies which are to be developed prior to operations commencing.

- Community Policy, (August 2013);
- Environmental Policy, (August 2013);
- Health and Safety Policy, (August 2013);
- Recruitment and Selection Policy & Procedure (draft, Aug 2015);
- Human Resources Policy (May 2016);
- Code Of Business Conduct and Ethics (June 2014);
- Disclosure, Confidentiality & Insider Trading Policy (June 2014);
- Anti-Corruption and Bribery Policy (November 2014); and
- Corporate Procurement Policy (February 2017).
1.2.8 Project Standards to be Applied

Environmental design criteria (EDC) for project operations were developed as an input to the feasibility study, setting limits and guidelines to be considered in the selection of equipment, plant and planning during project design. The EDC involved a review of relevant Macedonian, European Union and other international guidance to select the most relevant standards or guidelines where numerical standards and guidelines are available.

The EDC were generated based on the assumption that Euromax intends to develop, operate and close the Project in accordance with all relevant Macedonian legislation and relevant international standards and guidelines. The EDC are presented within Annex 1C.

1.3 Stakeholder Engagement

Stakeholders are individuals, groups or organisations that may be affected by the Project. There are no specific requirements for stakeholder engagement under Macedonian legislation, therefore public consultation and information disclosure activities undertaken to date comply with international standards and best practice guidelines as best described in the following documents:

- International Finance Corporation (IFC) - Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets. (IFC, 2007);
- European Bank for Reconstruction & Development (EBRD) - Environmental & Social Policy: Performance Requirement 10: Information Disclosure and Stakeholder Engagement. (EBRD, 2014); and

All stakeholder engagement for the ESIA has been completed according to the Stakeholder Engagement Plan (SEP).

1.3.1 Objectives

A SEP was developed for the ESIA with the following objectives:

- Identify Project stakeholders and present timely information to them;
- Provide ongoing opportunities for stakeholders to ask questions and express interests and concerns relative to the Project;
- Record stakeholder questions, interests and concerns such that these can be relayed to the Project proponent for integration in a timely fashion into work being done to develop the Project and the ESIA; and
- Supplement baseline data collection for the ESIA through qualitative information provided in the course of consultations that enhances understanding of the opportunities and constraints of potentially affected stakeholders.

The SEP for the ESIA and results of stakeholder engagement activities can be found in Annex 2.

1.3.2 Approach to Stakeholder Engagement

Formal stakeholder engagement through consultations were organised in “rounds” of meetings to present the Project, to develop the scope of issues to be addressed in the ESIA, to collect socio-economic baseline data and initiate discussions on Project impacts and proposed mitigations.

The first round (March 2015) involved meeting with affected municipalities and with representatives from the business community, farmers, healthcare providers, emergency services, the education sector, hunters associations, young adults and local leaders. In addition, at the same time as the initial round, a household survey was administered in Ilovica and Shtuka to gather socio-economic baseline data. During this data gathering comments on the proposed Project were also recorded.

A second consultation round was held in September 2015 where two public ‘open house’ meetings were held in Ilovica and Novo Selo, with additional meetings held with municipal government, Strumica Forestry...
Company, Strumica Museum, Strumichko Pole Water Management Company, the Ministry of Economy and Ministry of Environment and Physical Planning. Materials such as information, documents and maps were prepared and distributed and presentations were delivered in Macedonian.

A third round of stakeholder engagement took place on completion of the Macedonian EIA. The purpose of this third round was to inform stakeholders about the likely impacts of the Project, to demonstrate how views of stakeholders were taken into account in the Macedonian EIA and in Project decision making, and to discuss mitigations and benefits enhancement measures. This ESIA will take into account, and respond to all concerns and comments raised during all three rounds of stakeholder engagement for the Macedonian EIA.

Euromax has maintained an Information Centre in Ilovica since 2012 with dedicated personnel to provide information to the community and to respond to questions raised by stakeholders. Euromax staff have also completed meetings with schools, religious leaders, utilities and other interested groups and individuals. Hundreds of communication records have been compiled in relation to visitors to the information centre, meetings, telephone calls and emails. These communication records were reviewed for the ESIA, providing valuable information and contributing to baseline, impact assessment and environmental and social management planning for the Project.

Euromax has recently initiated a Liaison Committee with the villages of Ilovica and Shtuka, which acts as a vehicle to disseminate information and collate and address concerns and queries from the proximate communities. Euromax intends to expand its community relations efforts and will continue to meet with stakeholders during Project construction, operations and closure. An SEP for the Project is being developed.

1.3.3 Stakeholders

National and Local Level Government

Agencies of government are interested and affected parties by virtue of their roles in the approval process of the Macedonian EIA, as well as their responsibilities for populations under their jurisdiction that may be affected by the Project. Euromax has consulted with government departments, elected leaders and senior administrators since 2012.

Affected People

Interested and affected people have been identified over time through contacts with municipal governments and people in the Project area during the exploration, ESIA and engineering design studies. Affected people include people living in the communities of Ilovica, Shtuka and Strumica due to their proximity to the Project site and their higher potential to benefit from the Project and be affected by any environmental changes. Other communities that may experience effects (e.g. visual, noise, traffic) are: Borievo, Bosilovo, Dvos, Ednokukjevo, Novo Konjarevo, Novo Selo, Petralinci, Radovo, Robovo, Sekirnik, Staro Baldovci, Sushica and Turnovo.

1.3.4 Results

Each discipline-specific section of the ESIA lists all the environmental and/or social issues that were raised during consultations and presents a response to the concern or issue.

Stakeholder Engagement reports from each of the rounds of engagement for the ESIA are presented in Annex 2. Many specific concerns were raised, but the issues have been grouped by theme below. An indication of where in the ESIA that the specific concerns have been addressed are also presented below.

- Surface and groundwater quality and quantity: Stakeholders were concerned that mining activities will result in negative impacts to water, which is used for both human consumption and irrigation of gardens and agricultural fields. Specific issues and concerns relating to this theme are addressed in Sections 5.2 and 5.3.

- Air quality: Mining activity and associated transport can generate dust and emissions, with consequent impacts on health and quality of life of nearby people. Specific issues and concerns relating to this theme are addressed in Section 5.6.
Noise: Noise generated by mining activity and associated transport can be a disturbance. Specific issues and concerns relating to this theme are addressed in Section 5.5.

Soil: There was concern that mining activity will result in polluted soils and reduced agricultural productivity. Specific issues and concerns relating to this theme are addressed in Section 5.1.

Forest resources: The Project will result in removal of forest resources which will affect the ability to gather wood and other forest products such as plants and mushrooms. Specific issues and concerns relating to this theme are addressed in Sections 5.1, 5.8, 5.9 and 5.12.

Employment and business opportunities: There is interest to see the Project benefit the local community through employment and business development. Specific issues and concerns relating to this theme are addressed in Section 5.12.

Training needs and opportunities: People feel that they will be better positioned to take advantage of economic opportunity if they could improve their education and skills. Specific issues and concerns relating to this theme are addressed in Section 5.12.

Transport routes: whether ore will be transported through Shtuka village and whether the state of existing roads will be affected. Specific issues and concerns relating to this theme are addressed in the Project Description, Section 4.

Environmental protection and regulation throughout the life of the project. These themes are addressed through the Environmental Management System (ESMS) Manual, presented in Section 11 and Management Plans (Annex 6).

1.4 Approach to the Impact Assessment

1.4.1 Scope

Articles 81 (4) and 82 (1) of the Law on Environment define the mandatory need for an EIA scope. The project developer is required to request an opinion on the scope of EIA from the body of state administration responsible for the affairs of the environment.

The scope of the ESIA was developed in line with the decision issued by the Ministry of Environment and Physical Planning. To inform the scoping phase of the project the following activities were undertaken:

- Initial site (scoping) visit in September 2013 during which the following activities took place:
  - Project site visit;
  - Baseline requirements were defined;
  - Data requirements were identified for the baseline literature searches; and
  - Macedonian specialists and academics were identified and selected to support the ESIA.

- As part of the Stakeholder Engagement round 1 in March 2015, meetings were held between Golder and the following stakeholders to inform the baseline data gathering and terms of reference for the ESIA:
  - Novo Selo Municipality; and
  - Bosilovo Municipality

- In September 2015, meetings were held between Golder and the following Macedonian Government ministries to discuss the methodology, the baseline and the approach to the ESIA:
  - Ministry of Environment and Physical Planning; and
  - Ministry of Economy.
1.4.2 ESIA Methodology

The following basic elements make up the ESIA methodology. A more in-depth description of impact assessment, mitigation and cumulative impact assessment is presented in Annex 1.

- Establish study areas for baseline data collection and establish baseline conditions (Section 2.0).
- Establish the Project description to be assessed, including the incorporated environmental and social measures (Section 4.0).
- Evaluate stakeholder engagement information (stakeholder information relevant to each technical area is presented within each sub-section of Section 5).
- Confirm the key receptors and their sensitivity or importance (receptors relevant to each technical area are identified within each sub-section of Section 5).
- Characterise the potential effects on receptors (the effects analysis) (Section 5).
  The effects analysis is the modelling or qualitative analysis used to determine whether there is any change due to the development and to predict the magnitude of the change. Direct, indirect and combined effects will be considered in the ESIA.
- Determine the nature and scale of impact, combined with the importance/sensitivity of receptors if relevant (the impact assessment) (Section 5).
  The impact assessment uses the results of the effects analysis and the residual impact results presented by upstream (linked) disciplines to quantify the impact on key receptors (e.g. villages, dwellings, areas of cultural importance, watercourses, land use). The magnitude of the effect will be determined by taking into account the following factors:
  - Magnitude of change
  - Geographic extent of change;
  - Duration of change; and
  - Frequency.
- Consider the need for mitigation measures should impacts be considered unacceptable (Section 6).
  Should the results of the impact analysis show unacceptable results, mitigation may be identified according to the hierarchy of options:
  - Avoid
  - Minimise
  - Restore
  - Compensate
  - Improvement measures
- Assess the significance of residual impacts after mitigation (Section 7);
  Residual impacts are those that remain following the implementation of the proposed mitigation. Residual impacts will be defined based on the same process applied to the evaluation of impacts.
- Consider other operating or planned projects in the region (the cumulative impact assessment) (Section 8);
- Assess environmental risks and accidents by evaluating hazards, probability and management of risks (Section 10).
Develop monitoring and management plans (Section 11);

An Environmental Management System (ESMS) Manual is presented in Section 11. The ESMS manual is a high level framework which refers to a set of management plans (Annex 6), which identify management processes, mitigation and monitoring to be carried out during Project construction, operation and maintenance to manage key potential environmental and social impacts identified in the ESIA.

The following Management Plans are included in Annex 6:

- Compliance Monitoring Plan
- Water Management Plan
- Soils, Rehabilitation and Reclamation Management Plan
- Air Quality, Noise and Vibration Management Plan
- Construction Environmental Management Plan (CEMP)
- Biodiversity Action Plan
- Cultural Heritage Management Plan
- Social Management Plan:
  - Workers Health and Safety Plan
  - Land Acquisition and Compensation Plan
  - Community Health, Safety and Security Management Plan
  - Human Resources Plan
  - Local Content and Procurement Plan
- Closure Plan
- Traffic Management Plan
- Hazardous and Non-hazardous Waste Management Plan
- Hazardous Materials Management Plan
- Mine Waste Plan
- Resource Efficiency Plan
- Emergency Preparedness and Response Plan
- Stakeholder Engagement Plan

1.4.3 Critical Habitat

The European Bank for Reconstruction and Development (EBRD’s) Performance Requirement 6 (PR6) and Performance Standard 6 (IFC PS6 2012) and associated Guidance Note 6 (GN6) focus on the protection and conservation of biodiversity and introduces three classes of habitat to which the performance standard/requirement applies:

- Modified habitat;
- Natural habitat; and
- Critical habitat.
Modified habitats are found in areas that have previously been altered by human activity and may contain large portions of non-native plants and animals. Examples include agricultural landscapes and reclaimed areas. Modified habitats may or may not retain ecological functions that support significant biodiversity value. Where modified habitats retain significant biodiversity value they are subject to PR6/PS6, but are exempt otherwise (PS6, paragraph 12).

Natural habitats are those where the species composition and primary ecological functions of the area have not been fundamentally altered by human activity. Critical habitats are a subset of either modified or natural habitats that constitute areas of significant importance for biodiversity conservation.

Different mitigation standards are recognised under PR6/PS6 for development occurring in each habitat class. Consequently, identifying the types of habitat that might be affected by a project is a central aspect of understanding baseline conditions. In particular, identifying critical habitat is important because Paragraph 16 of PR6 sets rigorous criteria that must be met for projects proposed in areas of critical habitat.

Specifically, a project proponent will demonstrate that:

1. No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;
2. The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological process supporting those biodiversity values;
3. The project does not lead to a net reduction in the global and/or national/regional population of any International Union for the Conservation of Nature (IUCN) listed Critically Endangered (CR) or Endangered (EN) species over a reasonable period of time; and
4. A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client’s management program.

If these conditions can be met, Paragraph 16 of PR6 further requires a mitigation strategy designed to achieve net gains, over a reasonable period of time, for the biodiversity values for which the critical habitat has been designated. Consequently, projects proposed in areas containing critical habitat face challenges not faced by projects in natural or modified habitats that are not classified as critical.

In areas of Natural habitat all aspects of the mitigation hierarchy including offsetting need to be employed, to achieve no net loss of biodiversity.

Even in modified habitat, should significant biodiversity value be present, mitigations need to be employed to minimise impacts.

1.4.3.1 Method to identify critical habitat

Critical habitat exists irrespective of potential project development. Thus the determination of critical habitat at baseline, is independent from the specifics of the proposed project footprint. The project location is only used to identify the centre of a large ecologically relevant region within which to analyses for the presence of critical habitat, using the criteria described below. It is then in the subsequent impact analysis that the project footprint is considered to assess whether it will significantly impact critical habitat.

For this ESIA, baseline local and regional data for flora, fauna and aquatic species and their habitats already summarized above, are analysed to class habitats as modified, natural or critical. Given that critical habitat has the most onerous mitigation and compensation requirements, the emphasis is on determining whether such habitat is present. Critical habitat can be determined using five primary criteria provided in Paragraph 16 of PR6. The full criteria definitions are provided in Annex 5G:

1) Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species;
2) Habitat of significant importance to endemic and/or restricted-range species;
3) Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
4) Highly threatened and/or unique ecosystems; and/or
5) Areas associated with key evolutionary processes.

For criteria 1-3, quantitative thresholds for determining the presence of critical habitat have been given (Annex 5G), plus two tiers of critical habitat are possible, whereas no such thresholds or tiers are used for criteria 4 and 5.

Method of CH Determination for the Ilovica Project:

The approach to critical habitat determination at baseline comprises the following steps:

- Task 1: Gain an understanding of the biodiversity features and values of the landscape within which the Project is located. Determine appropriate spatial unit(s) of analysis to be used to determine if critical habitat is present within that defined spatial unit (the CHAA/RSA);
- Task 2: Prioritise biodiversity features and values and screen for the likelihood of potential critical habitat areas; and
- Task 3: Complete CH analyses for biodiversity features identified through screening using PS6/PR6 criteria and so identify critical habitat in the spatial unit of analysis.

The following precautionary approach has been adopted for screening and identifying critical habitat (Section 2.7.3). In addition to screening all globally and European listed CR and EN species, all species that are considered to be VU by the IUCN, in addition to being protected at the national level and also by the EU Habitats Directive under Annex II, and/or IV will also be screened. Furthermore, species such as the stone crayfish which are considered by the IUCN as being Data Deficient (DD) and are assessed to be in rapid decline throughout Europe (Füreder, et al. 2010) are also afforded screening to see if critical habitat is triggered in the CHAA. Finally, as an additional precautionary measure, all determination of CH will compare CHAA distribution with a European, rather than global range. Species and habitats that do not fulfil the CH screening criteria remain as features for proportionate mitigation, compensation and enhancement in congruence with accepted good practice standards.

The appropriate spatial unit for the CHAA is considered to be the RSA (Figure 1-3 below) to screen biodiversity features to be assessed for CH. This spatial unit of analysis is essentially a discrete management unit (DMU). Discrete management units are defined as an area with a clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas (GN6, paragraph 65). The RSA is delineated by water catchment areas, which provides a sensible ecological boundary for both terrestrial and aquatic ecosystems.

In the event that CH is determined to be present within the CHAA, it will be mapped as far as possible in order to facilitate the biodiversity impact assessment through the ESIA process. During the impact assessment phase effects on any CH will be quantified for the LSA, but in accordance with good practice the ecological significance of any residual impacts will also be assessed for the CHAA, which is equivalent to the RSA.

1.4.4 Discipline Integration and Linkages

An ESIA document reports an integrated process that needs to consider not only the full range of effects of the project directly on a physical, biological or social component, but also how effects of the project on one component can have an indirect or induced effect on another component. The ESIA team held a workshop at the start of the ESIA process to identify key linkages between technical disciplines and to ensure that effects analysis was undertaken at common receptors across technical disciplines.

Residual impact analysis results (including mitigation) of some upstream technical disciplines (e.g. air quality, noise, water, visual and soil) have been used to inform effects analysis and impact assessment of downstream disciplines (e.g. ecology and socio-economics). This means that mitigation is not considered more than once and the assessment of impacts is more efficient. The following provides some key examples of this linkage:
Residual results from air quality (dust deposition) has been used in the soils effects analysis and impact assessment;

Residual results from air quality (dust deposition), noise and soils have been used in the terrestrial ecology effects analysis and impact assessment;

Residual results from water and sediment have been used in the aquatic ecology effects analysis and impact assessment; and

Residual results from water, ecology, visual, noise, air quality and soils have been used in the socio-economic effects analysis and impact assessment.

1.4.5 Biophysical Study Areas

The baseline local and regional study areas were established to guide baseline data gathering for each technical discipline. The local study area (LSA) is the area within which all direct project impacts were expected to occur and was the focus for primary data gathering during the baseline study. The regional study area (RSA) is the larger area within which indirect project impacts may occur and provides a regional context for the environmental conditions within the LSA (based upon analysis of secondary data).

The study areas for each technical discipline are described in the ESIA baseline (Annex 3), but for the biophysical disciplines are generally delineated based upon natural geographic boundaries (e.g. river catchments), a polygon based upon a set radius from the site (e.g. 10 km from the centre of the site) or by identifying local communities potentially affected by the project (e.g. identification of communities most likely to benefit economically or be adversely affected). Figure 1-3 illustrates the biophysical local and regional study areas used in the baseline study.
At the impact assessment stage, the study areas for all biophysical disciplines have been collated to produce local and regional study areas for the biophysical impact assessments (Figure 1-4). By having a combined biophysical LSA, the analysis completed by all biological and physical disciplines is focused upon the same area and uses receptors or indicator locations which have been agreed across disciplines. Figure 1-3 above shows a Landscape Regional Study Area which extends beyond the Bulgarian Border in order to meet with the guidelines used for Landscape and visual impact assessment. The study shows, however that there are no transboundary effects.

![Figure 1-4: Biophysical local and regional study areas for the ESIA](image)

### 1.4.6 Socio-economic Study Area

Socio-economic impact assessment includes the communities that have the potential to experience socio-economic effects. Most socio-economic effects are expected to be felt by communities close to the Project, namely those in the municipalities of Bosilovo and, to an extent, Novo Selo. Collectively, these communities form the socio-economic local study area (LSA). Table 1-3 lists the LSA communities. Other communities were considered in the screening process, but were ruled out as no Project-associated effects were predicted.

<table>
<thead>
<tr>
<th>Community</th>
<th>Municipality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>Bosilovo</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Bosilovo</td>
</tr>
<tr>
<td>Strumica</td>
<td>Strumica</td>
</tr>
<tr>
<td>Borievo</td>
<td>Bosilovo</td>
</tr>
<tr>
<td>Bosilovo</td>
<td>Bosilovo</td>
</tr>
</tbody>
</table>
While socio-economic effects will be felt greatest locally, some effects may extend beyond the LSA. This is particularly true of positive economic and employment effects. The regional study area (RSA) for the socio-economic impact assessment is, therefore, the Republic of Macedonia.

### 1.5 Structure of the Report

The ESIA is structured as follows:

<table>
<thead>
<tr>
<th>Section number</th>
<th>Section Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td>2</td>
<td>Summary of Existing Environmental Conditions</td>
</tr>
<tr>
<td>3</td>
<td>Project Alternatives Considered by the Project Developer</td>
</tr>
<tr>
<td>4</td>
<td>Project Description</td>
</tr>
<tr>
<td>5</td>
<td>Assessment of Environmental Impacts</td>
</tr>
<tr>
<td>6</td>
<td>Mitigations</td>
</tr>
<tr>
<td>7</td>
<td>Assessment of Residual Impacts</td>
</tr>
<tr>
<td>8</td>
<td>Cumulative Impacts</td>
</tr>
<tr>
<td>9</td>
<td>Summary of Mitigation</td>
</tr>
<tr>
<td>10</td>
<td>Environmental Risks and Accidents</td>
</tr>
<tr>
<td>11</td>
<td>Environmental and Social Management System Manual</td>
</tr>
<tr>
<td>12</td>
<td>Conclusions and Recommendations</td>
</tr>
<tr>
<td>13</td>
<td>References</td>
</tr>
</tbody>
</table>
2.0 SUMMARY OF EXISTING ENVIRONMENTAL CONDITIONS

2.1 Geology, Geomorphology, Terrain and Soils

The geomorphology, terrain and soils baseline report is provided in Annex 3 to the ESIA. The key findings relevant to the impact assessment are summarised below.

2.1.1 Geomorphology

The majority of the local study area (LSA) is dominated by mountains which protrude prominently in the landscape relative to the lowland zone. In the highland zone, colluvial deposits and weathered bedrock (gneiss) are the most common surficial materials; in the lowlands, alluvial fan deposits are the most common. The combination of geomorphology, soil conditions, and climatic patterns in the LSA result in extensive areas of the LSA being prone to surface soil erosion, particularly during intense rainfall events. Gulley, sheet wash and rill erosion, landslides (active, inactive and relic) and rockslides occur in the LSA. The areas of highest potential for soil erosion in the LSA are associated with steep gullys and valleys of the highland zone including, but not limited to, the steep slopes along the Jazga and Shtuka Rivers.

2.1.2 Soils

The soils in the LSA are characterised as rapidly drained and coarse-textured with high proportions of gravel and cobbles. These soils contain low organic matter quantity, low nutrients, and low pH (ranging from 3.8 to 6.3 with the majority of the samples having pH < 5.5) in the surface layers. These combined soil characteristics are sensitive to acid deposition, particularly base cation loss (affecting fertility) and aluminium solubilisation (with potential for toxic affects to vegetation and immobilisation of phosphorus) (Holowaychuk and Fessenden, 1987).

Soil chemical parameters averaged between surface layers, and differentiated from highlands and lowlands (including metals), were below the Environmental Design Criteria (EDC) at baseline, however there were exceedances for one soil sample in the mine pit area and one sample in the lowland zone, due to natural hydrothermal concentration of metals, the same process that produced the ore body.

The feasibility of topsoil and subsoil salvage for reclamation is limited by steep slope gradients, thin layers of soil overlying bedrock, and high volumes of coarse fragments. The estimated recoverable volume of topsoil is approximately 65,500 m$^3$ whilst the recoverable subsoil is approximately 27,500 m$^3$.

2.1.3 Land Use Capability

Land use capability refers to the ability or the potential for the land to be used for a specified land use, such as agriculture, grazing, and forestry. The capability of the land for a given land use does not necessary mean that the land is currently used for a particular land use, but that its potential exists, regardless of current land use status (Drawing 5-1). For this reason, land use capability areas for agriculture overlap with land use capability areas for grazing land in the lowland zone; likewise, grazing land use capability overlaps with forestry land capability in the highland zone.

The lowland zone is generally considered highly suitable for sedentary cropland agriculture (irrigated) for a variety of crops that require well-drained soils and can tolerate naturally low pH and low nutrient conditions (such as potatoes). The highland zone is not suitable for cropland agriculture except for minor terraces along toe slopes of river valleys which are too small to be mapped at the scale of this assessment.

The highland zone is generally marginally suitable for pastoral grazing due to a sparse understorey herbaceous cover on forested habitats and steep valley slopes that limit traffic of managed herds (i.e. cattle). Moderately suitable areas for cattle grazing include moderately steep saddle ridge deposits and low relief terraced landscapes. The lowland zone is suitable for grazing on land parcels that are not actively used for cropland agriculture.

The highland zone is generally moderately suitable for forestry. There are many areas in the highland zone that are marginally suitable or not suitable because of very shallow soils, landslide scars that limit timber productivity, or extreme slope gradients. The most suitable areas for forestry in the Project area are in the
upper reaches of the Shtuka River catchment area. Although these areas are most suitable, there is limited access from mine exploration roads and the terrain is very steep, limiting the accessibility of commercial logging equipment. The lowland zone is generally not suitable for forestry, as the majority of the land is actively used for agriculture, residential or commercial purposes.

2.2 Water Quantity

2.2.1 Baseline Stream Flows

The flow in the Jazga and Shtuka rivers, under low flow conditions, at the village water supply intakes is important in controlling the rate of abstraction by the intakes and thus is a measure of the security of supply. The average rate of abstraction at the Ilovica intake was estimated to be 0.002 m$^3$/s over 24 hours and 0.001 m$^3$/s at the Shtuka intakes. The lower the flow in the river the less secure the abstraction rate will be. The flow that is exceeded 95% of the time (Q95) was selected as an indicator of water supply security. Table 2-1 presents baseline 1-day Q95 stream flows at the intakes to Ilovica and Shtuka village water supply systems (gauging stations JZGS01 and STGS01 respectively).

Table 2-1: 1-day Q95 flows (m$^3$/s) at Ilovica and Shtuka intakes, 1 January 1973 to 31 December 2008

<table>
<thead>
<tr>
<th></th>
<th>Jazga River at Ilovica intake (JZGS01)</th>
<th>Shtuka River at Shtuka upper intake (STGS01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 percentile flow (Q95)</td>
<td>0.005</td>
<td>0.002</td>
</tr>
</tbody>
</table>

A second measure of the security of supply used in the impact assessment is the number of days each year when abstraction from the rivers is inadequate to supply the demand from the villages and when augmentation is required from Ilovica water treatment works. In addition to the supply from the river intakes, Ilovica and Shtuka are able to receive a supply of treated water from Ilovica water treatment works. Households are metered and are charged by the Bosilovo Public Utility Enterprise (PUE) on the basis of the volume of water consumed. The valved connection between the water treatment works and the village reticulation networks is kept closed most of the time, the villagers preferring to use untreated river water on cost grounds. However, if supply from the intakes becomes insufficient to meet demands or the intake supply systems are out of order, Ilovica and Shtuka residents request the PUE to augment the villages’ supplies with treated water. Table 2-2 presents modelled long term baseline estimates of the average number of days each year that Ilovica and Shtuka are supplied from the water treatment works.

Table 2-2: Baseline estimates of annual frequency of supply of Ilovica and Shtuka villages from Ilovica water treatment works (WTW)

<table>
<thead>
<tr>
<th>Year</th>
<th>Average annual frequency of supply of Ilovica from WTW</th>
<th>Average annual frequency of supply of Shtuka from WTW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 1961 - 2014</td>
<td>3 days</td>
<td>55 days</td>
</tr>
</tbody>
</table>

The modelling and associated results are described in the Baseline Report (Annex 3).

2.2.2 Baseline Reliability of Ilovica Reservoir

Water abstracted from Ilovica reservoir is treated in Ilovica water treatment works and supplied to about 5,500 people in seven villages in Bosilovo Municipality. In summer, Ilovica reservoir also supplies irrigation water to residents in and around Ilovica and Shtuka. The reliability of Ilovica reservoir is an indicator of the security of supply to the seven villages and to Ilovica and Shtuka for agricultural water supplies. A reservoir storage yield analysis was carried out using modelled baseline inflows for the period 1961-2014 and abstractions in 2012 for public water supply (0.22 Mm$^3$/year) and agriculture (0.47 Mm$^3$/year). The analysis showed a baseline annual probability of supply failure (the reservoir drying up) of 0.0115. This is equivalent to a return period of failure of once on average in approximately 87 years. Under baseline (present) demand and abstraction conditions the water supply from the reservoir is considered to be secure.
2.2.3 Baseline Spring Flows in Ilovica and Shtuka

The flows in two public springs which are used by residents of Ilovica and Shtuka for domestic water supply are used as an indicator of the security of water supply in the two villages from these sources. The spring outlets are considered to be receptors of flows. Flows are monitored at the spring outlets.

Spring ISP41 in Ilovica flows all year round (based on observations over a 3 year period), with flow rates fluctuating between 0.1 and 0.5 l/s. Flow rates show a clear response to seasonal rainfall.

Spring SSP49 in Shtuka is located next to the Shtuka River and flows under baseline conditions at between 0.15 l/s and 0.3 l/s for most of the year (based on observations over a 3 year period). This spring shows almost no response to seasonal rainfall recharge and flow has been observed to cease at the end of dry summer periods.

At present and in both cases the precise location of the actual source to these springs is not known. In addition, the flows measure what is discharged via the pipes and do not necessarily measure the total discharge at the sources of the springs. Therefore, at present, it is proposed to consider effects and impacts at these receptors based on predicted changes to groundwater level regime and by assuming that the delivery outlet location corresponds to the actual spring source. Accordingly, these spring flow receptors are grouped with the wells located in Ilovica and Shtuka (below).

2.2.4 Baseline Groundwater Levels

The groundwater level in selected wells in Ilovica and Shtuka is used as an indicator of the security of water supply from groundwater in the two villages. In Ilovica, wells IB19 and IB39 were selected, and in Shtuka well SB47 was selected. These wells are located nearest the mine site and are likely to be the first to exhibit any change in water level due to mining. Groundwater levels in selected boreholes between Ilovica and Turnovo are used to assess the impact of mining activities in the upper Jazga and Shtuka catchments on groundwater in the Strumica valley. Table 2-3 presents baseline groundwater levels for the selected wells and at the spring flow sources referred to above. It should be noted that the baseline groundwater levels referred to in Table 2-3 are derived from groundwater modelling and not from actual monitored values. The modelled derivation is described in Annex 5B.

Table 2-3: Baseline modelled groundwater levels in receptor wells and at springs in Ilovica and Shtuka and between Ilovica and Turnovo

<table>
<thead>
<tr>
<th>Well or Spring</th>
<th>Modelled Groundwater Levels (masl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average value</td>
</tr>
<tr>
<td>Ilovica village</td>
<td></td>
</tr>
<tr>
<td>Well IB19</td>
<td>301.51</td>
</tr>
<tr>
<td>Well IB30</td>
<td>273.78</td>
</tr>
<tr>
<td>Well IB39</td>
<td>280.35</td>
</tr>
<tr>
<td>Spring ISP41</td>
<td>278.20</td>
</tr>
<tr>
<td>Shtuka village</td>
<td></td>
</tr>
<tr>
<td>Well SB47</td>
<td>306.27</td>
</tr>
<tr>
<td>Well SP57</td>
<td>282.14</td>
</tr>
<tr>
<td>Spring SSP49</td>
<td>295.59</td>
</tr>
<tr>
<td>Strumica valley between Ilovica and Turnovo</td>
<td></td>
</tr>
<tr>
<td>BH347</td>
<td>228.12</td>
</tr>
<tr>
<td>IC-15113</td>
<td>225.91</td>
</tr>
</tbody>
</table>

Further information on baseline groundwater levels at the wells and flows from the village springs are presented in the water quantity section of the ESIA Baseline (Section 5, Annex 3).
2.2.5 Aquatic Ecological Habitat

One indicator used to assess aquatic habitat is the width of channel bed and banks that is in contact with the flow at any one time, known as the wetted perimeter. Wetted perimeter data were calculated from river channel measurements made during spot streamflow measurements at gauging stations JZGS01 and JZGS02 on the Jazga River and stations STGS01 and STGS03 on the Shtuka River. The following relationships enable the wetted perimeter (P, metres) at these stations to be estimated if flow (Q, m$^3$/s) is known:

- Jazga River at station JZGS01: \( P = 1.7178Q + 2.8932 \)
- Jazga River at station JZGS02: \( P = 0.5354\ln(Q) + 4.4662 \)
- Shtuka River at station STGS01: \( P = 2.123Q + 2.369 \)
- Shtuka River at station STGS03: \( P = 5.3169Q + 1.8471 \)

The Q95 (the flow equalled or exceeded 95% of the time) was selected as the flow to be used to calculate the wetted perimeter at each station for the purpose of impact assessment. Table 2-4 presents baseline estimates of wetted perimeter calculated at the above stations.

<table>
<thead>
<tr>
<th>Station</th>
<th>Baseline Q95 (m$^3$/s)</th>
<th>Baseline wetted perimeter (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jazga River at station JZGS01</td>
<td>0.005</td>
<td>2.90</td>
</tr>
<tr>
<td>Jazga River at station JZGS02</td>
<td>0.004</td>
<td>1.55</td>
</tr>
<tr>
<td>Shtuka River at station STGS01</td>
<td>0.002</td>
<td>2.37</td>
</tr>
<tr>
<td>Shtuka River at station STGS03</td>
<td>0.002</td>
<td>1.86</td>
</tr>
</tbody>
</table>

Discharge versus wetted perimeter relationships were not required for the gauges on the lower Jazga and Shtuka rivers; JZGS03 and STGS02 respectively.

Details of the baseline measurements of wetted perimeter are presented in the water quantity section of the ESIA Baseline (Section 5, Annex 3).

2.2.6 Risk of Flooding

The present baseline risk of flooding in Ilovica and Shtuka villages and at the Turnovo-Sekirnik road crossing was assessed by calibrating a rainfall-runoff model to an observed flood event on each river and then predicting the 1 in 100-year peak flow resulting from a 24-hour rainfall with a return period of 100 years distributed according to a theoretical storm profile. As post-closure proposals have the potential to affect impending flood flows well into the future (≥ 100 years from present), baseline 1 in 100-year peak flows were also determined making allowance for the potential effect of climate change on design storm rainfall. These two scenarios are presented as the baseline and baseline including an allowance for climate change respectively. As an abbreviation, the latter is referred to as the baseline plus climate change (or baseline + CC).

Hydraulic models of river reaches at each location were developed based on topographic surveys of the cross sections and longitudinal sections of the river channels and adjoining flood plains. The estimated peak flows were then used in the hydraulic models to estimate the water surface profiles under peak flow conditions. The assessment of flood risk was made by considering the water surface profile in relation to public infrastructure such as nearby bridges, roads and buildings.

In general, both the baseline and baseline + CC flood risks in Ilovica were assessed to be very low. The circumstances under which actual flooding of Ilovica can be conceived include:

- Flood events with extreme return periods (possibly >500 year under baseline conditions).
- A major dam burst at Ilovica reservoir.
- A significant flood flow coinciding with a major channel blockage, for example at bridges by vegetation debris.
However, there are several river-side properties in Ilovica which have footings extending into the river channel and some of these are at moderate risk of structural damage under both baseline and baseline + CC design flood conditions. The predicted risk is exacerbated under the latter conditions should these particular dwellings have a sufficient life-span so as to be subject to potential climate change effects.

In general, both the baseline and baseline + CC flood risks in Shtuka were assessed to be quite high (moderate) with minor scale flooding of the village square occurring at return periods down to a few years. The circumstances under which significant flooding of Shtuka can be conceived include:

- Flood events with present return periods in excess of 50 years.
- A flood flow coinciding with a major channel blockage, for example at bridges by vegetation debris.

The baseline flood risk at the Turnovo-Sekirnik road was assessed to be moderate with the 25-year flood flow just being accommodated by the road culvert. The circumstances under which significant flooding of the road is likely to arise include:

- Flood events with a present return period in excess of 25 years.
- A flood flow coinciding with a major culvert blockage, for example by vegetation debris.

Details of the baseline flood risk assessment can be found in the water quantity section of the ESIA Baseline (Section 5, Annex 3).

### 2.2.7 Downstream Flow Contributions

The percentage contributions of flow from the Jazga catchment to flow in the Turija and Strumica rivers and from the Shtuka catchment to flow in the Strumica River were estimated over the period 1973 to 2008 using modelled daily flow records at gauging stations on all four rivers near their confluences and the observed flow record at the Hydrometeorological Service station at Novo Selo. Table 2-5 provides a summary of percentage contributions to downstream flows.

#### Table 2-5: Percentage contributions of modelled catchments to downstream flows, 1973-2008

<table>
<thead>
<tr>
<th>Receiving river</th>
<th>Median (50 percentile) contribution from modelled catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jazga River at JZGS03</td>
</tr>
<tr>
<td>Turija River at Turnovo (TJGS01)</td>
<td>6%</td>
</tr>
<tr>
<td>Strumica River at Sekirnik (SMGS02)</td>
<td>3%</td>
</tr>
<tr>
<td>Strumica River at Novo Selo (SMGS03)</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>4%</td>
</tr>
</tbody>
</table>

Further information on the contributions of the Jazga and Shtuka rivers to the Turija and Strumica Rivers can be found in the water quantity section of the ESIA Baseline (Section 5, Annex 3).

### 2.2.8 Baseline reliability of Turija Reservoir

Turija Reservoir is the proposed main source of fresh water supply to the Ilovica-Shtuka mine. Turija Reservoir is a multi-purpose reservoir, serving as the sole source of supply to Strumica, releasing environmental flows to the Turija River, maintaining flood control storage and supplying the Turija irrigation area with irrigation water supplies. Supplies to Strumica and environmental flow releases are prioritised over irrigation and are secure. According to SPWMC, about 2,500 ha within the command area, the area served by the irrigation system, have been irrigated each year over the past few years. The irrigation command area1 is 9,500 ha.

The behaviour of Turija Reservoir under baseline conditions was modelled using ResSim, a reservoir modelling package. Reservoir behaviour was modelled using the historical inflow record (1961-2014) and baseline demands on the reservoir. Assumptions made in the baseline ResSim model included:

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1 “Irrigation command area” is defined as the area which can be irrigated from a scheme and is fit for cultivation.
- Maintenance of 1 Mm³ flood storage throughout year;
- Supply of 5 Mm³/year supply to Strumica;
- Releases of 3.3 Mm³/year environmental flow;
- Irrigated area of 2,500 ha; and
- Irrigation scheme efficiency of 30%².

The reliability of irrigation water supplies was calculated under baseline conditions. Two measures of reliability of supply were calculated, using definitions from HEI, 2015:

- Temporal reliability, or the percentage of days of irrigation demand³ when the demand is not satisfied; and
- Volumetric reliability, or the percentage of the volume of demand which is not satisfied.

Table 2-6 presents baseline indices of temporal and volumetric reliability of irrigation water supplies from Turija Reservoir calculated for the modelled period 1961-2014.

Table 2-6 Baseline reliability of irrigation water supplies from Turija Reservoir

<table>
<thead>
<tr>
<th>Irrigation scheme efficiency</th>
<th>Temporal reliability</th>
<th>Volumetric reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage of days with irrigation demand when demand is not satisfied</td>
<td>Percentage of volumetric demand that is not satisfied</td>
</tr>
<tr>
<td>30%</td>
<td>22%</td>
<td>24%</td>
</tr>
</tbody>
</table>

Further information on the modelling of Turija reservoir is presented in the ESIA Baseline (Annex 3) and in ESIA Annex 5B.

### 2.3 Water Quality

Baseline water quality (surface and groundwater) in the upland Jazga and Shtuka catchments is characterised as relatively clean, is generally low in dissolved solids and is not highly modified from rainwater as there has been little interaction with sediments, rocks or humans. Downstream of Ilovica and Shtuka villages, water has a higher concentration of dissolved solids, a more neutral pH and a greater alkalinity and buffering capacity due to increased time in water flow pathways allowing more interactions with rocks and sediments in the catchment. Some groundwater and surface water close to the deposit area shows elevated iron and copper concentrations, depressed pH and lower alkalinity, indicating the influence of the deposit on baseline water chemistry.

Indicator locations for the receptors are defined in Section 5.3. Water quality parameters that have been selected to be indicators relevant to public health and aquatic ecology are also defined in Section 5.3. Baseline data for these parameters were used in the impact assessment. Baseline water quality data were obtained from two sources:

- Data collected by the project and by the Public Health Institute, Strumica, prior to the commencement of environmental baseline studies in 2013; and
- Data collected by the project during the baseline studies which started in 2013.

Baseline water quality studies are reported in Section 6 of the ESIA baseline (Annex 3). Drawing 2-1 (appended to the ESIA) shows the network of sampling points in rivers, springs and groundwaters developed during the baseline studies. The baseline data were collected by Euromax Resources technicians trained in

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² The average scheme efficiency of Turija irrigation scheme was calculated to be 32% by HEI (2016).
³ Irrigation demand was calculated by Hidro-Energo Enzenering (HEI, 2015) from crop water requirements, effective rainfall and irrigation system efficiency, according to the methodologies set out in FAO (1974), Doorenbos and Pruitt (1977) and Allen et al (1998).
industry standard sampling and analysis techniques by WSP PB. The methodologies required for sampling and field analysis, as well as storage and shipment of samples to laboratories, were documented in a set of standard operating procedures (SOPs) and used to train Euromax Resources technicians. The SOPs are presented in an appendix to the baseline report. Standard Quality Assurance and Quality Control (QAQC), documented in the project SOPs, was completed on the baseline dataset prior to use and the baseline data are stored in a project environmental database.

The following sections present water quality data used for the assessment of impact on:

- Public health, security of water supplies and irrigation; and
- Aquatic ecology.

### 2.3.1 Parameters of Concern to Public Health, Security of Water Supplies and Irrigation

The key parameters used for impact assessment are pH, sulphate, and selected metals such as iron, copper, arsenic, cadmium, nickel and zinc. These parameters are of concern to public health and security of water supplies, as defined by baseline geochemical studies. Water quality standards for drinking water used in the impact assessment are those of the World Health Organisation, EU and Macedonia. These are presented in the project Environmental Design Criteria (EDC) document. The suitability of water quality for irrigation is less strict than that of drinking water. Therefore, even though water use at receptors is generally used for both irrigation and water supply, only drinking water standards have been included to define the magnitude criteria in the impact assessment.

The baseline concentrations for key water quality parameters used within the impact assessment are presented in Table 2-6. These baseline concentrations reflect the maximum concentrations recorded at each location (with the exception of pH and alkalinity where the minimum is used). Using maximum recorded concentrations as the baseline dataset allows assessment of the worst case scenario of baseline concentrations being at their maxima when receiving additional pollutant load from project activities. The only chemical parameters where there are exceptions to this are pH and alkalinity. A low pH and alkalinity could be induced should acid drainage, which is a contaminant of concern, affect the water receptors. In this case the minimum baseline concentrations are presented in Table 2-6. There is both a minimum and maximum guideline value for pH within the water quality guidelines to reflect the potential effect of a drop in pH. Alkalinity is a measure of the buffering capacity of water, which indicates how a water might prevent a sudden drop in pH. Alkalinity does not have a direct guideline value but is a useful guide for the buffering capacity which will help to counter drops in pH.

In Table 2-6, project drinking water standard exceedances are highlighted with red text and project environmental quality standards exceedances are highlighted with pink fill.

#### 2.3.1.1 Ilovica Reservoir

Ilovica Reservoir is currently the source of supply for about 5,500 people. Reservoir water is treated to national and international standards in Ilovica Water Treatment Works prior to distribution to villages in Bosilovo municipality. Baseline data for Ilovica Reservoir which are used in the impact assessment (maximum recorded concentrations) were sampled at the inlet to the treatment works (ILWT01) and at river gauging station JZGS01 upstream of the reservoir. The results are presented in Table 2-6.

#### 2.3.1.2 Intakes on the Jazga and Shtuka Rivers

Baseline water quality was monitored for 34 months; quarterly between November 2013 and March 2015 and then on a monthly frequency from March 2015 onwards. Baseline results (maximum recorded concentrations) for the intake on the Jazga River (JZGS01) and the Shtuka River (STGS01) are presented in Table 2-6. These locations are used as indicator locations within the impact assessment (Section 5.3.3). It is assumed that river water sampled at the intakes will be representative of the water abstracted by the village water supply systems.

---

*Ilovica Gold-Copper project; Engineering and Social Engineering Considerations (Appendix 1C – Environmental Design Criteria); Golder (13514150363.545/B.0); July 2015*
Since abstracted water is distributed untreated (Section 2.2) it is also assumed that the quality of water as measured at the intakes is largely unchanged before it is delivered at the consumers’ tap. This also means that the distribution network is likely to be contaminated by sediment and naturally occurring bacteria from the rivers. This contamination has given rise to complaints from consumers in Ilovica and Shtuka regarding water quality and, as a result, resistance to paying the standard tariff for treated water whenever the treated water supply is connected.

In terms of water quality, the security of supply of the village water supply schemes are considered insecure as there is a risk to public health. Diarrhoea is anecdotally reported as a common illness in Ilovica and Shtuka.

2.3.1.3 **Wells and boreholes in Ilovica and Shtuka**

Baseline water quality was monitored quarterly at selected wells and boreholes in Ilovica and Shtuka over a period of 34 months between November 2013 and August 2016. These data are used in the impact assessment. The monitored wells and boreholes in Ilovica and Shtuka villages include IB30, IB39, SB47 and SB58. For the purpose of impact assessment only wells IB30, IB39 and SB47 are used as they have longer records. Initial water quality results from the more recent IB20 and SB58 monitoring locations appear to be very similar to those monitored over a longer time period. The baseline data (maximum recorded concentrations) are presented in Table 2-6. TMF008, a geotechnical borehole under the proposed TMF embankment, has been included in the table as it is used to predict chemistry of water discharging from the SCF in closure, but it is not used as a receptor location for impact assessment. Bacteriological water quality is not included in this section as wastewater will be treated to meet bacteriological quality guidelines as stated in the EDC document so there will be no project effect on bacteriological parameters. The full dataset, including bacteriological parameters, can be found in the water quality baseline report (Section 6, Annex 3).

2.3.1.4 **Spring flows in Ilovica and Shtuka**

The two springs in Ilovica (ISP41) and Shtuka (SSP49) used for public drinking supplies were also sampled quarterly over a period of 34 months between November 2013 and August 2016. These are also used in the impact assessment and the baseline data (maximum recorded concentrations) are presented in Table 2-6.

2.3.1.5 **Irrigation wells on the Strumica Plain**

Baseline groundwater quality on the Strumica Plain was monitored in 2015 at a shallow irrigation borehole (BH347), at a deep and shallow nested piezometer (IC15111 and IC15113) and at a test pumping well (IC16120). The baseline data for these points (maximum recorded concentrations) are presented in Table 2-6.

2.3.2 **Parameters of Concern to Aquatic Ecology**

The parameters used in the impact assessment which are of concern to aquatic ecology are: pH, TDS, TSS, EC, sulphate, iron, copper, arsenic, cadmium, nickel and zinc. These parameters were measured quarterly or monthly at the river sampling sites over a period of 34 months between November 2013 and August 2016. Baseline river monitoring sites monitored in the project area included gauging stations on the Jazga River (JZGS01 and JZGS03), the Shtuka River (STGS01 and STGS02), the Turija River (TJGS01) and the Strumica River (SMGS02 and SMGS03) (Table 2-6).

The above locations are used as indicator receptor locations within the impact assessment (Section 5.3).
ILOVICA-SHTUKA ESIA

Table 2-6: Maximum baseline water quality concentrations at impact assessment receptors
Project
Drinking
Water
Standards
(DWS)

Parameter**

Unit

Ag-D

mg/l

Al-D

mg/l

Field
alkalinity*

mg/l

As-D

mg/l

Ca-D

mg/l

Cd-D***

mg/l

0.003

Cl-ion

mg/l

250

CN-free

mg/l

CN-T

mg/l

CN-WAD

Project
Environmental
Quality
Standards
(EQS)

ILWT01

JZGS01

JZGS03

STGS01

STGS02

TJGS01

SMGS02

SMGS03

BH347

IC15111

IC15113

IC16120

ISP41

SSP49

IB20

IB30

IB39

SB47

SB58

TMF008

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.0007

0.00035

0.0012

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.00035

0.3

0.2

0.2

0.05

0.05

0.05

0.05

0.7

0.05

0.1

0.05

0.05

0.05

0.05

0.05

0.05

0.05

0.05

0.05

0.05

27

23

37

35

31

40

86

101

50

252

64

422

71

41

159

57

54

43

103

90

0.006

0.0007

0.0019

0.0013

0.0007

0.0028

0.0025

0.009

0.0005

0.003

0.0005

0.005

0.0031

0.0011

0.004

0.0036

0.003

0.0011

0.001

0.0005

19.7

23.6

30.5

32.1

32.7

35.6

59.4

63.5

39.9

22.8

47.1

49.6

62

29.5

60.9

66.9

49.3

43.5

45.8

39.2

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0006

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

0.0003

4.82

4

12.7

4.64

34.7

157

20.1

28.8

10.6

45

15.8

108

35.6

5.5

36.9

25.1

31.5

4.5

17.5

7.6

0.004

0.004

0.004

0.004

0.004

0.004

0.004

0.011

0.014

0.004

0.004

0.004

0.004

0.004

0.004

0.008

0.004

0.004

0.004

0.004

0.0045

0.011

0.012

0.0045

0.0045

0.0045

0.0045

0.014

0.014

0.014

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

mg/l

0.005

0.0075

0.006

0.0075

0.005

0.005

0.005

0.005

0.005

0.005

0.0025

0.0025

0.005

0.005

0.005

0.005

0.005

0.005

0.005

0.025

Co-D

mg/l

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.015

Field
conductivity

µS/cm

2500

235.3

254.9

349.3

427.5

329

866

566

606

396.1

1251

487.2

2161

812

395.1

777

626

569

376

500.5

272.4

Cr-D

mg/l

0.05

0.001

0.008

0.001

0.001

0.001

0.002

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

0.001

CrVI-D

mg/l

0.35

0.0025

0.004

0.0025

0.004

0.0025

0.005

0.0025

0.008

0.0015

0.0015

0.0015

0.0015

0.005

0.01

0.0015

0.0025

0.0025

0.0025

0.0015

0.0015

Cu-D

mg/l

2

0.1

0.0045

0.009

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.0045

0.031

Fe-D

mg/l

0.2

3.5

0.29

0.32

0.115

0.115

0.66

0.115

0.24

0.115

0.26

0.115

0.74

0.115

0.115

0.115

0.115

0.115

0.115

0.115

0.115

Fe-T

mg/l

5.55

1.28

5.72

0.49

0.5

1.15

1.32

0.98

0.115

0.27

3.4

6.37

0.115

0.115

0.115

0.115

0.115

0.115

2.46

2.35

F-ion

mg/l

1.5

0.2

0.2

0.2

0.2

0.2

0.3

0.3

0.5

0.2

0.6

0.2

3.8

0.3

0.2

0.2

0.3

0.2

0.2

0.3

0.2

Hg-D

mg/l

0.001

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

0.00005

K-D

mg/l

5.44

5.05

6.07

6.94

2.3

5.64

5.18

7.65

5.95

3.81

5.34

10.1

33.9

7.95

41.3

14.4

30.7

3.96

12.2

1.12

Mg-D

mg/l

4.1

4.8

6.89

7.3

7.4

9.99

14.2

14.6

8.5

4.1

10.3

12.1

15.4

6.6

11.4

13.6

11.2

8

12.8

2.3

Mn-D

mg/l

0.72

0.852

0.035

0.292

0.024

0.018

0.285

0.143

2.45

0.0035

0.739

0.017

0.144

0.012

0.0035

0.012

0.014

0.009

0.0035

0.023

1.56

Mo-D

mg/l

0.024

0.0015

0.005

0.0015

0.0015

0.0015

0.003

0.139

0.005

0.0015

0.026

0.0015

0.004

0.004

0.015

0.0015

0.008

0.006

0.0015

0.0015

0.0015

Na-D

mg/l

200

7.63

9.87

12.9

13

9.79

102

21.8

30.1

14.4

207

17.3

410

32.8

12.3

29.6

20.5

28.5

9.48

18.1

5.95

Ni-D

mg/l

0.02

0.02

0.0015

0.006

0.0015

0.0015

0.0015

0.015

0.0015

0.005

0.0015

0.003

0.0015

0.0015

0.006

0.01

0.0015

0.005

0.0015

0.0015

0.0015

0.004

N-NH3

mg/l

0.4

8.79

0.21

0.21

0.21

0.21

0.21

1.22

0.21

2.76

0.14

0.21

0.21

0.21

0.21

0.21

0.21

0.21

0.33

0.86

0.21

0.53

N-NO2

mg/l

0.91

0.04

0.04

0.04

0.04

0.067

0.15

0.078

0.22

0.0125

0.04

0.04

0.04

0.04

0.04

0.04

0.04

0.04

0.04

0.04

0.04

NO3-NO3

mg/l

50

22.36

1.55

4.6

11.9

4.9

30.3

11.5

8.7

39.8

65.7

1.55

93.6

18

105

14.8

77

125

95.2

9.5

35.6

1.55

OrthPO4-P

mg/l

2.21

0.6

0.6

0.6

0.6

0.6

0.6

0.6

0.8

0.6

0.6

0.3

1.2

1.6

0.7

2.7

2.2

1.5

0.6

0.6

0.3

Pb-D

mg/l

0.01

0.007

0.003

0.009

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

0.003

Field pH*

pH Units

6.5 - 9.5

5.94 - 8.97

6.6

6.2

6.5

6.3

6.3

6.3

6.8

6.8

6.7

7.1

6.4

7.3

6.0

6.1

6.1

6.1

6.2

6.1

6.6

6.2

P-T

mg/l

1.68

0.34

0.06

0.42

0.06

0.14

1.33

0.25

1

0.27

0.46

0.31

0.06

1.67

0.18

3.08

1.72

1.66

0.45

0.39

0.21

Sb-D

mg/l

0.005

0.0006

0.0008

0.0012

0.0008

0.0008

0.0008

0.0008

0.0008

0.0006

0.0006

0.0006

0.0006

0.0008

0.0008

0.0006

0.0008

0.0008

0.0006

0.0006

0.0006

Se-D

mg/l

0.01

0.0004

0.0012

0.0008

0.0012

0.0012

0.0008

0.0024

0.0016

0.0004

0.0004

0.0004

0.0013

0.001

0.0011

0.0004

0.0008

0.0008

0.0004

0.0004

0.0004

SO4-D

mg/l

250

27.4

30.7

30.1

37.1

29.7

33.8

40.2

104

33.4

225

41.2

446

51.6

36.8

55.9

47.5

49.7

66.1

42.5

26.4

0.2

0.01

0.05

0.0097

0.00008 - 0.0015

0.015

4.22

0.05

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0.00007

0.0017

2-9


<table>
<thead>
<tr>
<th>Parameter**</th>
<th>Unit</th>
<th>Project Drinking Water Standards (DWS)</th>
<th>Project Environmental Quality Standards (EQS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ILWT01</td>
<td>JZGS01</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/l</td>
<td>482</td>
<td>147</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/l</td>
<td>156</td>
<td>43</td>
</tr>
<tr>
<td>U</td>
<td>mg/l</td>
<td>0.03</td>
<td>0.00052</td>
</tr>
<tr>
<td>Zn</td>
<td>mg/l</td>
<td>0.074</td>
<td>0.024</td>
</tr>
</tbody>
</table>

* Minimum pH and alkalinity are presented as worst case rather than maximum as these have the most negative effect on water quality.

** Only parameters of interest for the impact assessment are presented in this table. The full baseline dataset, including a full list of parameters is available in Annex 3 (Baseline Studies).

*** Cadmium EQS standard is hardness dependent.
2.4 Sediment

The most important data requirements for the sediment impact analysis assessment are:

- Rainfall (which acts to erode soils);
- River flow (which dilutes eroded TSS concentrations);
- Soil type data, including particle size distributions (PSD) (which indicates the proportion of soil that may be eroded as part of the construction, operation and closure activities); and
- Sediment baseline data (provide empirically based and site specific gross, annualized erosion rates under existing pre-project conditions).

2.4.1 Rainfall & River Flow Data

The 54 year synthetic baseline rainfall data developed as part of the surface water ESIA baseline has been used directly in the sediment impact assessment modelling. The rainfall data are presented in Appendix 5-H of the ESIA baseline report (Annex 3). The modelled baseline river flow (estimated based on the synthetic baseline rainfall data) has also been used in the sediment effects analysis. Figure 2-1 presents the synthetic daily rainfall data utilised in the sediment modelling.

![Figure 2-1: Synthetic 54 year baseline rainfall record utilised in sediment modelling](image)

2.4.2 Soil Type Data and Particle Size Distributions

The findings of the geomorphology, terrain and soils baseline (Section 3, Annex 3) were used to inform the sediment impact assessment. This involved defining the distribution of material types across the proposed mine area to be applied to quantify the volume of material that might be eroded during a rainfall event. The soils baseline allowed the delineation of soil types and assemblages based upon soil characteristics, which are understood through field observations and laboratory analysis. The key data for sediment modelling is the PSD (particle size distribution) of each soil type; the soils baseline provided the clay, silt and sand fractions for each soil type. A PSD was assigned to the soils in the vicinity of each proposed mine facility taking into consideration the PSDs and soil distribution mapping. Table 2-7 presents the PSD data associated with the underlying soils for each mine facility.

<table>
<thead>
<tr>
<th>Table 2-7: Particle size distribution data utilised in sediment modelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility</td>
</tr>
<tr>
<td>TMF</td>
</tr>
<tr>
<td>Haul roads</td>
</tr>
<tr>
<td>Access roads</td>
</tr>
<tr>
<td>Mine workshop</td>
</tr>
</tbody>
</table>
2.4.3 Sediment baseline data

Baseline data on sediment yield and gross erosion rate for the local catchments provided an important tool for reviewing the amount of eroded material entering a watercourse (Section 7, Annex 3) under existing conditions. The annual average sediment yield and gross erosion rate in the catchment of Ilovica Reservoir, which comprises mainly the Jazga River catchment, were estimated over an appropriate period from within the 15-year operational life for the reservoir from 2000 to 2014. Expressed in terms of sediment yield per unit area of the Ilovica Reservoir catchment (area = 2,590 ha), the (minimum, rounded) average annual sediment yield to the reservoir is of the order of 2 t/ha/y.

As a comparison, widely-adopted gross erosion rates often adopted for mining projects for different land uses are presented in Table 2-8 (PT McElhanney, 2004).

Table 2-8: Generally adopted gross erosion rates for mining projects

<table>
<thead>
<tr>
<th>Land use/catchment type</th>
<th>Gross sediment yield (t/ha/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest/undisturbed areas</td>
<td>2</td>
</tr>
<tr>
<td>Rehabilitated areas</td>
<td>34</td>
</tr>
<tr>
<td>Areas undergoing rehabilitation</td>
<td>68</td>
</tr>
<tr>
<td>Active planting</td>
<td>117</td>
</tr>
<tr>
<td>Mining/active areas</td>
<td>146</td>
</tr>
</tbody>
</table>

Baseline sediment concentrations are presented in the sediment baseline study (Section 7, Annex 3). The baseline study concludes that, prior to any mining exploration influences, baseline TSS concentrations in the Shtuka and Jazga Rivers are considered to be approximately 250 mg/l for 95% of the time.

The suspended sediment concentrations recorded in the two watercourses will contribute to the classification of water for the Shtuka and Jazga. This classification is presented in the water quality baseline (Section 6, Annex 3).

Suspended sediment PSD was assessed for five samples collected from monitoring location JZGS01 during August 2015. The PSD based on these samples is typically in line with the soils PSD recorded in the catchment.

2.5 Noise and Vibration

2.5.1 Noise Baseline Survey

A baseline noise survey was undertaken jointly between Golder, Euromax Resources and the University of Goce Delchev (Shtip) in July 2015. The full baseline report is provided in Section 8 of Annex 3 to the ESIA, however a brief summary of its findings are provided below. Noise levels were measured at representative locations throughout the local study area (LSA) (defined in Section 1). Measurements were undertaken using appropriate equipment, the specification of which conformed to the relevant international standard.

---

5 This value differs from the value of 50mg/l presented in the Macedonian ESIA. Further data gathering in 2016 has provided an adjusted value.
equipment was within its laboratory calibration period and field calibration checks were completed before and after each measurement.

The relevant noise parameter to this assessment is the ambient level (L_{Aeq}) defined as the ‘equivalent continuous A-weighted sound pressure level, expressed in decibels’. It is a unit commonly used to describe construction noise and noise from industrial installations and is the parameter adopted both by international and local (Macedonian) guidance (refer to Section 5.5). The reference time interval is included within the description of the parameter, e.g. L_{Aeq,1hr} is the L_{Aeq} averaged over a period of 1 hour.

The baseline noise survey recorded the ambient noise level on a 10 minute averaging period, such that the variation in noise levels over time could be determined. The 10 minute L_{Aeq} may be aggregated to give hourly values and, in turn, daytime (12 hour), evening (4 hour) and night-time (8 hour) period averages. Monitoring within villages was undertaken over 24 hours per location, with shorter duration surveys undertaken at other locations. Noise monitoring locations were selected to capture a range of noise environments within the study area.

2.5.2 Baseline Survey Results

The measured noise levels for each of the baseline survey locations have been used to characterise the daytime, evening and night-time noise levels in each type of noise environment. A summary of the measured baseline noise levels is provided in Table 2-9.

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Period</th>
<th>Daytime (07:00 – 19:00)</th>
<th>Evening (19:00 – 23:00)</th>
<th>Night-time (23:00 – 07:00)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured Period-Averaged Ambient (L_{Aeq, Day-12 hr})</td>
<td>Minimum Measured Hourly-Averaged Ambient (L_{Aeq, 1 hr})</td>
<td>Measured Period-Averaged Ambient (L_{Aeq, Evening-4 hr})</td>
<td>Minimum Measured Hourly-Averaged Ambient (L_{Aeq, 1 hr})</td>
</tr>
</tbody>
</table>
| Areas outside of urban locations
| Limit Value | 40 | - | 35 | - | 35 | - |
| Met Station | 39.7 | 26.2 | 21.1 | 19.1 | 39.0 | 18.8 |
| Monastery of St George | - | 43.0 | - | - | - | - |
| Ilovica 1 | 47.9 | 45.4 | 49.3 | 38.9 | 47.2 | 34.5 |
| Ilovica 2 | 48.8 | 42.5 | 52.0 | 46.1 | 46.9 | 38.8 |
| Shhtuka | 46.8 | 40.9 | 55.2 | 50.2 | 47.6 | 41.1 |
| Areas exposed to intensive road traffic noise
| Limit Value | 60 | - | 55 | - | 50 | - |
| Sekirnik | 42.3 | 37.9 | 41.4 | 39.7 | 38.6 | 29.3 |
| Turnovo | 42.6 | 39.0 | 44.6 | 41.7 | 44.3 | 36.7 |
| Samuilovo | 49.1 | 46.3 | 49.7 | 41.9 | 45.6 | 36.1 |
| Novo Konjarevo | 56.1 | 51.3 | 53.9 | 52.1 | 50.6 | 48.3 |
| Third level of noise protection (mixed commercial and residential areas)
| Limit Value | 60 | - | 60 | - | 55 | - |
| Novo Selo | 50.5 | 47.2 | 50.8 | 45.2 | 46.9 | 40.0 |

Noise levels within the study area were not uniform and were found to vary spatially, according to the proximity of noise sources, such as existing major roads, watercourses, commercial properties and entertainment venues. The variation in ambient noise levels within and between settlements was found to depend primarily on the distance from the M6 main road. At locations away from the road, noise levels in villages through which the road passes (e.g. Sekirnik) were comparable to noise levels measured in villages far from the road.
(e.g. Ilovica). The dominant noise sources identified at each monitoring location were noted during the survey and are listed below in order of their relative contribution:

- Met Station – bird calls, insects, wind rustling of vegetation;
- Monastery of St George – nearby watercourse, bird calls, insects, wind rustling vegetation;
- Ilovica 1 – bird calls and occasional nearby road traffic movements;
- Ilovica 2 – bird calls, conversations of villagers, wind rustling vegetation;
- Shtuka – bird calls, domestic animals (chickens, dogs, horses), local traffic movements (tractors, cars);
- Turnovo – wind rustling vegetation, bird calls, insect noise, tractor movements in fields;
- Sekirnik – bird calls, wind rustling vegetation, tractor movements in fields, distant traffic on M6;
- Novo Selo - bird calls, nearby conversations and traffic;
- Samuilovo – bird calls, road traffic on M6, insect noise, domestic animals; chickens and pigs; and
- Novo Konjarevo - bird calls, road traffic on M6; cars, tractors, heavy trucks, villager conversations/activity.

2.5.3 Vibration Baseline

No existing sources of blast vibration were identified within the LSA. Continuous vibration (produced by road traffic, construction activities and industrial sources) propagates over comparatively small distances, in the order of tens of metres. Other than at locations immediately adjacent to the roadside, baseline vibration levels in the study area were therefore assumed to be zero, and as such, no baseline vibration survey was completed.

2.6 Air Quality

Baseline air quality monitoring commenced in December 2013 and continued until June 2015. The primary objective was to monitor the existing atmospheric conditions in the vicinity of the proposed mine at identified sensitive receptors, the majority of which lie within the nearby villages. Air quality monitoring was undertaken at eight representative locations within the study area (Table 2-10).

<table>
<thead>
<tr>
<th>Name</th>
<th>Coordinates (UTM Zone 34T)</th>
<th>Elevation (masl)</th>
<th>Description of location</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKD1</td>
<td>654815 4595458</td>
<td>794</td>
<td>On-site meteorological station</td>
</tr>
<tr>
<td>MKD2</td>
<td>653654 4593950</td>
<td>556</td>
<td>On-site to south of the ore body, east of area of additional facilities to support mining operations.</td>
</tr>
<tr>
<td>MKD3</td>
<td>651907 4593759</td>
<td>326</td>
<td>Water treatment plant north-east of Ilovica village</td>
</tr>
<tr>
<td>MKD4</td>
<td>652069 4593073</td>
<td>349</td>
<td>East of Shtuka, close to route of proposed access road</td>
</tr>
<tr>
<td>MKD5</td>
<td>650998 4593018</td>
<td>277</td>
<td>South of Ilovica, close to the TuriJA canal</td>
</tr>
<tr>
<td>MKD6</td>
<td>649098 4590216</td>
<td>212</td>
<td>North-east of Turnovo centre</td>
</tr>
<tr>
<td>MKD7</td>
<td>650004 4589828</td>
<td>211</td>
<td>West of Sekirnik, close to the M6 road</td>
</tr>
<tr>
<td>MKD8</td>
<td>653555 4590536</td>
<td>250</td>
<td>North-west of Sushica</td>
</tr>
</tbody>
</table>

Substance specific diffusion tubes for NO, NO₂, SO₂ and O₃ were deployed at each of the eight monitoring locations (NOₓ is calculated by the sum of the results from NO₂ and NO). The tubes were co-located with Frisbee type deposited dust gauges, which concurrently gathered average dust deposition rates.

In addition, a Turnkey Optical Scattering Instantaneous Respirable Indication Sensor (OSIRIS) particulate monitor was used to gather long term data at the Ilovica village water treatment plant. Short term monitoring was also completed at MKD3, MKD4 and MKD7 to provide indicative values, which have not been presented.
here. The OSIRIS unit simultaneously measured particulate matter sized from 1 μm (PM$_1$), 2.5 μm (PM$_{2.5}$) and 10 μm (PM$_{10}$).

The monitoring results are summarised in Table 2-11 and are detailed in the air quality baseline (Section 9, Annex 3). Overall, the baseline monitoring indicates that ambient air quality within the study area is below the Environmental Design Criteria (EDC). Table 2-11 summarises the long-term annual background concentrations for each pollutant, measured at each monitoring location.

Table 2-11: Long-term annual background concentrations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Annual EDC$^{(a)}$</th>
<th>MKD1</th>
<th>MKD2</th>
<th>MKD3</th>
<th>MKD4 (Sekirnik)</th>
<th>MKD5 (Ilovic)</th>
<th>MKD6 (Turnova)</th>
<th>MKD7 (Sushica)</th>
<th>MKD8 (Shutka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_x$ (μg/m$^2$)</td>
<td>30 (habitats)</td>
<td>7.34</td>
<td>7.08</td>
<td>8.80</td>
<td>9.31</td>
<td>11.53</td>
<td>12.12</td>
<td>16.50</td>
<td>9.73</td>
</tr>
<tr>
<td>NO$_x$ (μg/m$^2$)</td>
<td>40 (human health)</td>
<td>1.49</td>
<td>2.11</td>
<td>3.17</td>
<td>3.61</td>
<td>7.05</td>
<td>6.78</td>
<td>9.96</td>
<td>4.95</td>
</tr>
<tr>
<td>SO$_2$ (μg/m$^2$)$^{(b)}$</td>
<td>20 (habitats)</td>
<td>1.91</td>
<td>2.03</td>
<td>1.34</td>
<td>1.62</td>
<td>1.50</td>
<td>1.31</td>
<td>1.32</td>
<td>1.62</td>
</tr>
<tr>
<td>PM$_{10}$ (μg/m$^2$)$^{(c)}$</td>
<td>40 (human health)</td>
<td>n/a</td>
<td>n/a</td>
<td>11.86</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>PM$_{2.5}$ (μg/m$^2$)$^{(c)}$</td>
<td>20 (human health)</td>
<td>n/a</td>
<td>n/a</td>
<td>4.75</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Deposited dust (mg/m$^2$/day)</td>
<td>350 (amenity)</td>
<td>28.51</td>
<td>25.49</td>
<td>28.79</td>
<td>26.59</td>
<td>28.35</td>
<td>87.84</td>
<td>64.66</td>
<td>54.99</td>
</tr>
</tbody>
</table>

Abbreviations: mg/m$^2$/day = milligram per square metre per day; NO$_x$ = oxides of nitrogen; NO$_x$ = nitrogen dioxide; SO$_2$ = sulphur dioxide; μg / m$^2$ = micrograms per cubic metre

Notes:  
$^{(a)}$ Environmental design criteria (EDC) were established for three fields: protection of human health, protection of habitats and protection from loss of amenity. These limits apply as indicated in the table. Please refer to Section 5.6.5 for a full list of EDC.  
$^{(b)}$ No annual EDC for human health for this parameter. Please refer to Table 5-58 for the EDC for shorter averaging periods.  
$^{(c)}$ Long-term particulate monitoring was undertaken at MKD3 only.

2.6.1 NO$_x$ Results

Ambient NO$_x$ concentrations are relatively consistent across the study area, although variation is observed between lower concentrations in more rural locations and higher concentrations at locations closer to the roads and combustion sources in villages. Ambient concentrations across the study area are below the EDC limits for the protection of human health. Measured concentrations are also below EDC limits for the protection of ecosystems.

2.6.2 SO$_2$ Results

In the absence of significant local emission sources, ambient SO$_2$ concentrations are consistent across the study area, with little difference between rural locations and at locations closer to the roads and villages. Ambient concentrations across the study area are below EDC limits for the protection of human health. Measured concentrations are also below EDC limits for the protection of ecosystems.

2.6.3 Deposited Dust Results

Measured levels of deposited dust are typically higher closer to roadside locations than in other parts of the villages or in rural locations. The levels of measured deposited dust are influenced by meteorological conditions, with higher concentrations measured during dry summer periods with high winds. Measured deposition levels are below EDC limits on an annual and monthly average basis, although it is recognised that particular episodes may occur on a shorter term basis of a few hours.

2.6.4 Particulate Matter Results

Long term monitoring of PM$_{10}$ and PM$_{2.5}$ indicates that annual average levels are below the EDC limits, however short term periods of elevated concentrations were observed in the data. The periods of elevated concentrations were typically short, of up to an hour, following which concentrations returned to typical levels. Short term monitoring at other locations within the study area indicates the potential for higher ambient concentrations at locations closer to the M6, particularly Sekirnik, reflecting the trend in measured dust deposition levels. Whilst monitoring at Sekirnik was limited to a short period (approximately 10 days),
extrapolation of the measured levels indicates that PM$_{10}$ and PM$_{2.5}$ concentrations will remain below EDC annual limits. PM$_{10}$ data averaged over 24 hours at MKD3, MKD4 and MKD7 indicate that concentrations should also remain below the EDC daily limit.

2.7 Greenhouse Gas Assessment

There was no baseline data gathering specifically relating to the greenhouse gas assessment.

2.8 Biodiversity & Ecology

The following summary of ecology and biodiversity attributes, relevant to the impact analysis and assessment, is wholly derived from the biodiversity and ecology baseline report which can be found in Section 10 of Annex 3. Descriptions and justification for boundaries of the LSA and the RSA are also provided in the baseline report. The LSA comprises the area wherein potential project effects to biodiversity may occur, whereas for many taxa the RSA provides a more appropriate regional scale in which the ecological significance of LSA impacts can be assessed. The baseline study results, documented within Section 10, Annex 3, were derived from the following sources:

- Existing baseline data associated with the RSA/LSA where available;
- Desk-based review of literature and online sources consulted for background information on the regional biodiversity; and
- Field studies undertaken between autumn 2013 to summer 2015 inclusive, with a focus on the LSA.

2.8.1 Terrestrial Habitats and Species

The Mediterranean Biodiversity hotspot, which partially overlaps with the LSA and RSA (Figure 2-2), is noted for the diversity of its plants. About 25,000 species are native to the region, and more than half of these are endemic (found nowhere else on earth). This has led to the Mediterranean being recognised as one of the first 25 Global Biodiversity Hotspots (Myers, et al., 2000). It is important to note that the RSA and LSA are situated on the northern boundary of the hotspot and the characteristic endemic species referred to by Myers, et al., (2000) are absent from the RSA. Both the Mediterranean Biodiversity hotspot and Balkan Green belt (Figure 2-2) transect a number of countries over a continental scale. The Mediterranean Biodiversity hotspot extends from Cape Verde off the west coast of Africa to Eastern Turkey, while the Balkan Green Belt forms part of the European Green Belt that extends from Greece and Turkey in the south to the northern extent of Norway and Finland.
Habitat diversity in the vicinity of the Project includes intensive arable production in the Strumica valley which contrasts with the unimproved pastures that become more species-rich with greater altitude toward the sources of the Jazga and Shtuka streams. Forest communities are represented by broadleaved riverine (salix) fringes, boreo-alpine riparian galleries and continental (Quercus petraea) forests. Many of the forest communities are subject to licenced and un-licenced felling which in many cases has resulted in large areas of coppice regeneration growth rather than standard trees in evidence.

2.8.1.1 Ecosystems and habitats

Habitat quality within the LSA is underlined, to some extent, by the presence of species such as the large blue butterfly (Phengaris arion) a species listed as endangered at the European scale by the IUCN. The potential Annex I grassland communities, namely Balkanic montane Nardus stricta swards and Helleno-Balkanic short grass and therophyte communities are situated in discrete locations within the LSA. However, the grasslands are not extensive and are currently in poor ecological condition, fragmented and of low importance at the national scale (Micevski, 2015a, pers. comm.). Despite considerable anthropogenic pressure being applied to many of the forest and grassland communities within the LSA, ecosystem value is noted. Pressure on timber resources from logging and grassland communities from over-grazing and nutrient contribution is most evident at the lower altitudes of the LSA in congruence with the presence of access tracks and ease of accessibility. This pressure has resulted in natural habitats becoming at best semi-natural; and more modified habitat as a result. In contrast, communities such as the Beech/pine forest (Fago-pinetum silvestris) and Beech forest, sub-type 2 (Calamintho grandiflorae-Fagetum) can be considered more natural possibly owing to the lack of access and subsequent harvesting pressure at higher altitudes. Grasslands above 800 masl are generally more species rich as a result of lower nutrient contribution from grazing animals. The diversity of flora that had developed in these areas appears to be of value to the Lepidoptera order of insects which are most diverse in these locations (Figure 2-3; Micevski, 2015a, pers. comm.).
Figure 2-3: Pasture and forestry mosaic above 800 masl within the LSA.

2.8.1.2 Forest and scrub communities

Vegetation within the LSA is dominated by sessile oak forest (*Orno-Quercetum petreae*) which covers 1,447 ha (Drawing 10-4, Annex 3). Extents of other forest communities and habitat types are given in Table 2-12.

Table 2-12: LSA habitats and forest communities

<table>
<thead>
<tr>
<th>Habitats</th>
<th>Surface area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td>1,107</td>
</tr>
<tr>
<td>Settlements and fields</td>
<td>939</td>
</tr>
<tr>
<td>Standing water (reservoir)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Forest communities</strong></td>
<td></td>
</tr>
<tr>
<td>Sessile oak forest (<em>Orno-Quercetum petreae</em>)</td>
<td>1,447</td>
</tr>
<tr>
<td>Turkey oak forest (<em>Quercetum frainetto cerris</em>)</td>
<td>905</td>
</tr>
<tr>
<td>Oak and hornbeam forest (<em>Querco-Carpinetum orientalis</em>)</td>
<td>704</td>
</tr>
<tr>
<td>Beech forest, sub-type 1 (<em>Festuco heterophyllae-Fagetum</em>)</td>
<td>668</td>
</tr>
<tr>
<td>Beech forest, sub-type 2 (<em>Calamintho grandiflorae-Fagetum</em>)</td>
<td>279</td>
</tr>
<tr>
<td>Beech/pine forest (<em>Fago-pinetum silvestris</em>)</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,081 ha</strong></td>
</tr>
</tbody>
</table>
2.8.1.3  Species-rich pasture

Notable results from the baseline study were the presence of two grassland communities that potentially correspond with Annex I of the Habitat Directive (fragmented and partially degraded examples of Balkanic montane *Nardus stricta* swards and *Helleno-Balkanic* short grass and therophyte communities). Provisions of the habitat directive require member states to maintain these types of habitats at a favourable conservation status. Some of this habitat is present as shown in Figure 2-2 ‘Pasture and Forestry mosaic above 800 m’.

2.8.1.4  Natural and modified habitats

Pastures, forest and hay meadows have been defined as ‘natural’ if there has not been any significant modification due to coppicing, clear felling, addition of inorganic fertilisers or reseeding.

As described within the biodiversity and ecology baseline report (Section 10, Annex 3) much of the oak/hornbeam forest (*Querco-Carpinetum orientalis*) and sessile oak forest (*Orno-Quercetum petraeae*) is modified by frequent and extensive clear cut felling through licenced and un-licenced operations as observed during 2014 and 2015 field surveys. Areas of forestry which are more inaccessible within the LSA exhibit lower levels of modification with older trees in evidence.

2.8.1.5  Prime butterfly area

Much of the LSA is designated by Butterfly Conservation Europe as a Prime Butterfly Area (PBA; Figure 2-2). Prime butterfly areas are designated throughout Europe at a considerable scale. Indeed, PBAs cover more than 21 million ha across the continent and this equates to 1.8% of the European total land cover (Van Swaay and Warren, 2003). The aim of the PBA network is to ‘identify the Prime Butterfly Areas in Europe where conservation efforts should be focussed as a matter of urgency.’ The Ogražden PBA, like 56% of other PBAs in Europe does not receive any form of National protection (Van Swaay and Warren, 2003).

The Ogražden PBA stretches from the village of Ilovica upstream along the Jazga River toward the highest peak of Ogražden (1745 m) (Van Swaay and Warren, 2003). The designating butterfly species of the PBA are:

- Large blue (*Phengaris arion*); and
- Apollo (*Parnassius apollo*).

In addition to the species listed above other notable species are described by Van Swaay and Warren (2003). The boundary of the PBA has not been delineated in a digital format by the designating authority. However, having consulted the publication ‘Prime Butterfly Areas in Europe: Priority Sites for Conservation’ (Van Swaay and Warren, 2003) an indicative boundary has been created (Figure 2-2).

2.8.1.6  Species richness

Flora and Fungi

A total of 271 of the most prominent vascular plant species were recorded within the LSA during baseline survey. Furthermore, 138 species of fungi were also recorded within the LSA.

Floral species of conservation concern (SoCC) include bladder campion (*Silene vulgaris*) which is described on the European Corine List of threatened species (endangered at European level). This species appears to be relatively widespread throughout the LSA occurring at transects 1, 3, 6, 15 and 18 (Biomaster, 2014). This is in accordance with IUCN review, which notes this species’ use of a wide range of habitats, but usually in more open areas (IUCN, 2016a). It is assessed as least concern by IUCN. Three more floral species, pyramidal orchid (*Anacamptis pyramidalis*), butterfly orchid (*Anacamptis papilionacea*) and green-winged orchid (*Anacamptis morio*) are listed on Annex II of the CITES Convention, implying that the species are not under threat of extinction but they are at risk if trade in these species proceeds without strict control (Biomaster, 2014). The orchids were not widespread being only observed on one transect (transect 18). None of these orchids have been assessed by the IUCN Red List as of January 2016.

Fungi included *Boletus quelletii*, which is listed on the provisional European red list of threatened fungi and is described as category B ‘evidence of steady decline, some national extinctions, medium-level concern’.
Furthermore, Caesar's mushroom (Amanita caesarea) is considered to be endangered at the National scale. Fungi were widespread throughout the LSA, however most were collected in pasture, oak and beech forest and pine plantations.

**Fauna**

Biodiversity, especially species richness, has been evaluated within the LSA over a number of years. It is evident that a high level of species richness occurs for the butterfly group including the Large Blue which is listed as EN in Europe by IUCN. The LSA includes approximately 40% of the butterfly species known to inhabit Macedonia and the unimproved species-rich pasture and scrub mosaic habitat clearly benefit this group of insects. Figure 2-4 shows relative Lepidoptera species-richness within the LSA, based upon transect surveys undertaken by Biomaster (2014). The three zones shown are based upon species richness (where high value is based upon transects where >30 species were recorded, medium value upon transects where >20 species were recorded and low value upon transects where <10 species were recorded). Where transect data was not available, habitat quality was considered in order to provide a qualitative judgement.

In addition, one moth species, Jersey Tiger (*Callimorpha quadripunctaria*), was quantitatively evaluated inside the LSA and RSA in 2014 (Biomaster, 2015 Jersey Tiger Moth Study). The Jersey tiger moth is listed on the Habitats Directive.

![Figure 2-4: Butterfly species-richness in accordance with transects and habitat modelling.](image)

The coleopterans present within the LSA are represented by a number of species of conservation concern (SoCC) afforded protection under the European Habitats Directive and at the National scale. Due to prominent IUCN and Habitats Directive conservation status, special attention was given to saprophytic beetles for which quantitative studies were undertaken. Coleopterans, dragonflies and other insect groups were collected widely throughout the LSA.
Over half of Macedonia’s herpetofauna (reptiles and amphibians) have been recorded within the LSA during baseline surveys. The vast majority of herpetofauna recorded during baseline surveys are afforded National or European protection under the Habitats Directive. Some of these species are considered to be common, widespread and of least conservation concern. However, two species of tortoise recorded are protected under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). These are the Hermann’s tortoise (*Eurotestudo hermanni*) and the Common tortoise (also known as the spur-thighed tortoise) (*Testudo graeca*). *Eurotestudo hermanni* was observed in many of the transects, however, *Testudo graeca* was only observed on transect 9 along the Shtuka River.

A considerable number of bird species were recorded within the LSA: 113 species or 36% of the total bird fauna of Macedonia. This avian community comprised of common and widespread species with no notable transitory or migratory assemblages recorded during surveys that extended over a number of seasons. The only congregatory species recorded during the spring migration was Calandra lark (*Melanocorypha calandra*), with flocks of hundreds of individuals recorded on arable fields before cultivation. Baseline surveys also targeted potential migratory routes for birds and bats that could be affected by the proposed powerline route which dissects the LSA (Figure 2-5, below).

Similarly, the mammal species encountered during baseline surveys are generally common and widespread. Exceptions are the barbastelle bat (*Barbastella barbastellus*) which is listed by IUCN as VU in Europe and Mehely’s horseshoe bat (*Rhinolophus mehely*) which is listed by IUCN as VU (Europe and Global), though no significant roosting habitats were positively identified. These species along with Schreiber’s bat (*Miniopterus schreibersi*) are also on the national red list. These species were not widespread in the LSA only being observed on a few transects.
2.8.2 Aquatic Habitats and Species

Aquatic habitat surveys targeted communities of aquatic, emergent and marginal vegetation along the riparian fringe of flowing and still (lotic and lentic) aquatic systems within the LSA assigning EUNIS categories to these communities. Floral composition was assessed to cover a range of altitudes, soil types and hydro-morphological conditions. The following habitat types were recorded:

- Reed bed;
- Willow (Salix) woodland;
- Small permanent streams; and
- Ephemeral streams.

Spatial coverage of these habitat types is presented within the baseline report (Section 10, Annex 3).

2.8.2.1 Fish

Fish presence/absence and stock assessment surveys were undertaken as described within the baseline report (Section 10, Annex 3). Nine species of fish were captured, all of which were common and widespread with no SoCC noted. All of the species caught are classified as least conservation concern by the IUCN. Some of these species are captured for recreation and are eaten by local people.

2.8.2.2 Decapods

Eight sites were sampled for the decapod study. Within these sites 44 micro-sites were assessed. Twenty eight micro-sites located in the LSA and sixteen in the RSA. A total of 22 micro-sites hosted decapods, with stone crayfish at 21 micro-sites and freshwater crab at only one micro-site on the Shtuka River. Throughout the RSA and LSA stone crayfish were observed as juvenile and adult forms at different stages of sexual maturity.

These results provided indications as to the preferable habitat for these species within the RSA. Stone crayfish is a protected species in Macedonia, listed on Habitats Directive-II and Bern I & III, but has not been evaluated by IUCN.

2.8.3 Critical Habitat

The European Bank for Reconstruction and Development (EBRD’s) Performance Requirement 6 (PR6) and Performance Standard 6 (IFC PS6 2012) and associated Guidance Note 6 (GN6) present the objectives and methodology.

The methods used for determining types of habitats (natural, modified and critical), plus the criteria on which the critical habitat is identified is presented in Section 1.4.3 and Annex 5G.

2.8.3.1 Critical Habitat Screening

The appropriate spatial unit for the Critical Habitat Assessment Area (CHAA) is considered to be the RSA. Species known or potentially present in the RSA were screened against each of the five primary criteria. The subset of species that might meet these criteria were then analysed to determine whether Critical Habitat (CH) is present within the RSA.

Areas designated of high biodiversity value for one or more species were also considered for CH designation under criteria 4 (described in Section 1.4.3 and Annex 5G). In the Impact assessment, where CH was determined to have been triggered, its spatial extent in the LSA was mapped using habitat maps derived from fieldwork and also using expert opinion. In addition, habitat modelling, desk based assessment and consultation with local experts created an informed opinion of likely CH within the RSA in order to effectively map CH within the CHAA.

Table 2-13 presents the results of the CH screening process.
### Table 2-13: Critical habitat screening and determination

<table>
<thead>
<tr>
<th></th>
<th>CH Trigger (Yes/No)</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Biodiversity Sites</strong></td>
<td></td>
<td><strong>Criterion 4.</strong> The PBA is relatively species rich. Especially for the lepidopteran group. The presence of species such as the large blue (Endangered) and the Apollo (Vulnerable) is relatively unique and this type of habitat is clearly threatened at the European level. This site is judged by specialists to comprise of regionally important faunal and habitat attributes (Micevski, 2015, pers. comm., 07 September 2015).</td>
</tr>
<tr>
<td>Ogražden Prime Butterfly Area (PBA)</td>
<td>Yes</td>
<td>Considered under criterion 4. It is important to note that the RSA and LSA are situated on the northern boundary of the hotspot and the characteristic endemic species referred to by Myers, et al., (2000) are absent from the RSA. As such, regardless of Project implementation¹, criterion 4 and CH is not triggered.</td>
</tr>
<tr>
<td>Mediterranean Biodiversity Hotspot</td>
<td>No</td>
<td>Considered under criterion 4. The RSA and LSA are situated on the northern boundary of the hotspot and the characteristic endemic species referred to by Myers, et al., (2000) are absent from the RSA. As such, regardless of Project implementation¹, criterion 4 and CH is not triggered.</td>
</tr>
<tr>
<td>Balkan Green Belt</td>
<td>No</td>
<td>Considered under criterion 4. The RSA represents a virtually immeasurable fraction of this feature (site). The Balkan Green Belt forms part of the European Green Belt that extends from Greece and Turkey in the south to the northern extent of Norway and Finland. This feature is designed to promote ecological connectivity. As such, regardless of Project implementation, criterion 4 and CH are not triggered.</td>
</tr>
<tr>
<td><strong>Flora</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bladder campion (<em>Silene vulgaris</em>)</td>
<td>No</td>
<td>Considered under criterion 1. This species is classified as endangered and afforded protection. <em>Silene vulgaris</em> is widespread in the Mediterranean region, most parts of Europe, Macaronesia, Asia (to Siberia, the Russian Far East (west and east Siberia, Sakhalin, the Kamchatka Peninsula), China, India (Kashmir) and Nepal), and North Africa (Rankou <em>et al.</em>, 2015). The extent of occurrence (EOO) is greater than 20,000 km². The CHAA does not support &gt;10% of the European range for this species (Rankou <em>et al.</em>, 2015). As a maximum (assuming the minimum EOO) the RSA would amount to 2.7% of available habitat. Furthermore, it is not considered a regionally important population (Micevski, 2016, pers. comm., 26 October 2016).</td>
</tr>
<tr>
<td>Orchid species (multiple)</td>
<td>No</td>
<td>Considered under criterion 1. Pyramidal orchid, butterfly orchid and green-winged orchid are listed on Annex II of the CITES Convention, implying that the species are not under threat of extinction but they are at risk if trade in these species proceeds without strict control (Biomaster, 2014). These species are widely distributed throughout south western Eurasia⁷. The extent of occurrence (EOO) is greater than 20,000 km². The CHAA does not support &gt;10% of the European range for this species (Rankou <em>et al.</em>, 2015). As a maximum (assuming the minimum EOO) the RSA would amount to 2.7% of available habitat. Furthermore, it is not considered a regionally important population (Micevski, 2016, pers. comm., 26 October 2016).</td>
</tr>
</tbody>
</table>

¹ CH is triggered, or not, as the case may be at the baseline stage without consideration of effects attributed by a Project.

<table>
<thead>
<tr>
<th>CH Trigger (Yes/No)</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balkanic montane <em>Nardus stricta</em> swards and <em>Helleno-Balkanic</em> short grass and therophyte communities</td>
<td>No</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
</tr>
<tr>
<td>Barbastelle bat (<em>Barbastella barbastellus</em>)</td>
<td>No</td>
</tr>
<tr>
<td>Mehely’s horseshoe bat (<em>Rhinolophus mehelyi</em>)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Invertebrates</strong></td>
<td></td>
</tr>
<tr>
<td>Large Blue (<em>Phengaris arion</em>)</td>
<td>Yes</td>
</tr>
<tr>
<td>Long-horn beetle (<em>Morimus funereus</em>)</td>
<td>No</td>
</tr>
<tr>
<td>Rosalia longicorn (<em>Rosalia alpina</em>)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Decapods</strong></td>
<td></td>
</tr>
<tr>
<td>Stone crayfish (<em>Austropotamobius torrentium</em>)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
</tr>
</tbody>
</table>
Baseline results were also screened under PS6 criterion 5 (EDGE species). Information was sought from the Zoological Society of London (2015) and local experts (Biomaster). No species or habitats present within the RSA triggered criterion 5 critical habitat.

2.8.3.2 Critical habitat results

A total of thirteen sites, habitats and species were screened for critical habitat in accordance with the methods stated within Table 2-17. These features were screened under critical habitat criteria 1 (Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species) and 4 (Highly threatened and/or unique ecosystems). Critical Habitat was triggered under criteria 1 (tier 2) for the presence of the large blue butterfly. Additionally, critical habitat was triggered under criteria 4 (the Ogrążden PBA) on account of lepidopteran relative species-richness which contribute to a site which is considered by specialists to be regionally important and threatened at the European level (Micevski, 2015, pers. comm., 07 September 2016).

Whilst the PBA and its qualifying features have been evaluated as CH it is important to emphasize that the PBA contains habitat of differing biodiversity values. Indeed, much of the PBA includes cultivated arable habitat and settlements that include Ilovica and Shtuka. As defined previously lepidopteran species-richness and the presence of large blue are generally associated with grasslands above 800 masl. As such, it is presently understood that critical habitat spatially corresponds with zone 1, Figure 2-4. Natural habitat dominates the LSA. A total of 3738 ha of natural habitat (61.5%) occurs within the LSA with an additional 1225 ha (20.1%) of modified habitat and 1113 ha of Critical Habitat (18.3%) defining the LSA.
2.9 Ecosystem Services

Ecosystem services are the direct and indirect contributions made by ecosystems to human well-being and also to project performance. They are generally classified into four types (adapted from the Millennium Ecosystem Assessment, 2003):

- **Provisioning services**: the goods or products obtained from ecosystems, such as food, timber, fibre, and fresh water;
- **Regulating services**: the contributions to human well-being arising from an ecosystem’s control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards;
- **Cultural services**: the non-material contributions of ecosystems to human well-being, such as recreation, spiritual values, and aesthetic enjoyment; and
- **Supporting services**: the natural processes that are needed to maintain the other services, such as primary production.

The overall objective is to mitigate project impacts on “priority** ecosystem services so that the benefits people derive from these services are maintained when the Project is developed, operated and then closed. Similarly, 

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8 Priority ecosystem services are those services on which project impacts affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries, and those services that could prevent the project from achieving planned operational performance.
for services used and depended on by a Project, the goal is to ensure that there will be a sustainable supply throughout the Project’s planned operational life.

Despite considerable anthropogenic pressure being applied to many of the forest and grassland communities within the LSA, ecosystem value is noted. Pressure on timber resources from logging and grassland communities from over-grazing and nutrient contribution is most evident at the lower altitudes of the LSA in congruence with the presence of access tracks and ease of accessibility. This pressure has resulted in natural habitats becoming at best semi-natural; and more likely modified habitat as a result. In contrast, communities such as the Beech/pine forest (*Fago-pinetum silvestris*) and Beech forest, sub-type 2 (*Calamintho grandiflorae-Fagetum*) can be considered more natural owing to the likely lack of access and subsequent lower harvesting pressure at higher altitudes. Grasslands above 800 masl are generally more species rich as a result of lower nutrient contribution from grazing animals.

Ecosystem services presented in Table 2-14 comprise the following services (Landsberg *et al.*, 2011):

- Priority ecosystem services on which project impacts may affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries (highlighted in red text);
- Priority ecosystem services that could prevent the project from achieving planned operational performance e.g. water supply, regulation of flow and erosion control (highlighted in italicised green text); and
- Non-priority services (presented in black text).

### Table 2-14: Summary of Ecosystem Services Within the Local Study Area

<table>
<thead>
<tr>
<th>Provisioning</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food from:</strong></td>
<td></td>
</tr>
<tr>
<td>- Livestock</td>
<td>Animals are raised for meat and milk;</td>
</tr>
<tr>
<td>- Apiculture (bee keeping)</td>
<td>Honey is produced for family use and also likely small-scale trade;</td>
</tr>
<tr>
<td>- Arable, fruit and vegetable production</td>
<td>Local communities grow crops, vegetables and fruit;</td>
</tr>
<tr>
<td>- Capture fisheries</td>
<td>Some artificially stocked fish are captured and eaten by the local community;</td>
</tr>
<tr>
<td>- Wild foods (fungi/snails)</td>
<td>Edible plant species and snails are gathered in the wild. Residents of both Ilovica and Shtuka trade in commodities (<em>Biomaster</em>, 2015 and 2016a); and</td>
</tr>
<tr>
<td>- Hunting</td>
<td>Hunting is popular and species such as partridge, wolf and boar are shot. Wild and introduced game are both targeted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biomass fuel and timber</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Firewood is gathered for personal and commercial benefit; and</td>
<td></td>
</tr>
<tr>
<td>- Timber may be harvested for building and furniture making.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freshwater/Freshwater</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public water supplies are obtained from the Jazga and Shtuka Rivers and from groundwater sources (Annex 3, Chapter 5).</td>
<td></td>
</tr>
</tbody>
</table>

**Surface water sources**

The following are public water supply sources in the project catchments:

- One intake on the Jazga River upstream of Ilovica;
- Two intakes on the Shtuka River upstream of Shtuka; and
- Ilovica Reservoir, located on the Jazga River upstream of Ilovica, supplies water to seven villages on Strumica plain (Bosilovo, Sekirnik, Turnovo, Radovo, Borievo, Ednokukjevo and Robovo) and Shtuka in the summer and Ilovica in particularly dry years. The reservoir also supplies water for agricultural irrigation in and around Ilovica and Shtuka villages (this is referred to by villagers as the ‘technical water’ supply)

**Groundwater sources**

- Two spring sources in Ilovica and Shtuka;
- Wells and boreholes which are used to supply water to households within Ilovica and Shtuka villages;
Comprehensive information regarding ecosystem services identified within the prescribed study area can be found within the Ecosystem Services baseline (Annex 3, Chapter 11). Additionally, graphic representations of the indicative priority services distribution within the LSA is provided in Figure 2-7. The spatial occurrence of ecosystem services is derived from formal consultation, field observation and preliminary findings achieved through the development of the Land Acquisition and Resettlement Framework (LARF) plan.
Figure 2-7. Indicative spatial occurrence of ecosystem services derived from preliminary findings achieved through the development of the Land Acquisition and Resettlement Framework (LARF) plan.

2.10 Cultural Heritage

The cultural heritage baseline study is presented in the ESIA baseline (Section 12, Annex 3). The baseline cultural heritage conditions were characterised through a combination of desk-based study, community consultation and archaeological survey. All potential receptors were collated and mapped, with each given a unique identifier (Golder ID). The unique Golder ID for each potential receptor includes a two letter prefix, which defines the receptor type, followed by a sequential numbering system. Where multiple features of interest were recorded at the same receptor, the Golder ID contains a suffix to differentiate between features. This suffix is a lower case letter (e.g. ‘a’, ‘b’, ‘c’). Broad receptor type categories were derived from a high level appraisal and rationalisation of the dataset. These categories comprise:

- Structures of architectural interest – AI;
- Archaeological sites – AR;
- Cemeteries – CE;
- Mosques – MQ;
- Churches – CH;
- Natural features – NF;
- Communal features – CM;
- Sites of religious/ritual significance – RE;
- Historic events – HE;
- Spring sites – SP.
2.10.1 ‘Living’ Cultural Heritage

Fifty-three potential ‘living’ cultural heritage receptors were recorded during the baseline study. These include contemporary, tangible sites such as cemeteries and communal cultural assets. A brief summary of these is presented in Table 2-15.

Table 2-15: Summary of potential ‘living’ cultural heritage receptors recorded during baseline study

<table>
<thead>
<tr>
<th>Location/associated settlement</th>
<th>Cultural heritage receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project footprint</td>
<td>Two receptors were recorded: a spring site with an inscribed memorial stone and a waterfall that is a focal point for collecting plants of the Geranium genus, a plant which has ritualistic significance, specifically in relation to Easter celebrations.</td>
</tr>
<tr>
<td>Ilovica</td>
<td>Fourteen receptors were recorded: two cemeteries, a church, a mosque, three sites of religious/ritual significance, five springs, a communal feature (Ilovica Cultural Centre) and the site of an historic event.</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Nine receptors were recorded: two cemeteries, two churches, a site of religious/ritual significance, two springs, a communal feature (Shtuka Cultural Centre) and the site of an historic event.</td>
</tr>
<tr>
<td>Turnovo</td>
<td>Two receptors were recorded: a cemetery and a church.</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Five receptors were recorded: a cemetery, two churches, a communal feature (Sekirnik Park) and a structure of architectural significance.</td>
</tr>
<tr>
<td>Sushica</td>
<td>Six receptors were recorded: a cemetery, a church, a communal feature (the Sushica Cultural Centre), a former mosque and two springs.</td>
</tr>
<tr>
<td>En-route to Bulgarian border9</td>
<td>Six receptors were recorded: four churches, a monastery and a site of religious/ritual significance.</td>
</tr>
<tr>
<td>Wider region10</td>
<td>Nine receptors were recorded: eight churches and a monastery.</td>
</tr>
</tbody>
</table>

2.10.2 Intangible Cultural Heritage

The following three elements of intangible cultural heritage were recorded during the baseline study: religious beliefs and practices, traditional music and dance, and a traditional agricultural way of life.

- Orthodox Christianity and Islam are prominent faiths in the region, with Catholicism also practiced by a minority of the population. These religious beliefs are sincerely held and actively practiced throughout the region. Religious holidays and festivals are an important aspect of the cultural heritage of the population.

- Traditional music and dance, relating in particular to the Rusalii tradition, is preserved and commemorated in a number of the settlements, with an annual meeting of Rusalii dance groups held in Sekirnik.

- The traditional agricultural way of life is widespread and is observable in the landscape.

2.10.3 Archaeology

Seventy-six potential archaeological receptors were recorded during the baseline study, with a total of twelve located within, or in close proximity to, the proposed project footprint. These twelve receptors comprise a variety of archaeological site types, including settlements, burials and sites of historical industry. Varnica (AR-01) and Crkvishte (AR-04) are the only receptors in proximity to the project footprint which have been ascribed a date, with both believed to be Late Antiquity period sites (an archaeological chronology for Macedonia is presented in the cultural heritage baseline; Section 12, Annex 3). Exact dates remain unknown for the other ten receptors.

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9 Includes Novo Selo, Samuilovo and Novo Konjarevo.
10 Includes Drvosh, Radovo, Borievo, Monospitovo, Zubovo, Babarevo and Stinik.
2.11 Landscape and Visual

A baseline study was undertaken to identify the aesthetic quality of the landscape within and around the proposed mine and to identify the location and sensitivity of viewers within the Strumica Valley. The landscape baseline established the key characteristics and classification of the landscape within and adjacent to the concession area and identified areas/features most susceptible to change. The visual baseline identified potential visual receptors, particularly local residents within 25 km of the mine, from which the Project would be visible. The findings of the landscape and visual baseline study assessment can be found in Section 13 of Annex 3 to the ESIA.

The key elements of the baseline used in the impact assessment are summarised below.

2.11.1 Landscape Baseline

The characteristics of the landscape within and surrounding the proposed mine development were assessed based upon:

- 1:25,000 scale maps of the Strumica Valley and the surrounding mountains,
- Digital terrain data;
- High resolution aerial imagery; and
- Field observations.

The baseline assessment identified significant variation in the character and scenic quality of the landscape within the vicinity of the mine. The Strumica Valley is predominantly flat agricultural land, which contrasts with the mountain forests which rise steeply either side of the valley. Within this context, more subtle variations in characteristics were identified, determined primarily by land use, landform, and the type and density of vegetation cover.

The study identified areas displaying similar characteristics, referred to as ‘landscape character areas’ (LCAs), made up of recognisable patterns or elements (physical and perceptual) that occur consistently in a particular area and define the character and scenic quality of the landscape. Six LCAs were identified within or adjacent to the project area. These are described in the baseline report (Section 13, Annex 3) and are summarised in Table 2-16.

Table 2-16: Summary of landscape character areas

<table>
<thead>
<tr>
<th>LCA</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCA 1</td>
<td><strong>Open Agricultural Plain</strong>: defined by the flat, open and highly productive land within the flat Strumica Valley which supports intensive market gardening (the main land use in the valley).</td>
</tr>
<tr>
<td>LCA 2</td>
<td><strong>Agricultural Plain with Trees</strong>: defined by the flat productive land within the flat Strumica Valley and differs from the open plains by virtue of increased tree cover and semi-enclosed fields.</td>
</tr>
<tr>
<td>LCA 3</td>
<td><strong>Mountain Forest</strong>: defined by the oak forest on the rising ground either side of the Strumica Valley, which provides an attractive backdrop to the majority of the low-lying land in the valley bottom.</td>
</tr>
<tr>
<td>LCA 4</td>
<td><strong>Undulating Pasture/Scrub</strong>: defined by undulating pasture and scrub mostly occupying the lower slopes between the steep mountain sides and the valley floor.</td>
</tr>
<tr>
<td>LCA 5</td>
<td><strong>Vegetated River Corridor</strong>: defined by undulating pasture and scrub mostly occupying the lower slopes between the steep mountain sides and the valley floor</td>
</tr>
<tr>
<td>LCA 6</td>
<td><strong>Settlements</strong>: defined by the settlement boundaries and includes the town of Strumica and the villages in the Strumica Valley.</td>
</tr>
</tbody>
</table>

At the baseline stage, the majority of the Project footprint (including the access road and the powerline) was located within three LCAs:

- LCA 1 Open Agricultural Plain;
LCA 3: Mountain Forest; and
LCA 4: Undulating Pasture/Scrub

The key issues identified as requiring further consideration during effects analysis were:

- Identification of the LCAs affected by the project footprint; and
- Assessment of potential changes to landscape character within the LCAs affected, in order to inform appropriate measures to improve landscape integration.

### 2.11.2 Visual Baseline

The baseline visual assessment included Zone of Theoretical Visibility (ZTV) mapping and analysis to identify potential visual receptors, using digital terrain data at 30 m resolution. ZTV mapping was undertaken prior to field work, was based on preliminary mine design and covered a radius of 25 km from the approximate centre of the project area. Preliminary ZTVs were produced for the TMF (Drawing 13-2), the Open Pit (Drawing 13-3), the powerline (Drawing 13-4), The Process Plant (Drawing 13-5), the Workshop area (Drawing 13-6), and the Crusher (Drawing 13-7). All Drawings are presented in Annex 3, Section 13.

ZTV analysis indicated that due to the elevated position of the Project on the side of the Ogražden Mountains, one or more components of the project would be potentially visible from 32 settlements and a number of public/cultural viewpoints within the study area.

Preliminary analysis also indicated that parts of the mine (mainly the TMF) would be theoretically visible from the visitor attractions on the lower slopes of the Belasica mountain range and from the Tumba Peak. These locations were not visited during the field surveys, although ‘Google’ images indicated the waterfalls at Smolare and Koleshino are locally screened by mature woodland. Unrestricted views would be possible from Tumba Peak, although from this elevated viewpoint and at a distance in excess of 17 km it was considered unlikely that the proposed mine would affect its setting or the quality of the views from this strategic viewpoint.

A key part of the baseline study was the photographic recording of the views from the settlements and other key locations from which theoretical views of the mine were possible. Villages and other viewpoints within 25 km of the mine were visited in June 2015 to assess the type and quality of the existing view and the amount of screening afforded by intervening vegetation and structures not picked up on the ZTV computer model.

To assist in the assessment of visual effects, preliminary visualisations, which correspond to the site photographs, were produced from each viewpoint, showing the existing topography, preliminary mine footprint and the mine concession area. The wirelines and photographs are provided in Appendix 13-D of the baseline report (Annex 3).

The baseline study included an assessment of viewer sensitivity based on the type of viewer and the importance of their view in relation to their activity (e.g. permanent views from houses compared to transient views from roads).

### 2.12 Socioeconomics

This section presents a summary of key topics in the socio-economic baseline. For a more detailed discussion of baseline socio-economic conditions, please refer to Section 14, Annex 3.

#### 2.12.1 Political Environment

In 1945, after World War II, the region known as Vardarska Banovina became a constituent socialist republic (Macedonia) within Yugoslavia. Following decades of tension between the Yugoslav republics and the consequent dissolution of Yugoslavia, the Republic of Macedonia was formed in 1991. The republic is divided into 80 municipalities spread over eight statistical regions, including 10 municipalities that, collectively, form the capital city of Skopje.

Since its formation, the Republic of Macedonia has been involved in a naming dispute with the nation of Greece. In summary, the dispute is based largely on the Greek position that, given that the broader historical kingdom of Macedonia extends beyond the borders of the present-day Republic of Macedonia, into Greece, it...
would be inappropriate for one nation to claim the sole title “Macedonia”. In response, the Republic of Macedonia has suggested that it does not lay exclusive geographic or historic claim to the name “Macedonia”, but given that the people of the republic are largely ethnically Macedonian, adopting the national title of “Macedonia” would not be inappropriate. Despite reconciliatory efforts between the two nations, this dispute remains unresolved. The naming dispute with Greece has created a road block to the accession of the Republic of Macedonia to the European Union.

2.12.2 National Economy

Macedonia’s GDP has been above average for southeast Europe since 2009 and is currently around US$25 billion (US$11,700 per capita), with an average real GDP growth of 1.5%. With continual investment in manufacturing and exports, GDP is expected to climb by 3.8% in 2016. While the nation’s trade deficit is high (17.8% in 2014), it has been decreasing in recent years, in part due to the lowering cost of oil and gas imports.

There are three types of taxes in the country:

- **Income:** 10% of all profits [corporate income tax]; 10% of gross incomes [personal income tax];
- **Consumption:** 18% of taxable turnover of goods, services and imports\(^1\) [Valued Added Tax]; and
- **Property:** 3% of property sale price [property transfer tax]; 0.1% of held land value [Property Tax].

The service sector is the largest contributor to the Macedonian economy, accounting for approximately 64% of GDP in 2012. Recent foreign investment has seen the manufacturing and metal/mineral production industries grow in their role as a major part of the national economy (i.e. 18% of GDP in 2012). The agriculture and construction industries contribute a further 10% and 8% to national GDP. The four sectors, services, industry, agriculture and construction, generate 51%, 24%, 19% and 7% of national employment, respectively.

2.12.3 Regional and Local Economy

The Southeast Region is a major national agricultural producer, and leader of processing and packaging. Arable land and market gardens comprise the majority of the agricultural land in the municipalities of Bosilovo (85%, or 6,528 ha) and Novo Selo (62%, or 5,318 ha). The Municipality of Bosilovo produces a large volume of vegetables, tobacco, grapes, grain and fruit and has relatively higher crop yields than Novo Selo.

Agriculture dominates economic activity in Ilovica and Shtuka. Most households (72%) maintain arable land, and receive an average net income (income less upkeep costs) agricultural income of €2,690 annually. Some (34%) households also maintain vineyards for personal consumption, or pasturable land (40% of households) for grazing livestock. In terms of crop production, potatoes are grown by most (72%) households, while fewer households grow tobacco (54%), peppers (19%) and grapes (17%). Corn (maize) is also grown for fodder in the fields around the villages.

Livestock production in the Southeast Region is largely focused on sheep, cattle, and goats. Few households in Ilovica and Shtuka raise livestock for sale, with cows and goats kept in small numbers for milk, pigs for meat, and chickens for meat and eggs. A few households keep flocks of sheep, and there are several small-scale (i.e. 50 head) cattle ranching operations run out of the villages. Supplementing incomes from agricultural activity, some villagers harvest mushrooms on the forested slopes of Ograzhden Mountain for sale at local markets and collection centres, and a few keep bees for small-scale honey production.

Young farmers in Ilovica and Shtuka face challenges due to the cost of acquiring land and farm machinery relative to the low income associated with farming. The government has responded with offers of subsidies and lines of credit targeted to this demographic. Other agricultural challenges include concerns about pesticide pollution and a lack of a municipal agricultural wholesale or stock market and lack of agricultural produce processing facilities.

\(^1\) 5% for select goods and services subject to preferential taxation, such as products for human consumption, agricultural use, water, medical goods, and those used in public service.
Non-agricultural industrial activity in the Southeast Region includes small-scale construction, manufacturing, and textiles. The manufacturing industry in Southeast Macedonia is concentrated in Strumica, and services the agricultural industry by producing shipping crates, packaging materials, and other items used by farmers. Food processing and packaging is also an important part of the local manufacturing industry, preparing local agricultural produce and other consumable goods for sale. Some manufacturing of ceramics, bricks and metal products also occurs in the city. Textile producers in the city focus largely on the manufacture of clothing, and boutique sales, while a smaller number produce industrial apparel and protective garments.

Mining has not been a major industry in the Southeast Region, with only a small feldspar mine on Ograzhdhen Mountain and the Buchim Copper and Gold Mine in operation. Limited forestry activity occurs in the area around Ilovica and Shtuka with wood being sold to local processing companies and used as fuel for domestic furnaces. Recreational hunting occurs in the region but due to the relatively low abundance of wildlife, seasonal limits are very low. Game species include deer, wild boar, rabbits, birds, and wolves.

2.12.4 Employment and Incomes

Nationally, 70% of the population aged 20 to 64 is economically active, with a higher representation of males than females in the labour force. The nation has a 29% unemployment rate, with a significantly higher unemployment rate of 52% for the population aged 15 to 25.

Labour force indicators are noticeably more favourable in the Southeast Region compared to other regions with the highest participation and employment rates (69.9% and 56.8%) and the lowest unemployment rate (18.8%) in the country. Textiles, tobacco production, agriculture, construction, catering and trade are the major employment generating industries in the Southeast Region, while agriculture is the dominant industry in the municipalities of Bosilovo and Novo Selo. Involvement in salaried employment in Ilovica and Shtuka is relatively low (20% of total population), with agriculture, construction, manufacturing and hospitality as the main industries associated with salaried employment. This does not suggest an unemployment rate of 80% in the villages. Conversely, most of those who are economically active and not employed in the waged economy are otherwise engaged in agricultural production and sale, or another form of self-employment.

Nationally, average monthly wages and salaries have been increasing since the early 2000s, more than doubling from 10,552 denars (€173) in 2001 to 21,145 denars (€347) for an average annual income of 254,000 denars (€4,164) in 2013. Incomes in the Southeast Region are lower than any other region in Macedonia, with average monthly wage incomes of 16,500 denars (€269) at the regional level (influenced by the industrial, manufacturing and service sectors) and 15,600 denars (€256) at the local level (influenced by the greater reliance on agricultural and seasonal employment). Average monthly incomes for local agricultural producers (i.e. not influenced by the waged economy) are lower still at 13,700 denars (€224).

Females engaged in salaried employment in Ilovica and Shtuka earned, on average, more than males due to their higher representation in healthcare, education and manufacturing industries compared to men. Pensions for women and men are similar but are below the minimum wage set for the employed.

2.12.5 Population

The population of the Republic of Macedonia is approximately 2.1 million, of which 173,383 (8.4%) reside within the Southeast Region. The country has an aging population, with a median age of 37.8 years. The majority (66%) of the country’s population identifies as ethnically Macedonian, with Albanians, Turks and Romani making up smaller proportions of the population (25%, 4% and 2%, respectively). The population in the Southeast Region is predominantly Macedonian, with Turks, Serbians and Roma people representing the other demographic groups. Population growth in the Southeast Region has been slow as people are leaving the region’s rural areas to work in the capital or in other parts of Europe, with the region experiencing a negative net migration balance of minus 4,743 between 1994 and 2002.

The populations of Ilovica (1,907) and Shtuka (781) differ demographically only slightly. Ilovica has a younger population (median age 35.0) than Shtuka (median age 36.0), and more even gender ratio of males to females (51:48 in Ilovica, compared to 54:46 in Shtuka). Ethnically, both communities are predominantly Macedonian, though small Turkish, Romani and Bulgarian populations do exist in Ilovica. The Bulgarian population is predominantly comprised of females who relocated to the villages for marriage. Most ethnic Macedonians
practice Orthodox Christianity, while Turks and Romani typically practice Islam. Both Ilovica and Shtuka have experienced the same out-migration characteristic of the Southeast Region, with many trained people moving for work, and many young people moving to larger centres where employment and education opportunities are more abundant.

2.12.6 Education

Enrolment in primary school is mandatory for children up to age 15 in the Republic of Macedonia. In the Southeast Region, the majority of the population aged 15 years and over had completed secondary school as their highest level of education (37%), followed by primary school (31%), while 28% of the population had not completed primary school in 2002. The regional portion of the population aged 15 and over without primary school may be decreasing with recent educational reforms.

In Ilovica and Shtuka, 32% of the population aged 18 and over has not completed primary school, while 36% has primary school as their highest level of education achieved. Males are more likely to have a technical secondary school diploma while females are more likely to have attended a general or vocational secondary school program. Females are less likely to complete primary school than males while the completion of higher education was similar between genders. Education focused on technical occupations is offered by secondary schools in Strumica and is centred on meeting the needs of current economic activity.

2.12.7 Health

Life expectancy in the Republic of Macedonia is 75.2 years. Diseases of the circulatory system are the leading cause of death nationally, in the Southeast Region and in Strumica, followed by respiratory diseases. Seasonal Air quality in the Southeast Region is of concern and contributes to respiratory illness (related to the burning of unseasoned timber in the winter months for heating and cooking). Smoking and alcoholism are major health problems facing the nation, and improvements have been called for in the financing and delivery of healthcare services related to these issues. Most healthcare services in the country are state-funded and free to all citizens and registered long-term residents. A private healthcare system is available at cost; however few choose or are financially able to opt into the system. Overall health in terms of life expectancy has improved in Ilovica and Shtuka in recent years, however obesity, diabetes and lung cancer are of increasing concern in the villages, as in the Southeast Region.

2.12.8 Infrastructure

Municipal services in the country are delivered and funded by municipalities. Lack of funding in the municipalities has resulted in poor delivery of municipal services (e.g. utilities, water treatment and distribution) in some areas and has been identified as a priority area for development across the country.

With no access to a shipping port, the majority of Macedonian exports (93%) were transported via road in 2014. The Southeast Region is connected by regional highways and roadways and local access roads. The country’s public enterprise rail system extends geographically from north to south and east to west, and across national borders with Kosovo, Serbia and Greece. There are, however, no rail lines that extend into the municipalities of Strumica, Bosilovo or Novo Selo. Air travel to and from the Republic of Macedonia is available, with international flights routing through Skopje and Ohrid.

The road system in the Republic of Macedonia connects its eight regions. The M6 highway is used to access the Southeast Region, and runs through the Strumica to the Bulgarian border. Local roads connect adjacent villages (e.g. Ilovica and Shtuka). Traffic on the M6 east of Strumica is mixed, including large trucks, personal vehicles (e.g. pick-ups, cars), motorcycles, tractors, bicycles, horse and cart, and pedestrians. Traffic volumes on the highway are high (i.e. 150 to 300 vehicle movements per hour), with lowest volumes experienced on Sunday. Throughout the course of a day, traffic volumes generally increase from 07:00 to 12:00, are consistent from 12:00 to 17:00, typically decreasing thereafter.

In the Southeast Region, 90% of households have access to piped water for drinking and most households (95%) do not use any additional form of water treatment for their drinking water. Piped water is available in the Municipality of Bosilovo from the Ilovica water treatment facility. Many households in Ilovica and Shtuka obtain water from the Jazga and Shtuka Rivers, and from groundwater sources (e.g. wells). Ilovica reservoir
water is supplied to agricultural land upgradient of the Turija canal, whereas households with land to the south (downgradient) of Turija canal, use the canal water for agricultural purposes.

The majority of households (94%) in the Southeast Region have access to sewage systems, with piped sewage systems more common in larger urban environments and septic tanks and latrines more common in rural locations. The abundance of septic tanks in the Municipality of Bosilovo and their relatively poor condition has led to concerns of their contribution to groundwater contamination. The lack of sewage treatment facilities and regional waste treatment centre or landfill has led to unofficial dumping sites in the river valleys which also impact water quality in rivers and contribute to poor air quality due to the fires in dumps.
3.0 PROJECT ALTERNATIVES CONSIDERED BY THE PROJECT DEVELOPER

3.1 Introduction

The purpose of the analysis of alternatives is to refine the project description to deliver an economically feasible mine design that is robust from engineering, environmental and social perspectives. This section examines the various alternatives considered during the refinement of the project design. Consideration of alternatives is also required under the Regulation on the Content of the Requirements to be met in a Project Environmental Impact Assessment Study (Official Gazette of the Republic of Macedonia no. 33/2006).

The IFC and EBRD both provide guidance in their environmental and social policies and respective Performance Standards (IFC, 2012) and Performance Requirements (EBRD, 2014). Analysis of alternatives is addressed in the following EBRD Performance Requirements:

- Performance Requirement 1: "The ESIA will include an examination of technically and financially feasible alternatives to the source of such impacts, including the non-project alternative, and document the rationale for selecting the particular course of action proposed."

- Performance Requirement 3: "The environmental and social assessment process will identify opportunities and alternatives for resource efficiency relating to the project in accordance with GIP. In doing so, the client will adopt technically and financially feasible and cost effective measures for minimising its consumption and improving efficiency in its use of energy, water and other resources and material inputs as well as for recovering and re-utilising waste materials in implementing the project."

- Performance Requirement 5: "The client will consider feasible alternative project designs to avoid or at least minimise physical and/or economic displacement, while balancing environmental, social, and economic costs and benefits."

- Performance Requirement 6: Where the assessment has identified that the project could have significant, adverse and irreversible impacts to priority biodiversity features, the client should not implement any project-related activities unless: there are no technically and economically feasible alternatives; the overall benefits outweigh the project impacts on biodiversity; stakeholders are consulted in accordance with PR 10; the project is permitted under applicable environmental laws, recognising the priority biodiversity features; appropriate mitigation measures are put in place, in accordance with the mitigation hierarchy, to ensure no net loss and preferably a net gain of priority biodiversity features over the long term, to achieve measurable conservation outcomes."

- Performance Requirement 8: “Where the client’s screening process identifies potential adverse impacts at the early stages of project development, preference should be given to avoiding adverse impacts during the design and site selection phases.”

Other than the considerations of the Performance Requirements, the criteria applied when analysing alternatives for project design include:

- The health and safety of workers and residents in surrounding communities;
- The significance of potential social, health and environmental impacts and the ability to mitigate adverse impacts through evaluation of alternative options;
- The economic extraction and production of copper concentrate and gold to meet market specifications;
- Minimising the number of residents that would be displaced or disadvantaged economically and physically;
- The availability of infrastructure and labour, including the integration of local skills base;
- Compliance with all applicable laws and regulations in the Republic of Macedonia and the international standards which the Project is committed to meeting; and
Cost-benefit analyses to enhance project benefits to surrounding communities, workers, investors, and the Macedonian government (through tax revenue and social investment).

**Alternatives Considered**

Project alternatives were examined throughout the development of the Ilovica-Shtuka Project, including the Preliminary Economic Assessment (PEA; TetraTech, 2012), various trade-off studies (TetraTech, 2013; AFW, 2015a, 2015b), the Pre-Feasibility Study (PFS; Euromax, 2014) and the Feasibility Study (FS; Euromax, 2015a).

The alternatives that have been considered during the project design are grouped as follows:

- Mine design and infrastructure;
- Logistics and transport;
- Water supply;
- Employee accommodation;
- Non-mining waste management;
- Closure alternatives; and
- The ‘No Project’ alternative.

### 3.2 Project Need

**Macedonian economic activities**

Macedonia’s GDP has been above average for southeast Europe since 2009 and is currently around US$25 billion (US$11,700 per capita), with an average real GDP growth of 1.5%. With continual investment in manufacturing and exports, GDP is expected to climb by 3.5% in 2015 and 3.8% in 2016. While the nation’s trade deficit is high (17.8% in 2014), it has been decreasing in recent years, in part due to the lowering cost of oil and gas imports.

There are three types of taxes in the country:

- Income: 10% of all profits (corporate income tax); 10% of gross incomes (personal income tax);
- Consumption: 18% of taxable turnover of goods, services and imports\(^{12}\) (Valued Added Tax); and
- Property: 3% of property sale price (property transfer tax); 0.1% of held land value (Property Tax).

The service sector is the largest contributor to the Macedonian economy, accounting for approximately 64% of GDP in 2012. Recent foreign investment has seen the manufacturing and metal/mineral production industries grow in their role as a major part of the national economy (i.e., 18% of GDP in 2012). The agriculture and construction industries contribute a further 10% and 8% to national GDP, respectively. The four sectors (services, industry, agriculture and construction) generate 51%, 24%, 19% and 7% national employment, respectively.

Macedonia produces a number of metals, including copper, ferroalloys, and steel, as well as mine output of lead and zinc. Mining and quarrying made up 1.3% of GDP in 2011 and 1.4% in 2012/2013; the mining and metal ores subsection represented 75% of this sector or 1% of the GDP in 2013. Lead ores and concentrate represent the largest value of exported minerals, while copper ores and concentrate are second, ahead of zinc ores and concentrate. In total, these top three minerals represented an export value of US$156.4 million in 2014. In the last six years (2008-2014) the estimated average annual production of copper ore was 4,256,000

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\(^{12}\) 5% for select goods and services subject to preferential taxation, such as products for human consumption, agricultural use, water, medical goods, and those used in public service.
In the same period, the estimated average annual production of copper content in concentrate was 39,764 tonnes (Euromax, 2015b).

Regional economic development

The Southeast Region of Macedonia covers 10.9% of the nation's total land area and is home to 8.4% (i.e., approximately 173,000 people) of the nation's population, amounting to a population density of 63.3 people per km$^2$. The favourable growing conditions in the Southeast Region have provided for the Region's critical role as a major agricultural producer. Vegetable, fruit and industrial crop production, and associated food processing and packaging, have driven much of the Region's rural economy.

Non-agricultural industrial activity in the Southeast Region includes small-scale construction, manufacturing, and textiles. The manufacturing industry in Southeast Macedonia is concentrated in Strumica, and services the agricultural industry by producing shipping crates, packaging materials, and other items used by farmers. Food processing and packaging is also an important part of the local manufacturing industry, preparing local agricultural produce and other consumable goods for sale. Some manufacturing of ceramics, bricks and metal products also occurs in the city. Textile producers in the city focus largely on the manufacture of clothing, knitted items and boutique sales, while a smaller number produce industrial apparel and protective garments.

Mining has not been a major industry in the Southeast Region of Macedonia. There is a small feldspar mine on the Ograzhden Mountain that employs approximately 100 workers. Feldspar from the mine feeds the ceramic industry in Macedonia. The Buchim Copper Mine is the only significant metal mine in the Southeast Region. Located 45 km northwest of Ilovica, the Buchim Mine began operations in 1979 and is still in operation today (Solway Group, 2010; Mining Atlas, 2015). The proposed Ilovica-Shtuka Project will represent a marked growth in the mining industry in the Southeast Region and, in particular, the municipalities of Bosilovo and Novo Selo.

Economic development and investment in the rural region outside of Strumica and around Ilovica and Shtuka has generally been low. Individual villages do not have their own budgets, and municipal budgets are limited. As a result, little funding is available for rural economic development.

In recent years, out-migration has been a constraint to business development in the area around the primary affected communities. Many businesses feel the negative effect of losing young, qualified and trained workers, as people leave the Region and, in some cases, the country, in search of higher paying employment elsewhere.

Project contribution

The average annual copper production from the mine will be approximately 16,000 tonnes, which represents approximately 30% of the average annual national production of copper (compared to the period 2008 to 2014). With 83,000 ounces of annual gold production, the Ilovica-Shtuka Project will also be the largest gold producer in Macedonia.

The Project will have a positive impact on Macedonian exports. The export value of copper and gold concentrate and doré from the first year of operation is estimated at approximately US$274 million at metal prices of $1,220/oz for gold and $2.90/lb for copper, which represents an increase of around 7% when compared to the total value of Macedonian exports for 2014. The average annual value of exports during the 20-year life of mine will be approximately US$188 million per annum.

One of the most important economic roles of the Project is that of a value creator: generating the financial resources that the Government and Municipalities can invest. A state royalty will be paid, which has been estimated to be approximately US$3.6 million per annum at full production from the mine. According to the Minerals Law, royalties are distributed between the national government (receiving 22% of the royalty) and the municipalities in which the concession activity is performed (receiving 78% of the royalty). As a result, the Municipalities of Bosilovo and Novo Selo will both have significant economic injections to their budget: the Ilovica-Shtuka Project will contribute approximately US$61 million over the life of mine (Section 4.8).

Once in operation, the Ilovica-Shtuka Project is expected to have approximately 500 direct employees, which will further contribute to the economic benefits to the national government (made up of social contributions and personal tax).
The employees will also benefit from the investment that the company will make in skills development and training and as such, provide high value employment. Investment in “human capital” will not only increase the skills and expertise of people, but investment in training will bring benefits to the region by developing a host of transferable skills, such as mechanical engineering, operation of heavy goods vehicles (HGV), electrical engineering, plumbing, carpentry and welding.

Whilst direct employment on the Project is an obvious benefit, there will also be indirect employment opportunities through local contractors and sub-contractors. Euromax will contribute to the local economy through its policy of seeking to maximise the procurement of goods and services from local suppliers through transparent and equitable purchasing procedures. These purchases affect the creation and development of local businesses that provide relevant products, inputs, and services to the mine.

With approximately 500 direct employees and a significant number of local contractors and service providers, the effects of the mine’s operations will be positive both in terms of the employment available and the regional businesses involved in the supply of goods and services to the mine.

### 3.3 Analysis of Alternatives

#### 3.3.1 Mine Design and Infrastructure

**Mining method and pit design**

The deposit is near surface and suitable for open pit mining. Underground mining is not feasible because of the nature of the ore body, its shape and proximity to the surface.

The proposed method of mining is by conventional open pit methods using drilling and blasting, loading with excavators and shovels, and hauling with rigid dump trucks. Ore will be deposited to the ROM pad for primary crushing and then transported to the process plant by conveyor.

The pit has been designed based upon investigations of the resource during the PEA, PFS and FS. The current pit design and mine schedule was initially developed during the FS and developed further into detailed design by SRK.

**Process design and product**

Investigations of the deposit demonstrated the presence of valuable copper and gold resources. Studies conducted to inform the PEA modelled the outputs of a flotation process, which indicated a possible recovery of 90% copper and 83% gold. The PEA only considered the processing of sulphide ore (the majority of the mineralised material), with oxide ore considered as waste for the purposes of designing the process plant. The PEA flow sheet consisted of crushing, milling, two-stage rougher scavenger flotation with four stages of cleaner flotation and two stages of regrinding to achieve a saleable copper concentrate with additional gold credits.

Further studies conducted during the PFS resulted in a change to the process, with the addition of carbon-in-leach (CIL) tanks to further improve gold recovery and the production of gold doré bars to achieve maximum added value within Macedonia. This change was prompted by a proposal from a national stakeholder that a smelter be constructed to add value to the processing of copper. This proposal was neither economic nor likely to be required in the long term, however it did prompt further consideration of how best to add value to the product prior to export.

The PFS set out the process using the block diagram below. Based on testwork undertaken, a copper flotation circuit that contains rougher, scavenger flotation followed with concentrate regrinding and cleaner flotation was recommended as the primary processing method. The cyanidation of flotation tails showed additional potential for gold recovery. A CIL circuit with 24 hour retention time was recommended to maximise gold recovery. A cyanide detoxification process on the CIL tails was included to meet industry best practice for cyanide management and use. Overall copper and gold recoveries were estimated at 84% and 88% respectively.
The FS further optimised this process to deliver a process plant with a capacity of 10MT per year, of which approximately 1MT goes through the CIL circuit. This change reduces the volume of cyanide and associated reagents required, thereby reducing the operational cost associated with the CIL circuit, while maintaining gold recovery. The project schedule being assessed in this ESIA is based upon engineering studies completed since the completion of the FS studies and assumes a 20 year life of mine.
Tailings management facility

The PEA considered six potential locations for the tailings management facility (TMF):

- TMF options 1, 2 and 3 were located in the Shtuka Valley to the southeast of the mine. The location was considered to be ideal, however the topography of the valley meant that the ratio of the dam volume to volume of tailings would be high. It was considered that a series of two or three dams in this valley might be suitable to hold all the volume of tailings over the LOM.

- TMF options 4 and 5 were located in the valley to the north of the pit. The valley is wider and shallower and was not considered practical as any dam would have to be much longer and larger.

- TMF option 6 was located to the northeast of the pit and the topography, lower construction costs, isolated location and simpler rainfall management made it the preferred option. This location did have disadvantages though, including its altitude (which would mean pumping the tailings up 300 m) and proximity to the Bulgarian border (potential for transboundary issues, including the fact that it lies in a water catchment area that flows into Bulgaria).

A subsequent trade-off study looked at potential TMF locations around the mine site and considered tailings disposal methods from environmental, economic and technical perspectives. Site selection focussed on the Jazga and Shtuka valleys and evaluated alternatives in terms of disposal of tailings and waste rock within these two valleys. The tailings disposal methods considered were conventional slurried tailings disposal, dry stack (filtered tailings), and co-disposal of filtered tailings and waste rock. The trade-off study concluded that co-disposal was the best option for all considerations except operating costs. The proposed location was within the Shtuka Valley and featured a tailings and waste rock co-disposal facility with multiple raises going up the valley, with a downstream water collection pond to capture water diverted around the perimeter of the facility.

TMF design was further advanced during the PFS, where the Faculty of Civil Engineering in Skopje were commissioned to provide preliminary design of a conventional TMF with thickened liquid tailings and a tailings dam. The design was based upon a number of assumptions, including that the TMF be located in the Shtuka Valley, that the embankment be constructed with waste rock where possible, and would use only a single embankment. Seven profiles were considered – three downstream (river bed elevation of 490 masl), three upstream (river bed elevations 490-550 masl), and one diversion dam upstream of the TMF. The preferred option selected for design (based upon geotechnical investigations of soil and rock medium within the Shtuka Valley) was the middle of the three upstream locations and the upstream diversion dam.

The TMF design provided in the PFS also recommended the installation of a water diversion around the TMF and the use of a geomembrane liner for the upstream face of the dam.

The TMF design was refined during the FS process and beyond into detailed design, based upon the findings of the PFS. The location and overall design has remained the same, with a slight increase in the final height and areal footprint. The FS has also shown that a geomembrane liner will only be required for the upstream face of the starter wall (constructed to an elevation of 625 masl and with capacity for the first year of tailings production). It is not currently a requirement to line TMF’s for the disposal of copper gold porphyry tailings in Macedonia, neither is it common practice in large parts of Europe. Together with the challenging topography of the site and the low permeability of the tailings to be deposited, this led to the decision to only line the upstream face of the starter wall.

Two deposition strategies were considered for the TMF:

- Centrally located supernatant pond (as was presented in the feasibility study) which requires deposition around the perimeter of the TMF; and

- Supernatant pond at the rear of the facility, which only requires deposition from the embankment crest initially.
A centrally located pond was initially considered, primarily to simplify return water pump barge operations whilst locating the pool a safe distance from the front face of the TMF for stability reasons, to blanket a significant proportion of the basin with the very low permeability tailings and minimise the pond size if required.

However, a deposition strategy with the pond at the rear of the facility for the majority of the mine life is proposed as the preferred option for the detailed design, primarily due to the need to store water on the facility during the wet season to allow the TMF to provide part of the plant’s water requirements during the dry season.

Water Management Structures in the Shtuka Valley

The water management structures associated with the TMF include:

- A river diversion dam and partially lined channel upstream of the TMF to capture and divert non-contact water around the TMF and into the Storm Water Dam (SWD). The following alternatives were considered:
  - A large diversion channel capable of conveying the PMF, which was disregarded as the size would have been over engineered and the engineering was not practicable;
  - An unlined diversion channel, which was disregarded for a partially lined channel in order to reduce infiltration and maintain low flows from the upper catchment, which will be discharged to the watercourse downstream of the TMF to maintain low flows downstream of the project infrastructure; and
  - A discharge point for the diversion channel downstream of the Storm Water Dam (SWD), which was disregarded due to the additional construction, infrastructure and associated time and costs required to construct the extra length of diversion channel. In addition, any excessive suspended sediment captured in the diversion channel will not be discharged to the environment but managed by the sediment management infrastructure associated with the SWD.

- Seepage Collection Facility (SCF) downstream of the TMF to collect seepage from the TMF and surface runoff from the dam wall. The following alternatives were considered:
  - A combined, lined SWD and SCF. The separation of these two elements in the mining infrastructure will allow seepage under non storm conditions to be separated from storm water and runoff requiring sediment management and should minimise water quality issues associated with seepage for the TMF (which will be returned to the top of the TMF during normal operating conditions). The separation of the facilities will also allow for the phased decommission of these facilities post-closure; and
  - Locations downstream of the current siting of the SCF were considered, but the SCF has been sited as close to the TMF as possible to limit the possibility of contamination of water resources. Flow accretion surveys were completed along this stretch of the Shtuka watercourse to see if there is a likely location where sub-surface flow naturally daylights, thereby indicating a natural location for seepage collection. The flow accretion surveys did not identify such an obvious location.

- Storm Water Dam downstream of the SCF to collect and temporarily store/attenuate storm water run-off, retain sediment with an unlined permeable SWD retaining structure and to allow continuous flow of non-contact water during normal flow conditions. The following options were considered:
  - A lined water retaining structure to manage seepage and storm water runoff (although this would limit flow to water users further down the valley); and
  - Locations upstream and downstream of the current siting of the SWD were considered, but the SCF has been sited close to the SCF as possible to limit the volume of non-contact and contact surface water runoff reporting to the SWD.

Waste rock

Two main alternatives have been considered to deal with the overburden and waste rock associated with excavation of the mine pit. Early studies calculated waste rock volumes of around 400 MT and proposed a waste rock dump within the concession area. The second (and preferred) option is to use the waste rock as
a construction material for the TMF embankment. This has a number of benefits, including the reduction of capital cost for the TMF, reduction of capital and operating costs associated with the waste rock, and reduced environmental impacts associated with a smaller project footprint.

The FS and subsequent detailed design has built upon this proposed use of waste rock in building the TMF embankment. It is estimated that the bulk of the waste rock from the pit will be used annually to raise the TMF wall. Any potentially acid generating waste rock will be identified and incorporated into the inner zones of the TMF embankment. Material with low or very low acid rock drainage potential will be used for construction of the outer zones of the TMF embankment.

Waste rock will also be used as construction material for water management facilities around the site, including the diversion dam, the SWD and the SCF.

Surplus waste rock (estimated at approximately 40 MT) will be placed as buttresses on the downstream face of the embankment. At closure, this surplus waste rock will be reclaimed and used as a capping material on the TMF to augment available subsoil and topsoil across the site for reclamation.

**General and hazardous waste**

All final waste disposal will be located off site. Waste will be segregated and sorted at site and stored until sufficient quantities are available for removal to another facility. The final destination for waste generated at site will be an existing licenced facility for waste streams which are produced throughout the project life-cycle (non-mineralised waste and general waste). A waste management contractor will be appointed to manage the waste disposal system for the Project. Appropriate waste streams will be transported off site to a nearby licenced waste disposal facility.

The alternative considered during the design process was to have a waste collection, sorting and management facility on the site. The alternative on-site waste management facility was located to the east of the process plant and would have been a multi-product waste storage, handling and treatment facility for waste streams which are produced throughout the project life-cycle (non-mineralised waste and general waste):

- **Waste disposal site (Class A landfill)** – for restricted, hazardous materials. The cumulative size of the Class A landfill would have been 3,000 m² or 100 m x 30 m.
- **Waste disposal site (Class D landfill)** - for (a) all wastes not categorised as general waste (include domestic waste, non-hazardous business waste, garden waste and biomass, waste packaging, waste tyres, and building and demolition waste). The cumulative size of the Class D landfill would have been 5000 m² or 100 m x 50 m.

The alternative on-site option has been disregarded as Euromax wish to use local infrastructure as much as possible and where necessary help local operators to meet international best practice for the disposal of Project related waste. A waste transition yard, a waste management facility storage yard and a salvage yard remain part of the Project design.

**Stockpiles**

**Oxide ore**

Due to the properties of the oxide ore, it was originally considered in the PEA to be a waste material. Subsequent studies identified that it could be high-graded and processed through the CIL circuit to achieve an economic product. It was intended that oxide ore would be stockpiled throughout operations and then processed in the final years of operations, once all sulphide ore has been extracted and processed.

A number of stockpile locations were considered throughout the course of the PFS and FS. The PFS recommended that the oxide ore stockpile be located on an area of higher ground to the north of the process plant. During the course of the FS, the proposed location was moved twice to achieve better efficiency and easier environmental management. The selected location within the Jazga Valley enabled the stockpile to be managed within the valley walls, was at the shortest transport distance from the pit which reduced transport and double-handling costs, and enabled environmental management.
Nevertheless, it was concluded in the Macedonian EIA that water quality of the Jazga would worsen due to the oxide ore stockpile. On this basis, the oxide stockpile was therefore removed from the project design.

**Soils**

Very limited volumes of subsoil and topsoil will be available for reclamation. These will be stockpiled for use during the life of mine or at closure. Initial locations for stockpiling soils have been identified in Section 4, however, the locations of soil stockpiles will be determined in the closure plan as part of the Environmental and Social Management System (ESMS).

**Energy supply**

The project location is not serviced by an existing power supply, so options have been considered which focus upon the construction of a new powerline (connecting to an existing high voltage line in the Strumica Valley) and the use of diesel generators.

Due to the close proximity of suitable electrical infrastructure, diesel generators have always been considered a source of back-up power during operations, as well as the main source of power in the early stages of the construction period.

The main source of power will come from the construction of a new powerline to connect into the 110kV high voltage line running along the Strumica Valley. All electrical infrastructure in Macedonia is owned and managed by the Macedonian electricity company (Macedonian Electricity Transmission System Operator of Macedonia [AD MEPSO]). The PFS proposed that a branch line be constructed from an existing substation near Sushica to the electrical substation at the process plant.

As part of the FS, Euromax entered discussion with AD MEPSO regarding the ability of the network to provide supply to the Project. In order to achieve stability of supply to the Project and other users, several connections and routes were considered and the only option that satisfied MEPSO’s internal criteria is the construction of two 110kV powerlines: one from Berovo to the mine site (Ilovica substation) and another from the Ilovica substation to Sushica. This permanent infrastructure will become part of the Macedonian national grid which will be owned and operated by MEPSO and will considerably augment security of power supply in the region for all users. It is intended that the powerline will be constructed in the early stages of the construction phase to minimise reliance upon generators, thus minimising diesel consumption and combustion emissions.

**3.3.2 Logistics and Transport**

**Within site**

Within the site, two key modes of transport have been considered. Due to the terrain and proposed mining method, the majority of on-site transport will be focused on access roads and haul roads. In addition, a series of conveyors are proposed to efficiently transport and handle ore from the ROM pad to the process plant and between different process areas. The combination of these transportation options is considered to be the most efficient and limits the environmental impact of on-site transportation.

The alignment of the access and haul roads have been refined over time to provide the most efficient access routes, while avoiding sites of high environmental or cultural significance as identified during the Macedonian EIA.

In particular, the on-site access road in the FS has been moved from the North Eastern side of the pit up the Jazga valley, to on the South eastern slope of the Shtuka valley adjacent to the TMF (Figure 3-3). The alternative was disregarded as the FS on-site access road was located in proximity to a sensitive archaeological monument (Crkvishte) identified by Strumica Museum archaeologists. There were concerns that construction of the road could lead to the site being damaged and its setting compromised.
The local region is well serviced by paved roads in good condition. At the present time, access to the concession area is via the village road serving Ilovica and Shtuka. This road is unsuitable for use by project vehicles during the construction and operations phases due to the narrow width of the existing road, health & safety considerations for existing road users (which include personal vehicles, tractors, and horse & cart), and the condition of the road which was not constructed for frequent use by heavy vehicles. As such, a new off-site access road will be constructed to join the concession area directly to the M6 highway which runs east-west along the Strumica Valley, between Strumica and the Bulgarian border.

A number of alignments for the off-site access road have been considered. Two alternative options were considered in the Macedonian EIA:

- Option 1 runs up the western side of the Shtuka River, then joins the existing Ilovica/Shtuka village road, before crossing the Shtuka River downstream of the village; and
- Option 2 runs up the eastern side of the Shtuka River.

Both of these options have been disregarded and the chosen approach of temporary and permanent access roads was selected against environmental, social and economic criteria, though primarily related to minimising the number of agricultural plots affected by the construction of the roads so as to minimise impacts to farmers and their livelihoods.
A land acquisition and compensation programme is underway to understand the land ownership of both alignments and to undertake engagement with affected individuals/families.

**Transportation methods**

A number of transportation options have been considered throughout the development of the Project, including road, rail and helicopter transportation.

Due to the lack of existing rail infrastructure in the region and the cost of constructing new infrastructure, the use of rail transport would have to be supported by road transportation to reach the project site. Rail transport has primarily been considered for the export of copper concentrate (by road to a rail depot in Bulgaria, from where it could be transported by train to the smelter) and for the delivery of equipment and plant from other parts of Macedonia and Europe (supported by road transport to the project site). The need to transfer from rail to road transport in order to reach the project site introduces inefficiencies and extra costs, and as such, rail is not the preferred method of transport in most cases.

Helicopter transport has been considered for the export of doré, however is not the preferred method of transport due to the lack of available helicopter transportation in Macedonia, the cost of this form of transportation when compared with road transport, and the potential for disturbance to local communities.

Road transport is considered the primary mode of transport for off-site project traffic, including the delivery of plant, equipment and supplies to the Project, transport for workers, export of copper concentrate and doré, and eventual removal of plant and equipment at mine closure. The project site is well connected to existing road networks, with the M6 regional highway providing connection to Bulgaria and to Strumica from where the highway network provides access to Skopje, Greece and other destinations. Road transport offers the most flexibility in terms of the timing and routing of traffic and the importation of equipment and supplies from a number of sources. There are also experienced haulage contractors within the region who will provide support to the Project, thus distributing the economic benefits of the development.

**3.3.3 Water Supply**

There are a number of alternative sources of water which are under consideration for the Project. A combination of these options is likely to form the project water supply, therefore none can be considered alternatives to the project water supply solution at this stage, but their characterisation has allowed a designation of major or minor sources of water supply as presented in Section 4, Project Description.

Water reclaim from the TMF and SCF will form a part of the project water supply; the alternative to reclaim would mean an increased demand for fresh water and therefore was disregarded on financial and environmental grounds.

**Surface water extraction**

Direct abstraction from surface water was considered for the project water supply with relation to the Jazga and Shtuka rivers. However, due to the seasonal variability in flows and resulting low level of reliability, this option was not preferred for the main water supply. It was also recognised that any surface water extraction would need to maintain downstream environmental flows, so as to not affect existing water users. Nevertheless the Jazga reports to the Ilovica Reservoir and therefore will form part of the project water supply solution.

Abstraction for the Strumica River was considered, however the hands off flow study established it is a transboundary watercourse, which means that the security of supply could not be maintained for the Project.

Abstraction of water retained in the SWD during periods of higher flows and increased runoff was considered. However during these periods water retained on the TMF and in the SCF will form a priority source of project water supply in order to manage the amount of water retained by these structures, reducing seepage and managing structural risk. Water retained by the SWD will be allowed to discharge to the environment under control.
**Groundwater extraction**

Options considered for groundwater extraction to provide project water supply include the dewatering of the pit, investigation of groundwater resources in the upper catchments of the Jazga and Shtuka rivers, and the potential for groundwater extraction from alluvial aquifers in the Strumica Plain.

Site investigations have demonstrated that the geology in the vicinity of the pit is fractured, but formation permeability is very low. Ingress of groundwater to the pit is expected to be negligible and may not arise, therefore does not provide a viable alternative water supply of significance. Nevertheless, any groundwater entering the pit will mix with surface water inflows and will be pumped to the process water storage facility at the process plant.

Investigation of groundwater resources in the upper catchments was based upon analysis of remote sensing data and geological and soils mapping. This analysis identified that there are no areas in the upper catchments which have potential for significant groundwater supply.

An investigation is currently in progress to assess the water supply potential of the Strumica Plain alluvial aquifer in the vicinity of the Project. Assessment of the drilling results is ongoing, but indicate that the test locations may have low to moderate groundwater supply potential and therefore do not provide a viable alternative water supply of significance.

**Turija Reservoir**

The major potential source of supply is Turija Reservoir via a pipeline constructed from Turija dam to Ilovica Reservoir.

The options for conveyance of water to Ilovica Reservoir are still under consideration. Ilovica Reservoir would be augmented via a pipeline and pumps constructed between Turija Reservoir and Ilovica Reservoir. The methods of conveyance under consideration include:

- Upgrade existing open channel, covered trapezoidal channel;
- Unpressurized pipeline; and
- Pressurized pipeline.

**3.3.4 Employee Accommodation**

During operations, all workers will live in nearby towns and villages, with site visitors being accommodated in existing hotels or refurbished guest houses. Construction staff will be accommodated off-site at existing facilities (hotels or existing (commercial) buildings appropriately refurbished), most likely in Strumica.

In the Macedonian EIA, on-site accommodation was considered for the construction phase of the Project for up to 800 workers. This was disregarded on financial and environmental grounds. A review of locally available accommodation revealed availability and the removal of facilities on site would lead to reduced temporary infrastructure, reduced sanitation facilities, reduced waste on site and economic benefits in the form of accommodation and living costs into the local economy.

**3.3.5 Closure Alternatives**

A closure plan will be developed as part of the Environmental Management Plan and will be revised throughout the mine life. The current preferred alternative is:

- To retain the TMF and pit, subject to rehabilitation to make these facilities safe and the establishment of vegetation to create functioning ecosystems as far as possible;
- To retain the access road, powerline and any other facilities that may be of use to the community, Forestry Company or municipalities; and
- To remove all other infrastructure and rehabilitate/ revegetate.
3.4 "No Project" Alternative

This option would:

- Maintain the status quo of the socio-economic environment, with no change to the current economic conditions and livelihoods;
- Avoid the potential risk of any disturbance to the communities or long-term changes to the landscape;
- Avoid the potential (real or perceived) environmental and social impacts, risks or threats (subject to the detailed analysis in this ESIA); and
- Avoid long term legacy issues associated with land use, aftercare management and maintenance of the site.

However, the zero option would also result in the loss of:

- Economic opportunity to exploit a nationally important resource with economic benefits to the region and national economy for the duration of the Project;
- Local employment opportunities and associated economic benefits derived from employment for the duration of the Project and beyond;
- Associated development and subsequent long-term improvements to local infrastructure including roads, energy, waste and water management; and
- The opportunity to upgrade and develop skills, with the associated economic benefits to local communities as a consequence of services and contracts delivered to maintain and support the mining operations.
4.0 PROJECT DESCRIPTION

4.1 Project Location

The location of the proposed mine is within the Municipalities of Bosilovo and Novo Selo in south-eastern Macedonia. The mine is situated approximately 180 km southeast of Skopje, 18 km east of Strumica (the nearest town to the Project), 20 km by road from the border with Bulgaria and approximately 15 km due north of the border with Greece. The region is characterised by forested hills up to 1,400 mASL with the broad Strumica Valley to the south which is dominated by agricultural production. The Project footprint will cover an area of approximately 500 hectares (ha) within a concession area of 1,500 ha, as shown in Figure 4-1 and Table 4-1.

The Municipalities of Bosilovo and Novo Selo are located in the south-eastern corner of Macedonia. The Municipality of Bosilovo covers an area of 150 km$^2$ and lies at an elevation of 250 m above sea level. The municipality has a total population of approximately 14,260 people living in 16 settlements: Bosilovo, Turnovo, Radovo, Ilovica, Shtuka, Sekirnik, Borievo, Monospitovo, Robovo, Ednokukjevo, Petralinci, Saraj, Gecherlija, Drvosh, Hamzali, and Staro Baldovci. The municipality of Novo Selo covers an area of 425 km$^2$ and has a total population of approximately 11,570 people living in 16 settlements: Novo Selo, Badilen, Bajkovo, Barbarevo, Borisovo, Drazhevo, Koleshino, Mokrievo, Mokrino, Novo Konjarevo, Samuilovo, Smolare, Staro Konjarevo, Stinik, Sushica, and Zubovo.

![Figure 4-1: Concession area.](image)

<table>
<thead>
<tr>
<th>Point No.</th>
<th>Easting</th>
<th>Northing</th>
</tr>
</thead>
<tbody>
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<td>4596000.000</td>
</tr>
<tr>
<td>T-2</td>
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<td>T-3</td>
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<tr>
<td>T-4</td>
<td>7654200.000</td>
<td>4596000.000</td>
</tr>
</tbody>
</table>
4.2 Incorporated Environmental and Social Measures

An Environmental Impact Assessment (EIA) was submitted to the Macedonian regulator in April 2016 (hereafter referred to as the Macedonian EIA, Golder document 1351415036.701/A.0). The Project Description assessed in the Macedonian EIA was based on a draft of the NI 43-101 Feasibility Study Technical Report dated 2 October 2015. At the time of writing no written feedback has been received from the Macedonian EIA review process, however stakeholder engagement activities completed by Golder throughout the Macedonian EIA process and feedback provided during the Public Enquiry has been incorporated and responded to within this ESIA.

Since the cut-off date for the Macedonian EIA project description, the NI 43-101 Feasibility Study Technical Report (S2233-0000-BA00-RPT-2000, dated 16 February 2016) was completed and detailed engineering studies have been initiated. This latest information (as of October 2016) has been compiled to inform the Project Description assessed by this ESIA (Section 4.4).

Early in the process for the Macedonian EIA, Golder and Schlumberger Water Services (now WSP Parsons Brinckerhoff) developed the Environmental and Social Engineering Considerations report (Golder, 2015). This report provided initial environmental and/or social considerations to inform the Feasibility Study for the Ilovica-Shtuka Project. The report provided recommendations that could be incorporated into the Feasibility Study design to avoid or minimise environmental and social impacts which would otherwise require mitigation or management. The Environmental and Social Engineering Considerations report is presented, along with the environmental design criteria, in Annex 1C. Recommendations from the Environmental and Social Engineering Considerations report are in the process of being incorporated into the design, as set out in Section 4.2.1. The information provided in this report updates that set out in these previous studies.

4.2.1 Summary of Incorporated Environmental and Social Measures

Erosion Control and Sediment Management

As a result of works carried out by a contractor, erosion control measures may be required. These could include the development of stable embankment slopes, mechanical stabilisation, installation of erosion control features, and prompt revegetation of appropriate areas. These measures will meet the commitments in the ESIA and will be set out within the relevant contractual arrangements.

Specifications for the installation of physical erosion control features to meet commitments in the ESIA (such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting to control erosion prior to the establishment of a protective vegetative cover) will also be set out within the relevant contractual arrangements.

As soon as practicable, temporarily disturbed areas will be graded, revegetated and reclaimed so that surface water run-off from these areas will, where feasible, be similar to natural or pre-mining conditions.
Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible.

Vegetation clearance should be minimised and areas only cleared immediately before work takes place, as far as possible. This will be included as part of the scope of work for the bulk earthworks contracts.

**Dust/Air Quality Management**

- Dust suppression will be achieved through spraying with a water truck and/or fixed sprinklers on roads, stockpiles, during construction and also for crusher, conveyor and material transfer points during operations.
- Reduce dust from transport by sealing major roads (e.g. off-site and on site access road), establishing speed limits around the site and near villages, and covering dusty loads where possible and when required. Minor roads (e.g. haul roads) will have a gravel surface.
- Minimise drop heights and have sprayers/dust control at material transfer points (e.g. conveyors, dumping of waste rock). Sprayers/dust control specifications to meet the commitments in the ESIA will be placed on the construction/operational contractor.
- Should contract mining be used, specification for blasting of ore and waste rock to minimise dust will be a requirement for contractors and will be further detailed as part of the operational plan for the mine.
- Specifications for mobile equipment and generators will include measures to minimise dust and air emissions from each type of vehicle. Use of low sulphur diesel is recommended for mobile equipment.
- The use of recent model vehicles and best available technology for emissions reduction/capture will be taken into consideration during the specification and selection process for project equipment (e.g. generators, processing plant, boilers/furnaces).
- There will be a regular schedule of vehicle and generator maintenance. Pre-use checks will be completed for equipment and all faulty items shall be attended to immediately. No major repairs or services shall be carried out on site unless the contractor has provided for a suitably equipped facility.

**Water Management**

- Euromax Resources has a policy of zero surface water discharge from the site during construction and operations phases, to maximise use of site runoff for process water supply and minimise impacts on water quality in local streams.
- Following mine closure, surface water discharges requiring treatment will be treated prior to being discharged to the environment.
- Temporary water management and sediment control structures will be designed to control discharge to the environment through storm events with a 25-year return period.
- Permanent water management and sediment control structures (permanent through construction and operations phases) will be designed to control discharge to the environment through storm events with a 100-year return period.
- Water management structures that will remain following closure should be designed to retain flood water and control discharge during the Probable Maximum Flood (PMF), computed using the Probable Maximum Precipitation for the site.
- Discharge of groundwater from the site will be minimised as far as possible.
- Clean and dirty surface water will be segregated though use of berms, cut-off trenches, diversion channels, oil/water separators, culverts and other feasible measures.
- Clean surface water run-off will be directed around the mine site, and other infrastructure and all other disturbed areas to natural drainage paths. Some clean runoff from the plant area will flow to and be
stored on the TMF. Clean runoff entering the TMF will combine with TMF supernatant and will be recirculated to the process plant water supply.

- Under normal conditions rainwater and dewatered groundwater pumped from the pit will be captured and pumped to the plant for use as process water.

- Minimising the disturbance to natural ground cover will be included within the construction contractor’s scope of work and will be monitored during the construction period. Increased runoff due to vegetation clearance will be stored and attenuated before controlled discharge to the watercourses. No unnecessary vegetation removal will take place adjacent to rivers and streams.

- Contaminated water will not be discharged from the site but will be stored, treated and re-used as process make-up water wherever possible. Design of the processing plant includes for storage in the process water pond and re-use within the plant.

- Specifications for sedimentation and flow control measures to meet the commitments in the ESIA for all ditches on slopes will be placed on the construction/operational contractor and set out within the relevant contractual arrangements. Energy dissipaters will be installed to prevent the carriage of sediment with fast flowing water. Examples of these would be diversion channels, sedimentation ponds, rock filters, plastic water dams and concrete energy dissipaters.

- All ponds containing process, contact, or waste water will be maintained at a level to allow sufficient capacity below spillway level to prevent frequent overflow. Ponds will be managed during the operational period at the normal operating level with the freeboard capacity reserved for upset conditions and probable maximum inflows and including the relevant design return period for temporary or permanent structures (presented above). Ponds will be managed during the operational period with stormwater retention facilities to be empty under normal operation circumstances. Spillways on ponds will be designed to permit the passage of the design flood.

- Any new river crossings (roads) will be constructed so that natural flow regimes are not adversely affected and substantial scour does not occur. Sufficient conveyance capacity will be provided through culverts or bridge sections of the watercourse will be designed to avoid any deleterious effects.

- A seepage collection system has been incorporated in the design of the TMF to enable capture and monitoring of seepage in the Seepage Collection Dam.

- Sewage will be treated and treated effluent will be incorporated into the plant process water system and will not discharge into the environment. Treated effluent will be required to conform to the relevant Macedonian waste water regulations and European Union's Urban Wastewater Directive.

- Stream channel stability will be protected by limiting in-stream and bank disturbance, and employing appropriate setbacks from riparian zones. No unnecessary construction will take place within riparian zones.

- Specifications for storm water drains, ditches and stream channels to protect against erosion and meet the commitments in the ESIA will be set out within the relevant contractual arrangements. Options could include a combination of measures such as adequate dimensions, slope limitation techniques, synthetic liners or the use of energy dissipaters, such as rip rap or brushwood.

Hazardous Materials Area

- Fuel and chemical storage and usage areas will be demarcated, sealed and bunded with stormwater directed around these areas. The bunded areas are designed to hold 110% of volume of the largest expected spillage event in a specific area.

- Fire water storage tanks will be installed at the processing plant and at the mining infrastructure.

- Fuel storage will occur at the mining infrastructure. Fuel suppliers will supply and maintain the equipment. The design of this area will allow for secondary containment (bunded area) and concrete hard standing
and will be guided by the fuel supplier’s recommendations. The bunded area will allow for containment of 110% by volume of the largest expected spillage event.

Visual Impacts

- To minimise visual disturbance, the specification to use earth colours on project buildings/facilities will be placed on the construction contractor via contract conditions for the process plant and mine infrastructure buildings.

- Progressive reclamation of disturbed areas will take place where feasible. Revegetation will use vegetation representative of natural vegetation in the area using locally procured seeds or plants as far as possible. This will be incorporated into the mine closure plan and included in scopes of work for contractors.

- Use of directional lighting (focused away from receptors) has been incorporated into design. Ten 30 m high mast lights with adjustable orientation have been allowed for. The light positions and directions on the site will be defined in the ESMP and through contract conditions. No lighting has been allowed for on the access road to the mine.

Noise Management

- The Best Available Technology for equipment (including jackhammers and compressors) will be chosen to limit noise generation and limit occupational exposure. Equipment will specify the limits for noise generation in line with local authority regulations.

- The on-site speed limit will be no more than 50 km/h to reduce noise and disturbance.

- Operational activities in the pit and blasting for civil construction (including haul and access roads and TMF diversion channel) will include careful blast design, blanketing during blasting as required to prevent fly rock, dampen noise and reduce disturbance.

4.3 Project Phases

The ESIA assesses impacts associated with three phases of the life of mine:

- Construction: two year period during which mine facilities are constructed and the pit area is stripped in preparation for mining;

- Operations: a 20 year period of open pit mining, processing of the ore, production and export of copper concentrate and gold doré, and deposition of the tailings; and

- Closure: a two year period during which mining infrastructure is decommissioned and removed (where possible) and land is rehabilitated and revegetated.

For the purposes of the ESIA, the term ‘post-closure’ is used to describe the period after closure of the mine. Post-closure has been considered where effects of the project extend beyond the closure period (e.g. management of discharges, formation of pit lakes post closure). The ESIA assesses effects and impacts in the post-closure period up until closure objectives have been met and environmental monitoring indicates that active management of the site is no longer required.

4.4 Project Facilities

Figure 4-2 shows the proposed layout of the facilities at the Ilovica-Shtuka Gold-Copper Project, as assessed in the ESIA.
4.4.1 **Key Differences: Macedonian EIA and ESIA**

The Macedonian EIA (1351415036.701/A.0) assessed an earlier version engineering design for the Ilovica-Shtuka Project. Since the submission of the Macedonian EIA a number of the project components have changed in design. Table 4-2 presents the key changes to the project description and where these elements are described further in this document and Figure 4-3 shows the change in footprint from Macedonian EIA to ESIA.

**Table 4-2: Key Differences for ESIA: Macedonian EIA and ESIA compared**

<table>
<thead>
<tr>
<th>Project Component</th>
<th>EIA Project Description</th>
<th>ESIA Project Description</th>
<th>Described further in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Phases</td>
<td>Operations phase = 23 years</td>
<td>Operations phase = 20 years</td>
<td>Section 4.3</td>
</tr>
<tr>
<td>Pit footprint</td>
<td>Footprint changed</td>
<td></td>
<td>Figure 3</td>
</tr>
<tr>
<td>Pit Blasting Activity</td>
<td>Preliminary blasting regime</td>
<td>Updated pit blasting regime</td>
<td>Table 3, Section 4.4.2</td>
</tr>
<tr>
<td>In pit vehicle use</td>
<td>Preliminary Vehicles identified</td>
<td>In pit vehicle numbers</td>
<td>Table 4</td>
</tr>
<tr>
<td>Tailings Management Facility (TMF)</td>
<td>Preliminary volumes, Dumping schedule, footprint and locations of diversion channel</td>
<td>Updated TMF footprint (including abutment), diversion location and size and spillway size</td>
<td>Figure 3, Section 4.4.3</td>
</tr>
</tbody>
</table>
### ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Component</th>
<th>Current Design</th>
<th>Proposed Changes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMF diversion</td>
<td>Preliminary design criteria</td>
<td>New alignment, footprint and design criteria</td>
<td>Section 4.4.3</td>
</tr>
<tr>
<td>Plant site (inc. ROM, crusher and conveyor)</td>
<td>Preliminary emissions and reagents</td>
<td>Updated emissions and reagents&lt;br&gt;Crushed ore stockpile volumes and storage pad areas</td>
<td>Section 4.4.4, Table 5, Table 6</td>
</tr>
<tr>
<td>Off Site Access Roads</td>
<td>Two options considered</td>
<td>A new off-site access road alignment and footprint to be developed in two stages:&lt;br&gt;Temporary during construction and permanent for operations and closure&lt;br&gt;Definition of traffic speed</td>
<td>Figure 9, Section 4.4.6</td>
</tr>
<tr>
<td>On Site Access Road</td>
<td>Preliminary alignment in Jazga valley</td>
<td>New on site access road alignment and footprint in Shtuka valley, routed around the TMF&lt;br&gt;Links with new off-site access road&lt;br&gt;Definition of traffic speed</td>
<td>Figure 10, Section 4.4.7</td>
</tr>
<tr>
<td>Haul Roads</td>
<td>Preliminary alignment</td>
<td>New haul road alignment, footprint and design criteria for drainage&lt;br&gt;Definition of traffic speed&lt;br&gt;Altered revegetation strategy for associated cut and fill</td>
<td>Figure 11, Section 4.4.8</td>
</tr>
<tr>
<td>Transport</td>
<td>Preliminary numbers based on original design</td>
<td>Updated on-site and off-site vehicle movements for worker transport, materials transport and export of product</td>
<td>Section 4.6</td>
</tr>
<tr>
<td>Storm Water Dam (SWD)</td>
<td>Conceptual design only</td>
<td>New SWD location and footprint and design criteria for flood attenuation, sediment settlement, receive diversion channel discharge and spill from SCF</td>
<td>Figure 4, Section 4.4.9</td>
</tr>
<tr>
<td>Seepage Collection Facility (SCF)</td>
<td>Conceptual design only</td>
<td>New SCF location and footprint and design criteria for receive seepage and runoff from TMF and spill from extreme event to SWD</td>
<td>Figure 4, Section 4.4.9</td>
</tr>
<tr>
<td>Stockpiles</td>
<td>Conceptual design only</td>
<td>Volume of topsoil estimated, new locations</td>
<td>Figure 4, Section 4.4.10</td>
</tr>
<tr>
<td>Worker Accommodation</td>
<td>On site camp considered (2.5 hectares)</td>
<td>Workers will be housed in local accommodation in Strumica</td>
<td>Section 4.4.11</td>
</tr>
<tr>
<td>Worker numbers</td>
<td>Construction – approx. 800&lt;br&gt;Operation – approx. 492</td>
<td>Construction – approx. 1200&lt;br&gt;Operation – approx. 487</td>
<td>Section 4.9.1</td>
</tr>
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4.4.2 Open Pit

The mine will be a conventional drill and blast, truck and shovel operation. Pre-production waste rock stripping will provide material for constructing the Tailings Management Facility (TMF) embankment.

Construction

During the construction phase, selected areas of the open pit will be stripped of waste rock in preparation for ore mining. Prior to waste stripping, vegetation clearance and soil stripping (where possible) will occur to prepare the site for mining operations. Any salvaged soils will be stockpiled for future use in rehabilitation and revegetation of the site. Stripping will involve blasting and earth moving to excavate the overburden/waste rock (which will be used in construction of the TMF wall). Around 2 to 3 blasts per week are anticipated during the construction phase; blasting activities are only to be undertaken during daylight hours.
A staged approach will be adopted to management of storm runoff and sediment control from the excavated pit area. This approach is explained in detail in Section 4.4.9.

**Operations**

During operations, the pit will operate 24 hours per day. Blasting will occur in the daytime only but will be on a daily basis (assuming on average 1 blast per day). Prior notification of blasting will be provided to police and local authorities.\(^{13}\)

Roughly 90% of the material in bulk excavations will require blasting. However it can also be expected that compressors and paving breakers (“jackhammers”) will be used in performing restricted excavations. Excavation of the open pit will commence with a higher grade starter pit on the eastern side of the open pit area, with a series of pushbacks in subsequent years to reach the final pit extent. The mine schedule is based upon a 10MT per annum process plant, with a variable strip ratio averaging 11 MT of waste rock per annum. Ore will be loaded into 140 tonne trucks and transported to the ROM pad. Waste rock will be loaded into 140 tonne waste trucks and transported to the TMF embankment. For the purposes of air quality modelling, ore and waste rock moisture content is assumed to be 2%.

Figure 4-4 presents the yearly volumes of material excavated from the pit. Figure 4-5 presents the phasing of the pit through the life of mine. Waste will be used to construct the TMF embankment (Figure 4-6) and all other material (HG = High Grade, LG = Low Grade) will be processed, the waste product from which will ultimately be deposited in the TMF as tailings. Figure 4-7 and Figure 4-8 expand upon this to provide the composition of the waste (grey).

During Years 1 and 2 active management of storm runoff and sediment control will be in place and is described in Section 4.4.9. From Year 3 onwards to end of mine life the pit will have a bowl form and in-pit water will be pumped to the process water storage facility at the plant site.

\(^{13}\) Communities are usually notified of blasting by the municipalities or emergency response institutions, such as the Crisis Management Centre, via the media.
Figure 4-4: Total Material Movement from the Pit (indicative dates only)

Figure 4-5: Pit phasing through the life of mine (east-west cross section) (Source: SRK)

Table 4-3 presents the details of the blasting regime in the pit. The explosives to be used will be an ammonium nitrate fuel oil (ANFO) or ANFO/Emulsion blend.
Table 4-3: Blasting drilling parameters for the pit.

<table>
<thead>
<tr>
<th>Drilling Parameters</th>
<th>Units</th>
<th>Production</th>
<th>Trim</th>
<th>Pre-Split</th>
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<tr>
<td>Bench Height</td>
<td>(m)</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
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<tr>
<td>Subdrill</td>
<td>(m)</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>Drill Angle</td>
<td>(°)</td>
<td>90.0</td>
<td>90.0</td>
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<tr>
<td>Hole Diameter</td>
<td>(mm)</td>
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<tr>
<td>Subdrill</td>
<td>(m)</td>
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<td>-</td>
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<tr>
<td>Spacing</td>
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<td>Burden</td>
<td>(m)</td>
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<td>Charge Height</td>
<td>(m)</td>
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<tr>
<td>Explosive Density</td>
<td>(t/m³)</td>
<td>0.95</td>
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<tr>
<td>Charge Per Hole</td>
<td>(kg)</td>
<td>200</td>
<td>132</td>
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<tr>
<td>Powder Factor</td>
<td>(kg/m³)</td>
<td>0.64</td>
<td>0.61</td>
<td>-</td>
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</table>

Source: SRK

Table 4-4 presents the vehicle numbers within the pit throughout the life of mine.
Table 4-4: Vehicle Numbers in the pit during life of mine

<table>
<thead>
<tr>
<th>Equipment Requirements</th>
<th>Units</th>
<th>-2</th>
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<th>17</th>
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<tbody>
<tr>
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<td>(#)</td>
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Source: SRK
**Closure**

At closure, all mobile equipment will be removed from the pit, terraces will be stabilised, re-contoured and ripped if necessary to allow vegetation to establish and a pit lake will develop over a period of up to 40 years.

The land around the pit will be fenced to prevent people or animals from entering the area. Signs will be erected advising of the hazards of the pit and pit lake.

**Post closure**

Post-closure, the pit lake will have a positive water balance and should spill once filled, which will take approximately 90 years (Section 5.3) after the mine stops operating. Measures to manage the water quality of discharge from the pit lake are presented in Section 6.3.

It is intended that the site would not require further intervention unless monitoring identifies that additional effort is required to manage water quality. Ownership and management of the site would revert back to the Forestry Company, assuming that the land will be reforested and re-categorised as forestry by the Macedonian authorities.

**4.4.3 Tailings Management Facility**

The proposed tailings management facility (TMF) will be a valley impoundment and involves the construction of an embankment across the Shtuka Valley to the southwest of the process plant. The tailings in the facility will be contained along the northern, eastern and southern sides by the natural contours of the valley, and on the western side by the TMF embankment.

**TMF Construction**

The TMF construction will occur in the following chronological order:

- In-catchment sediment management for construction, including construction of Storm Water Dam (SWD) for flood attenuation and settlement of sediment;
- Clearance of trees in the starter wall footprint;
- Progressive clearance of trees in Tailings deposition footprint;
- Construction of road to starter wall;
- Construction of road to river diversion dam;
- Construction of the river diversion channel;
- Construction of river diversion dam;
- Construction of starter dam; and
- Construction of Seepage Collection Facility (SCF).

During construction, overburden/waste rock from the pre-stripe area of the pit will be used to construct the TMF starter wall. The starter wall will be constructed to a height of approximately 45 m (an elevation of 625 mASL) prior to Year 0 (the commissioning milestone date), when tailings deposition in the facility will commence. The upstream face of the starter wall will be lined to an elevation of 625 mASL with a 2 mm HDPE liner to limit seepage during the first year of tailings deposition.

Any salvaged soils from clearance activities will be stockpiled for future use in rehabilitation and revegetation of the site.

Upstream raising of the TMF was deemed to not be a viable option due to the fine nature of the tailings, the very high rates of rise on the facility, the required storage capacity, and the high seismicity potential of the site. As it is likely that the tailings will take some time to consolidate, the facility has been designed using the downstream method of construction and dam wall raising to safeguard the long term structural integrity of the facility. The TMF embankment will be constructed throughout the life of mine. Figure 4-6 presents a long...
Figure 4-7 presents the volumes of material deposited in the TMF embankment throughout the life of mine (WRD = waste rock deposited in the downstream abutment).

The TMF will be constructed from waste rock dug out of the Open Pit. TMF construction (Starter wall construction) will start in Years -2, -1. The Operational life of the TMF and Plant will be 20 years. The TMF and Plant will be commissioned at the start of Year 1.

The TMF construction phasing provides adequate freeboard at all times to allow the facility to accommodate a Probable Maximum Flood (PMF) event (defined in Annex 1C), as well as to accommodate wall settlements should a seismic event occur. The TMF has been designed to accommodate the run-off from a PMF 24 hour event.
**Operations**

Throughout the operations phase, approximately 7 million cubic metres of tailings will be produced each year. Tailings will be gravity-fed from the plant to the TMF and deposited via pipeline and spigots. Tailings will have to be pumped to the furthest deposition points during the middle and later stages of the project due to longer pumping distances, higher friction losses and the reduction in static head between the plant and the TMF.

Supernatant water from the TMF will be returned to the process plant where it will be used as process water and make-up water for the pumping of tailings to the TMF. During normal operating conditions, between 746 m$^3$/hr and 917 m$^3$/hr of water will be returned to the Plant, although this will depend on the availability of interstitial water on the TMF. Supernatant water will be returned via a barge pumping system located on the southern side of the TMF.

The TMF supernatant water volume will be a function of the plant water requirements and the PMF retention volume. This may however have to be adjusted to meet stability requirements (i.e. minimum 2 m vertical freeboard, i.e. 200 m beach assuming 1% beach slope). Water accumulated during extreme events will be released in a controlled manner via the emergency decant system for spilling into the environment subject to water quality.

Tailings deposition on the TMF during the last three years of operation will be adjusted in such a way that the supernatant pool will be repositioned towards the southwestern side of the TMF. Once the tailings on the TMF have achieved a suitable degree of consolidation to support earthmoving equipment, the tailings will be shaped to the final landfill form for closure.

Throughout the operations phase, construction of the downstream wall raises will be a continuous operation. Waste rock and low grade material from the pit will be used as construction material. Surplus material will be stockpiled against the TMF embankment. Waste rock material with acid rock drainage (ARD) potential will be incorporated into the inner zones of the TMF embankment and buttress, surrounded by materials with low or very low ARD potential. Figure 4-8 presents the composition of waste material to be deposited showing different ARD potential to be managed within the TMF embankment and buttress. It is assumed that deposition of waste will be deposited in the sequence shown in Figure 4-8.

![Figure 4-8: Composition of mine waste to be deposited in the TMF embankment by Acid Rock Drainage (ARD) type (indicative dates only). (Source: SRK)](image)

At the end of operations, the TMF will have a storage capacity of approximately 140 Mm$^3$ (or approximately 210 Mt) and the TMF wall will have a closure elevation of approximately 776 mASL (approximately 2 m higher than the top tailing elevation). At closure, the TMF will have a top tailings surface area of approximately 191 Ha.
**Closure**

The objectives of the closure and reclamation of the TMF are to:

- Provide long-term engineering and chemical stability;
- Prevent the migration of airborne contaminants (dusting);
- Minimise rainfall infiltration into the TMF;
- Minimise long-term seepage and impact on groundwater;
- Prevent erosion from surface run-off;
- Blend with the natural surroundings; and
- Provide after use potential.

A key objective of closure of the TMF will be to minimise the likelihood of the formation of ARD and control storm water run-off. Given that the tailings will have a very low permeability and will not promote infiltration, this can be best achieved by promoting run-off and the growth of a vegetation cover to minimise infiltration further. The vegetated surface will also minimise the potentially damaging effects that soil erosion could have on the stability of the closed facility.

The TMF will be designed to ensure that short term attenuation of the PMF will not impact flood risk downstream of the TMF (assuming no WSD at closure).

At closure, it will be necessary to construct a closure spillway for the TMF to enable rainfall run-off to spill from the TMF surface. The closure surface of the TMF will be shaped to direct water towards the south of the facility, discharging down the southern side of the valley to a point downstream of the SWD. The system will be separate to the aforementioned Shtuka River diversion channel, so as not to mix clean and dirty water, and allowing for treatment (active or passive) of the run off from the TMF should it be required prior to discharge to the environment. Ten chute blocks and seven baffle blocks will be incorporated into the spillway to allow for the dissipation of energy. The spillway will be approximately 5.5 m wide at the base and 2 m deep with 1V:1H side slopes. The TMF spillway will be lined with reinforced concrete.

Closure of the surface of the TMF will include the filling-in, shaping and doming of the facility prior to capping with a layer of crushed waste rock, top soil or subsoil or other soil forming materials before the top surface and side slope of the facility are revegetated.

Post-closure, it is intended that the site would not require further intervention unless monitoring identifies that additional effort is required to manage water quality or vegetation establishment. Ownership and management of the site would pass/revert to the Forestry Company, assuming that the land will be re-categorised as forestry by the Macedonian authorities.

**TMF Diversion**

A diversion channel will be constructed to capture all in bank flow from the Shtuka River at a point upstream of the TMF, where a diversion dam will be constructed.

Flow for the upper catchment will be conveyed around the TMF under gravity and discharge it into the SWD (Section 4.4.9). The diversion channel will reduce the runoff catchment area draining to the TMF from approximately 12.9 km² to approximately 4.75 km².

The diversion channel will be designed to convey flow up to that generated during a 24 hour 100 year storm event in the upper Shtuka catchment and divert ephemeral drainages and runoff from all areas upgradient of the diversion channel. The diversion dam and diversion channel will be designed to safely spill a PMF event into the TMF.
Following closure, the Shtuka River diversion channel will continue to function until it falls into disrepair (provision for storm water retention on the TMF in post-closure will not include the diversion channel in order to take a conservative approach under which the diversion channel falls into disrepair).

4.4.4 Plant Site (including ROM, crusher and conveyor)

The process plant is designed to process 10 Mt/a of ROM (run of mine) ore. The Ilovica-Shtuka process plant consists of crushing, milling, flotation, regrinding, leach, CIL, elution, electrowinning and tailings treatment operations.

**Construction**

The construction phase will involve vegetation clearance, site preparation/levelling and construction of project facilities and infrastructure. Earthworks and construction will result in a number of exposed slopes, particularly for terraced (or disturbed) areas. All slopes that have been exposed during excavation and earthworks will be appropriately designed so that restoration may commence immediately after construction.

The average depth to rock is around 1.2 metres. Roughly 80% of the material in bulk excavations will require blasting. It can also be expected that compressors and paving breakers (“jackhammers”) will be used in performing restricted excavations.

Restoration of excavated slopes will entail (a) topsoil spreading, (b) stabilisation of topsoil followed by (c) reseeding or planting with appropriate indigenous vegetation. Where slopes are too steep for revegetation (largely blasted rock faces), they may be cleaned and scaled, shotcreted, rockbolted or meshed as necessary. Where gabions are used as permanent retaining structures these may be revegetated.

The crusher design will consist of a reinforced concrete crusher building enveloped on three sides with a composite ROM pad. The ROM pad construction will consist of reinforced earth providing the structural integrity on the interface walls with the balance of the ROM pad volume consisting of mass fill; sourced either from earthwork operations or mine waste. All earthworks and deposition of material for construction of the ROM pad will be by means of earthmoving equipment accessing the valley via construction road and end tipping for placement and compaction where applicable.

Where any solid edifice such as earthwork fill or concrete structure impinges on existing water courses, culverts will be installed to convey an appropriate design flow according the temporary (25 year return flow) or permanent (100 year return period flow) nature of the culvert. Where earthworks fill is not necessary for support of, say, sections of the overland conveyor, trestle supported gantries will be provided, as a preference, to span water courses.

**Operations**

During mine operations, the process plant will operate 24 hours per day, with the exception of the crusher and conveyor which will only operate 16 hours per day.

**Process description**

- **Primary crushing**: ROM ore is received via haul truck and dumped directly to the ROM bin. The ROM bin feeds the primary crusher where the ore is crushed. Dust suppression is provided to the ROM bin via the dust suppression water tank. The crushed ore is fed to the coarse ore stockpile via the primary crusher discharge apron feeder, primary crusher sacrificial discharge conveyor and the stockpile feed conveyor. Conveyor length from the primary crusher to the coarse ore stockpile is 1.6 km.

- **Milling**: Ore from the coarse ore stockpile is fed to the milling area, which is used to liberate the copper minerals for the downstream flotation process. The circuit comprises a Semi-Autogenous Grinding (SAG) mill operating in closed circuit with a pebble crusher. The SAG mill feeds forward to two parallel ball mills in closed circuit with cyclone clusters. The overflow from the cyclone clusters feed the trash screens. The underflow from the trash screens discharge to the flotation conditioning tank.
Flotation: The flotation circuit consists of pre-flotation screening, roughers, cleaners, cleaner scavengers and re-cleaners. A regrind Mill is present in the circuit to achieve better liberation in the ore cleaner, cleaner scavenger and recleaner stages.

Concentrate regrind: Concentrate from the roughers is pumped to the concentrate regrind mill.

Concentrate handling: Concentrate received from the flotation circuit must be dewatered and filtered prior to storage. A dewatering thickener acts as the first stage of dewatering feeding a Fast Opening Filter Press which will produce a final product for storage and final dispatch.

Conditioning, leaching and Carbon in Leach (CIL): Post flotation a process of leaching and adsorption is introduced in order to extract and purify a gold/silver solution for electrowinning. Cleaner Scavenger tails from flotation are dewatered in a pre-leach thickener. The underflow is then pumped to a conditioning tank where air, lead nitrate and lime are added. The conditioning tank then overflows into the leach tank. Cyanide is added to the leach tank for the dissolution of gold. A six stage counter-current CIL process is then used to actively adsorb gold from solution to a carbon medium. The gold depleted slurry is then sent to tails via the cyanide destruct facility and the gold rich carbon processed further via acid wash columns.

Cyanide destruction: Cyanide destruction is achieved in a series of three cyanide destruction tanks, each agitated and fed with plant air. Reagents in cyanide destruction: sodium metabisulphite, slaked lime, copper sulphate, hydrogen peroxide.

Acid wash, elution, electrowinning & regeneration: The acid wash step is used to remove any lime on the carbon. The Elution step is to remove the metals that have been adsorbed onto the carbon in the CIL. The solution that has stripped the metals from the carbon is then plated onto cathodes in the electrowinning cells. The metal "sludge" is then washed off the cathodes and filtered to remove the water. The filter cake is then calcined and smelted to produce doré bars.

Tailings management: The discharge from the acid wash is sent to the neutralisation tank where it is neutralised and then sent to the tails thickener feed box. Tailings are also received from the rougher cells. The slurry is fed through a single thickener where overflow water is recovered and underflow is discharged to tailings storage ponds along with cyanide destruction tails.

The crushed ore stockpile (at the end of the overland conveyor from the crusher) provides for 24 hours of nominal mill throughput of 1250 tonnes per hour. The bulk density will vary between 1.4 and 1.8. Therefore the volume will be 16 500 m$^3$ to 21 500 m$^3$.

**Materials and Reagents**

Numerous reagents are used throughout the process, each performing specific functions in the process. These are likely to include: frother and activator, collector, cyanide, lime, caustic soda, hydrochloric acid, lead nitrate, sodium metabisulphite (SMBS), hydrogen peroxide, coagulant and flocculant.

**Table 4-5: Estimated volumes of materials and reagents**

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<td>State</td>
<td>Formula</td>
<td>Supply Strength (w/w%)</td>
<td>Dosage Strength (mg/l or %)</td>
<td>Estimated consumption (t/month)</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------</td>
<td>-----------</td>
<td>---------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Flocculant</td>
<td>tonne</td>
<td>powder</td>
<td></td>
<td>100</td>
<td>2500</td>
<td>20</td>
</tr>
<tr>
<td>Sodium Silicate</td>
<td>tonne</td>
<td>40%equiv</td>
<td>Na2SiO3</td>
<td>36.8</td>
<td>10%</td>
<td>2270</td>
</tr>
<tr>
<td>Collector - Areso 7249</td>
<td>tonne</td>
<td>Liquid</td>
<td></td>
<td>100</td>
<td>10%</td>
<td>80</td>
</tr>
<tr>
<td>Frother - MIBC</td>
<td>tonne</td>
<td>Liquid</td>
<td>C6H14O</td>
<td>100</td>
<td>100%</td>
<td>30</td>
</tr>
<tr>
<td>Hydrated Lime</td>
<td>tonne</td>
<td></td>
<td>Ca(OH)2</td>
<td>&gt;90</td>
<td>15%</td>
<td>950</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>tonne</td>
<td>powder</td>
<td>NaOH</td>
<td>100</td>
<td>25%</td>
<td>20</td>
</tr>
<tr>
<td>Hydrochloric Acid</td>
<td>tonne</td>
<td>Liquid</td>
<td>HCL</td>
<td>33</td>
<td>3%</td>
<td>130</td>
</tr>
<tr>
<td>Sulphamic Acid</td>
<td>tonne</td>
<td>solids</td>
<td>H3NSO3</td>
<td>100</td>
<td>5-8%</td>
<td>1</td>
</tr>
<tr>
<td>Activated Carbon</td>
<td>tonne</td>
<td>solids</td>
<td>C</td>
<td>100</td>
<td>50%</td>
<td>3</td>
</tr>
<tr>
<td>Sodium Metabisulphite</td>
<td>tonne</td>
<td>powder</td>
<td>NaHS2</td>
<td>90</td>
<td>31%</td>
<td>670</td>
</tr>
<tr>
<td>Copper Sulphate</td>
<td>drum</td>
<td>powder</td>
<td>CuSO4</td>
<td>100</td>
<td>20%</td>
<td>10</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>tonne</td>
<td>Liquid</td>
<td>H2O2</td>
<td>45</td>
<td>45%</td>
<td>1</td>
</tr>
<tr>
<td>Borax</td>
<td>tonne</td>
<td>powder</td>
<td>Na2B4O7.10H2O</td>
<td>100</td>
<td>100%</td>
<td>0.1</td>
</tr>
<tr>
<td>Silica</td>
<td>tonne</td>
<td>powder</td>
<td>SiO2</td>
<td>100</td>
<td>100%</td>
<td>0.05</td>
</tr>
<tr>
<td>Soda Ash</td>
<td>tonne</td>
<td>powder</td>
<td>Na2CO3</td>
<td>100</td>
<td>100%</td>
<td>0.05</td>
</tr>
<tr>
<td>Nitre</td>
<td>tonne</td>
<td>powder</td>
<td>KNO3</td>
<td>100</td>
<td>100%</td>
<td>0.2</td>
</tr>
<tr>
<td>Lead Nitrate</td>
<td>tonne</td>
<td>powder</td>
<td>Pb(NO3)2</td>
<td>99</td>
<td>20%</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: AMECfw

**Emissions**

Emissions will be refined once the final process test work is complete and incorporated into Management Planning as appropriate.

Table 4-6 presents the air emissions from the processing of ore.
Table 4-6: Relevant Substances for the Gold Ore Processing Industry Emissions

<table>
<thead>
<tr>
<th>Substance</th>
<th>Chemical Formula</th>
<th>Comminution</th>
<th>Flotation</th>
<th>Thickening, Cyanidation, Carbon Loading</th>
<th>Elution And Electro Winning</th>
<th>Carbon Regeneration Kiln</th>
<th>Smelting</th>
<th>Mobile Equipment</th>
<th>Mining Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon disulfide</td>
<td>CS₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide (inorganic) compounds</td>
<td>CN⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>HCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>HS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury &amp; compounds</td>
<td>Hg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxides of Nitrogen</td>
<td>NOₓ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulate Matter ≤10.0 um (PM₁₀)</td>
<td>PM₁₀</td>
<td>329408</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>SO₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Volatile Organic Compounds</td>
<td></td>
<td>TBC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source (AMECfw)

TBC – To Be Confirmed

14 Sampling and testwork to date has not shown elevated levels of mercury in either the Ilovica-Shtuka ore or analyses of the products of processing testwork for the Project. Future testwork will continue to analyse for mercury to make sure any potential concentration of mercury in the processing circuit is adequately mitigated.
Environmental controls:
Separate dust suppression systems are provided at the primary crusher area and stockpile locations. Dust suppression is located at all major dust generating locations throughout the crushing and stockpile areas, crusher discharge, transfer points, and all feeder discharge points, to comply with air quality emissions standards.

Euromax Resources has a policy of zero surface water discharge from the site during construction and operations phases, to maximise use of site runoff for process water supply and minimise impacts on water quality in local streams.

Prevention and management of spills will be handled in accordance with good industry practice and the recommendations given in the Engineering Considerations report. These include bunding, secondary containment structures (to 110% capacity), storing fuel or other storage tanks on hardstanding and the installation and maintenance of oil and grease traps. The Project’s spill prevention and control procedure sets out a range of preventative measures and the response to spills.

Closure
The following methodology is proposed for the demolition and associated rehabilitation of the site of the processing plant in line with accepted closure methods and requirements:

- Conduct a detailed site assessment/survey aimed at identifying and quantifying all waste;
- Determine waste disposal options;
- Dismantling and removal of saleable plant infrastructure;
- Demolition of redundant steelwork;
- Identification and quantification of the extent of surface contamination (concrete and soil) and demarcation of such; Planned demolition of concrete foundations and removal of contaminated soil where present in a phased and structured manner to prevent ‘cross-contamination’ (i.e. contamination of clean areas);
- Disposal of all waste and waste material with accurate, detailed waste accounting records;
- Removal of concrete foundations to one metre below natural ground level;
- Backfilling with stockpiled subsoil/topsoil and contouring;
- Removal of alien/invasive plant species;
- Vegetation establishment in line with recommendations in the ESMP; and
- Final performance assessment and application for closure.

Concentrate storage pads will cover an area of approximately 360 m² within the process plant. Closure will include demolition of concrete slab and amelioration of the substrate of impacted areas. Any contaminated topsoil or upper soil horizon will be placed on the tailings management facility prior to its final closure. The same strategy and methods will be applied for the conveyor from the primary crusher to the coarse ore stockpile and the conveyors within the plant area.

Due to the low availability of soils on site, is deemed unfeasible to apply topsoil over the total extent of the project footprint at closure. It is therefore recommended that the use of topsoil be limited to and/or optimised within areas where disturbance of the surface is considered to be most significant.

The plant site will be revegetated in accordance with the closure plan and biodiversity action plan.

Post closure
Post-closure, it is intended that the site would not require further intervention unless monitoring identifies that additional effort is required to establish and maintain vegetation cover. Ownership and management of the
site would pass/revert to the Forestry Company, assuming that the land will be recategorised as forestry by the Macedonian authorities.

### 4.4.5 Mine Workshop

The mining and administration complex will be an infrastructure area located at the south centre of the overall site and will consist of buildings and workshops (offices, truck and equipment workshops, tyre repair facilities, boiler workshop, component stores, change house, control room and gate houses, and sewage treatment plant).

#### Construction

The construction phase will involve vegetation clearance, site preparation/levelling and construction of project facilities and infrastructure. Earthworks and construction will result in a number of exposed slopes, particularly for terraced (or disturbed) areas. All slopes that have been exposed during excavation and earthworks will be appropriately designed so that restoration may commence immediately after construction. Restoration of excavated slopes will entail (a) topsoil spreading, (b) stabilisation of topsoil followed by (c) reseeding and or planting with appropriate indigenous vegetation.

#### Operations

During operations, the mine workshop will be operational 24 hours per day. The mine workshop area includes the entry/exit point for all vehicles entering the site, including the gate house, security, and parking areas. Euromax Resources has a policy of zero surface water discharge from the site during construction and operations phases, to maximise use of site runoff for process water supply and minimise impacts on water quality in local streams.

Vehicle refuelling and maintenance will occur at the mine workshop and as such, this will be the location where a number of hazardous materials are stored and used. Control measures are specified in the spill prevention and control procedure (Amec Foster Wheeler, 2015c).

#### Closure

Some infrastructure at this location might be suitable for post-mining use, such as offices and stores area which could potentially be integrated into a sustainable social development plan for the area. Demolition of other structures and rehabilitation will be undertaken in a similar manner as described for the process plant.

The mine workshop area will be revegetated in accordance with the closure plan and biodiversity action plan.

#### Post closure

Post-closure, it is intended that the site would not require further intervention unless monitoring identifies that additional effort is required to establish vegetation. Ownership and management of the site would pass/revert to the Forestry Company, assuming that the land will be re-categorised as forestry by the Macedonian authorities.

### 4.4.6 Off-site Access Roads

A new off-site access road is planned to connect the Project to the existing M6 highway which runs between Strumica and the Bulgarian border. The new off-site access road will be developed in two stages to serve mine construction and mine operations.

- The temporary off-site access road (shown in green, Figure 4-9), to be used during construction, is located along the eastern bank of the Shtuka river and through agricultural land. It does not cross the Shtuka River. The route is on existing tracks currently used to access fields. Existing tracks will be upgraded and widened for the duration of the construction phase until the permanent access road is complete. Access for agricultural workers will not be affected.

- The permanent off site access road (shown in purple, Figure 4-9) will be a new paved road between the concession and the M-6 to a new junction between Serkirnik and Turnovo. This new road will allow project traffic access and local farm access during operations and minimize traffic congestion through the
villages of Shtuka, Ilovica and Turnovo. There is no public access to this new road during operations. Access will be controlled during operations at the junction between the temporary and permanent off-site access road.

Figure 4-9: Off Site access road

Construction

The temporary off-site access road will have a gravel topped finish and a single carriageway width of 4.0 m plus 1.5 m wide shoulders on either side. Passing places will be constructed at suitable intervals to allow two way traffic when necessary.

The permanent off-site access road will have a carriageway width of 7.0 m, plus 1.5 m wide gravel shoulders on each side. The road will be sealed asphalt/‘black top’. A 2.5 - 3.0 m wide corridor on the uphill side will be included to accommodate roadside drains. As the access road cuts through agricultural fields, service roads for local farmers have been included on both sides of the project access road to give access to fields without the need for crossing points on the project access road. The service roads will have a width of 5.0 m, with 1.5 m shoulders.

The junctions for the permanent and temporary access roads with the existing main road will be in line with the design requirements of the Macedonian road authorities and will be submitted for approval by the PESR. The temporary junction will require road widening and access lanes and will be asphalt finish for approximately 50 m from the new junction.
**Operations**

The permanent off-site access road will be in use 24 hours per day with mixed mine traffic usage, from personal vehicles to trucks making deliveries or exporting copper concentrate and/or gold. Further details of traffic volumes are provided in Section 4.6. During operations, it will be maintained by Euromax (or an appointed contractor) in cooperation with the municipality. Speed limits will be set according to the requirements of the Macedonian road authorities.

**Closure**

Once the permanent off-site access road is constructed, the temporary off-site access road will be cleared and returned to local use.

The permanent off-site new access road will remain in place permanently and would be handed over to the Municipality of Bosilovo for ongoing management as a local road to provide access to fields and remaining infrastructure put to alternative use, and possibly as an alternative means of accessing Ilovica and Shtuka, with appropriate road extensions to the villages.

4.4.7 **On site Access Road**

The on-site access road selected for access within the concession joins the permanent offsite access road and is located along the left hand side (looking downstream) of the Shtuka valley. It runs adjacent to the TMF diversion channel and crosses the Shtuka at the diversion dam. Figure 4-10 presents the on-site access road location.

**Construction**

The permanent on-site access road will have a carriageway width of 7.0 m, plus 1.5 m wide gravel shoulders on each side. The road will be sealed asphalt/’black top’. A 2.5 - 3.0 m wide corridor on the uphill side will be included to accommodate roadside drains.

**Operations**

The on-site access road within the concession will be sealed and used by project traffic only. It will be maintained by Euromax (or an appointed contractor) during operations. Speed limit within the mining concession will be no more than 50 km/h.

**Closure**

Within the concession area, the access road will remain in place for use by future land users and in cooperation with the Municipality and forestry authorities who may find it useful to access areas to the north of the concession.
4.4.8 Haul Roads

Haul roads will be constructed between the pit and the TMF embankment and to the mine workshop area. Figure 4-11 presents the haul roads and when they will be constructed during the mine life.
Figure 4-11: Haul Roads showing likely time of construction (Source: SRK)

Figure 4-12 shows the separation of contact and non-contact water on the haul roads which would naturally discharge to the watercourses downstream of key mining infrastructure.
Figure 4.12: Haul roads showing indicative drainage (Source: AMECfw)
Construction

The haul road surface will be crushed aggregate. Haul roads will be 25 m wide with road drainage on the upgradient side of the road and a camber on the road to encourage contact water to fall to the drain. The drainage system will be designed to a designed to convey a 100 year return period storm falling directly on the road to sediment settling locations at accumulation points.

Non-contact water drains will run adjacent and upgradient of all haul roads to ensure that non-contact runoff from upgradient areas can be separated from contact water on the haul roads. Non-contact water from upgradient areas will pass under the road via culverts.

The culverts under access roads or haul roads dimensions should be sized based on a design flood discharge with at least a 1 in 25 year return period, which would be derived based on the upslope contributing area. During storms exceeding this criteria, some overtopping of roads is expected. The culverts should be provided with appropriate erosion protection (rip-rap) to reduce flow velocities downstream of the outlet prior to the water being conveyed through silt fences, sized to retain material down to a fine silt or, alternatively, small sediment traps/ponds.

Haul roads will be constructed with a 3 m high safety bund along the outer edge of the roads. These bunds will be maintained throughout operations.

Blasting will be used in key sections of the 25 m wide road. The blasting regime will be defined by the construction contractor. However, prior notification of blasting will be provided to police and local authorities and all blasting will be blanketed, as needed and as identified in the ESIA, to prevent flyrock. This will also have the effect of damping the noise generated by blasting.

Earthworks construction will result in a number of exposed slopes. All slopes that will be exposed during excavation and earthworks, for example earthwork cuts and terrace fills, will be either revegetated, or where slopes are too steep for revegetation (largely blasted rock faces), they may be cleaned and scaled, shotcreted, rockbolted or meshed as necessary. Where gabions are used as permanent retaining structures these may be revegetated.

Operations

Haul roads will be in use 24 hours per day. Speed limit within the mining perimeter will be no more than 50 km/h. Water spraying (included as a design mitigation to reduce dust) is assumed to have 85% efficiency. Maximum length of haulage for ore is 2.7 km (to the ROM pad) and for waste rock is 5.4 km (to the TMF embankment).

Closure

Rehabilitation will be confined to ripping the compacted surfaces for natural vegetation to become re-established more easily. Shotcreted areas and other areas physically stabilised will not be rehabilitated nor revegetated in line with the natural steeper rock faces.

Post closure

Post-closure, it is intended that the site would not require further intervention unless monitoring identifies that additional effort is required to establish and maintain vegetation. Once vegetation has become established, areas of forest suitable for harvest will be managed by the Forestry Company, assuming that the land will be re-categorised as forestry by the Macedonian authorities. Any areas designated for biodiversity enhancement will be managed according to the biodiversity action plan.

4.4.9 Water Management

The project components addressed in the design of water management for the Ilovica-Shtuka Project are the process plant area, the open pit and mine infrastructure area, the run of mine (ROM) pad (including crusher), the access road, the plant feed conveyor and tailings management facility (TMF).
**Construction**

In the early stages of construction, all surface water management and sediment control infrastructure will be put in place. This will include:

- A diversion channel and diversion dam to divert the Shtuka River around the TMF. The diversion channel will intercept the upper catchment of the Shtuka valley, i.e. upstream of the diversion dam and divert ephemeral drainages and runoff from all areas upgradient of the diversion channel. The diversion channel will discharge into the Storm Water Dam;

- A Storm Water Dam (SWD) to be constructed on the Shtuka River downstream of the TMF. The SWD will attenuate high flows up to a 25 year return period storm and allow settlement of sediment-heavy runoff from the stripped dam site and from the partially stripped TMF basin. Normal flows will be allowed to discharge through the porous dam of the SWD, to maintain ecological flows downstream, and high flows will be attenuated to ensure that flood risk is not increased downstream;

- Stored water meeting the project TSS (total suspended solids) discharge standard will be released to the Shtuka River. The SWD will mitigate a potential impact of construction of the TMF on water quality in the Shtuka River. It may be necessary to flocculate water stored in the SWD to remove fine particles, i.e. clay particles;

- A Seepage Control Facility (SCF) to be constructed on the Shtuka River between the TMF and the SWD to capture seepage from the TMF and runoff from both the TMF embankment and waste rock abutment during operations. The seepage control dam is provided to mitigate a potential impact of seepage from the TMF on water quality in the Shtuka River;

- Runoff/sediment control dams to be constructed on ephemeral water courses draining areas to be stripped, for example below the mine infrastructure area. Ponds will capture sediment-heavy runoff and prevent discharge to the Jazga and Shtuka rivers. All surface water runoff entering these ponds will pass through silt traps prior to entering the main pond. Captured water will be used for construction and dust suppression;

- During construction, large cleared areas will be rilled on contour to reduce downslope sheet flow and minimise surface erosion. Silt fences should then be installed within the cleared areas and around the downslope boundaries approximately on contour;

- Excavation for the construction of the pit will commence in Year -2 at the top of watershed between the Shtuka valley and the Jazga valley, and will proceed down slope within a subcatchment which drains to the Jazga River. Excavation will be preceded by removal of the vegetation cover, with vegetation removal keeping just ahead of excavation in order to minimise exposure of soils to rainfall and erosion. Forest cover will be retained as long as possible to minimise erosion. During construction Years -2 and -1 any sediment mobilised on the excavated area will be controlled before entry into the Jazga River by managing runoff in sumps on the excavated area. Construction contractor will divide the excavated area into micro-catchments which drain to sumps on the excavated surface. The sumps will be sized according to the area draining to them, but will provide 200 m$^3$ of storage per hectare of drainage area. Coarse sediment suspended in site runoff will settle out in the sumps. The sumps will be allowed to drain onto the hillside (not drainage lines) in wide, horizontal, shallow channels cut by the operator to prevent overflows concentrating in erosive streams. Sediment control fences will be constructed on the hillside below the excavated area. The overflow will be in the form of intermittent shallow 'sheet flow' after rainfall. This sheet flow will infiltrate the soils on forested slopes below the excavated area, depositing any transported sediment. Only in exceptional circumstances will flow and sediment reach the Jazga River. This drainage system will be adequate while the excavated area is relatively small and separated from the Jazga River channel in Years -2 and -1 by forested hillslopes; and

- In Year -1 an access road to the ROM pad will be constructed across the ‘pit subcatchment’. An embankment carrying the road will be constructed across the main drainage line in the lower part of the ‘pit sub-catchment’ downslope from the excavated area. The road and embankment will be designed so that they form a barrier to flow and a pond at the drainage line which captures and stores runoff and
sediment arriving at the road from the excavated area upslope and prevents discharge to the Jazga River up to the 25-year, 24-hour design storm for temporary structures. Captured runoff will, in all cases, be pumped to the process water storage facility at the plant site. Only water from the Ilovica Reservoir will be pumped into the raw water facility. Captured sediment will be periodically excavated and deposited on the TMF.

Sediment will be dredged from all sediment management facilities at an appropriate frequency according to best industry practice and will be stockpiled as a soil forming material for closure or disposed of in the TMF.

**Operations**

Water and sediment management during operations will be provided by the water and sediment management works constructed during the construction phase, namely:

- The diversion dam and diversion channel will divert the Shtuka River and ephemeral drainages around the TMF. The diversion channel will discharge to the SWD;

- The SWD will store sediment-heavy runoff from the TMF embankment and infrastructure within its catchment on the right bank of the Shtuka River, during up to a 100 year return period storm. Stored water meeting the project TSS discharge standard will be released to the Shtuka River. The SWD is provided to mitigate a potential impact of the TMF on water quality in the Shtuka River. It may be necessary to flocculate water stored in the SWD to remove clay particles;

- The SCF will collect seepage from the TMF and runoff from the TMF embankment. Seepage and runoff collected will be pumped back for supply to the process plant. During high return period storm events some runoff may overflow the seepage control dam and flow into the SWD. The seepage collection facility will be sized to retain seepage and contact water and only allow spilling should dilution mean that spilled water is of an acceptable quality. The seepage control dam is provided to mitigate a potential impact of seepage from the TMF on water quality in the Shtuka River;

- In Years 1 and 2 the road and embankment downslope of the excavated area will control runoff and sediment arriving from upslope and prevent discharge to the Jazga River under design storm conditions. Captured runoff will be pumped to the process water storage facility at the plant site. Captured sediment will be periodically excavated and deposited on the TMF;

- From Year 3 onwards to end of mine life the pit will have a bowl form. In-pit water (groundwater and rainfall runoff) will be prevented from draining out of the pit under gravity from Year 3 until the end of mine operations. During this period, captured water will be pumped to the process water storage facility at the plant site and a low water level will be maintained in the pit sump;

- Runoff/sediment control dams, for example below the mine infrastructure area, will capture runoff and sediment. Where possible contact water will be recirculated to the process plant. Runoff from the plant area will drain to and be stored in the TMF for subsequent recirculation to the process plant water storage dam; and

- A sump will be constructed at the crusher building for collection of rain water and washdown water. This will be pumped to the process dam along with water from the pit dewatering.

In addition, side drains will be installed adjacent to all roads. Side drains will capture runoff and direct it to runoff/sediment dams.

Dams, ponds and silt traps will be appropriately designed to allow vehicle access for desilting, clearing and cleaning. It is expected that any silt removed, as part of routine operational maintenance will be stockpiled for use as soil forming material in reclamation or deposited at the tailings management facility.

**Closure**

During and following closure, water and sediment will be managed by the following activities:
The diversion dam and diversion channel will continue to function following mine closure. However, provision for storm water retention on the TMF in post-closure will not include the diversion channel in order to take a conservative approach under which the diversion channel falls into disrepair;

A spillway will be constructed in the TMF that will be designed to safely pass the Probable Maximum Flood, ensure that flood risk in the downstream villages is not increased from the baseline scenario following closure and that water quality discharged is acceptable;

If flood risk analysis shows that the TMF can manage flood events so there is no increased risk to the downstream settlements compared to baseline, the SWD will be commissioned during post closure;

The SCF will continue to collect seepage from the TMF and runoff from the TMF embankment plus the waste rock abutment. Seepage and runoff collected will drain by gravity to treatment, to be specified as mitigation in the ESIA. The SCF and any additional water treatment will mitigate a potential impact of seepage from the TMF on water quality in the Shtuka River;

Runoff/sediment ponds will be decommissioned during the closure phase, once monitoring identifies that discharge water quality is acceptable for discharge to the environment; and

Pumps in the pit will be decommissioned during mine closure. It is expected that the pit will gradually fill with water (rainfall runoff and groundwater inflow). Flood risk measures will be put in place if required and an engineered facility will be installed at the pit overflow point which allows the overflow to drain by gravity to a treatment plant for pH correction and removal of metals. Water will be treated to a standard suitable for discharge to the environment, which will be specified as mitigation in the ESIA. The timing of overflow is expected at up to 90 years after cessation of pumping.

4.4.10 Soil stockpiles

Construction

Small quantities of soil (topsoil, subsoil) may be recoverable during vegetation clearance and site preparation in the construction phase. The Macedonian EIA identified that the estimated total volume of topsoil to be salvaged at construction will be in the region of 65,000 m³. This is subject to change with the updated footprints. Any recoverable soils will be stockpiled within the concession area for future rehabilitation of the site.

Stockpiles will be managed according to good international practice (e.g. separating topsoil and subsoil, avoiding compaction) to maintain soil quality. Permanent stockpiles will be reseeded during construction in order to mitigate erosion.

The locations of soil stockpiles will be determined in the closure plan as part of the Environmental and Social Management System (ESMS).

Stockpiles will be shaped to drain, i.e. not to form ponds. The height of the stockpiles will depend on the volume in each stockpile shaped with an appropriate factor of safety applied to the slopes.

Operations

Stockpiles of soil and soil forming materials will be maintained and managed according to the ESMS.

Closure

Stockpiled soil and soil forming materials will be used in the rehabilitation of the site at closure. As such, soil stockpiles will be removed and their sites rehabilitated.

Mine infrastructure areas where revegetation is most likely will be prioritised for topsoil deposition. It is likely that the TMF will be capped with a layer of crushed waste rock selected from the TMF abutment or other soil forming materials before the top surface and side slope of the facility are revegetated.
4.4.11 Accommodation

Construction

Construction staff will be accommodated off-site at existing facilities (hotels or existing (commercial) buildings appropriately refurbished), most likely in Strumica.

Euromax and the company's contractors will require approximately 430 beds in Strumica during the construction period for expat and non-local Macedonian employees, who could be accommodated in existing hotel space (a Euromax accommodation survey identifies more than 700 places in Strumica hotels). There remains an option for contractors to take over unfinished buildings in Strumica and surrounding villages and finish them to the required standard for their use during the construction period, or to lodge with families in the area.

Operations

During operations, all workers will live in nearby towns and villages, with site visitors being accommodated in existing refurbished hotels or guest houses.

Closure

During closure, all workers will live in nearby towns and villages.

4.4.12 Other Facilities

Medical centre

An on-site medical clinic will be in place throughout construction, operations and closure. In addition, there will be a 4x4 ambulance and paramedic at the site. The clinic will likely be at the mine workshop site, with a first aid post at the plant site.

Security

The site perimeter will be fenced, with additional security fencing around certain facilities (a total of 22,300 m of fencing). A gate house will be located at the site entrance (where the access road enters the concession area) which will be manned by security personnel. The gold room building will be designated a high security zone with its own integrated personnel and vehicle access.

Security fencing will be removed at closure and disposed of in accordance with statutory and regulatory requirements.

4.5 Water and Power Supply

4.5.1 Water Supply

Project Water Strategy

Since water resources in the Strumica River basin are extensively used and the potential exists for the project to affect the water supplies of other water users in the area it will be important to minimise the project's water footprint. To achieve this, the project's water strategy will involve:

- Conservation of water in tailings, wastewater and site runoff to achieve zero surface water discharges from the site, and re-cycling of conserved water into the water supply system;

- Using water resources that others are not using. Water supplies from Turija reservoir, groundwater and other sources in the Strumica valley are currently under investigation;

- Maintaining the reliability and protecting the quality of existing water sources for domestic users and agriculture and aquatic ecology; and

- Cooperation with local and national water sector institutions.
Major Sources of Water Supply

A site water balance predicts that the process plant (including the TMF) would have a negative water balance and would require between 210 m³/hr and 330 m³/hr of make-up water after TMF, pit and sewage waters have been reclaimed. A minimum of 210 m³/hr of this must be fresh water. Two major sources of water will supply the mine:

- Conserved on-site sources of water; and
- External sources of fresh water.

Conserved on-site sources of water

The sources of water conserved on site and re-used in the mine water supply system are:

- Reclaim from the TMF, including water pumped from the SCF;
- Pit water; and
- Treated wastewater.

Reclaim water from the TMF pond is a major source of water for the process plant. The TMF pond will contain water transferred to the TMF in the tailings stream. Water will be pumped from the TMF pond to the process plant water storage facility. Pumps will be barge-mounted. The site water balance predicts that the TMF pond will be able to contribute a significant proportion of the total demand of the process plant. In line with Euromax’s strategy of conservation and recycling of water, the tailings pond will also receive water pumped from the Seepage Collection Facility (SCF) situated downstream of the toe of the TMF embankment. Water pumped to the TMF from the SCF will comprise:

- Seepage from the base of the downstream face of the TMF embankment;
- Groundwater flow combined with minor seepage from the tailings reservoir intercepted by the SCF;
- Storm runoff from the downstream face of the embankment;
- Storm runoff from the mine infrastructure area which will be captured in the infrastructure area runoff dam and pumped to the SCF; and
- Treated sewage effluent (approximately 0.04 Mm³/year) from a sewage treatment plant at the lower infrastructure area which will be discharged to the infrastructure area runoff dam and pumped to the SCF (also see Section 4.7.4).

Table 7 presents estimated annual quantities of water reclaimed from the TMF pond divided into water from the tailings stream and water pumped from the SCF. Water quantities transferred to the tailings pond from the SCF are expected to be relatively minor in relation to quantities of water in the pond originating from the tailings stream. Groundwater flow and seepage have been estimated by 2D and 3D groundwater modelling.

The quantities presented in Table 7 are mean annual results from the site water balance model. The model also provides estimates on a monthly basis and includes variability for prolonged dry periods and storm events. When accounting for these conditions, the model shows that:

- In the early years of mine life, the TMF water balance will be negative, so more than the minimum fresh water demand of 210 m³/hr will be required to make up the reclaim demand;
- Depending upon the rainfall conditions, the TMF water balance will become positive between years 2 and 5 so will be able to support the full reclaim demand; and
- Later in mine life (after year 10) there may be a requirement to manage excess water on the TMF.

Tailings pond water will be of relatively poor quality. The chemistry of the tailings pore water as delivered to the TMF will be dominated by the ore beneficiation process: alkaline, metalliferous and to have a low
concentration of CN as a result of the CN destruct plant. Pond water quality, in addition, will be influenced by catchment runoff and evaporation.

The quality of water pumped from the SCF is expected to be dominated by a mix of acidic, metalliferous water from the TMF embankment and alkaline, metalliferous water from the tailings.

**Table 7: Estimated annual volumes of conserved water from the TMF and seepage collection dam**

<table>
<thead>
<tr>
<th>Year</th>
<th>Water from tailings stream</th>
<th>Seepage collection pond return*</th>
<th>Runoff and precipitation</th>
<th>Losses</th>
<th>Reclalm to plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year -2</td>
<td>0.00</td>
<td>0.00</td>
<td>0.37</td>
<td>0.37</td>
<td>0.00</td>
</tr>
<tr>
<td>Year -1</td>
<td>0.00</td>
<td>0.00</td>
<td>0.47</td>
<td>0.47</td>
<td>0.00</td>
</tr>
<tr>
<td>Year 1</td>
<td>8.73</td>
<td>0.68</td>
<td>0.45</td>
<td>3.16</td>
<td>5.82</td>
</tr>
<tr>
<td>Year 2</td>
<td>10.99</td>
<td>0.83</td>
<td>0.63</td>
<td>3.49</td>
<td>8.83</td>
</tr>
<tr>
<td>Year 3</td>
<td>10.99</td>
<td>0.79</td>
<td>0.69</td>
<td>3.57</td>
<td>8.50</td>
</tr>
<tr>
<td>Year 4</td>
<td>10.99</td>
<td>0.94</td>
<td>0.81</td>
<td>3.61</td>
<td>8.93</td>
</tr>
<tr>
<td>Year 5</td>
<td>10.99</td>
<td>0.99</td>
<td>0.87</td>
<td>3.67</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 6</td>
<td>10.99</td>
<td>1.02</td>
<td>0.94</td>
<td>3.74</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 7</td>
<td>10.97</td>
<td>1.04</td>
<td>1.03</td>
<td>3.81</td>
<td>8.92</td>
</tr>
<tr>
<td>Year 8</td>
<td>10.99</td>
<td>1.04</td>
<td>1.07</td>
<td>3.90</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 9</td>
<td>10.99</td>
<td>1.06</td>
<td>1.12</td>
<td>3.97</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 10</td>
<td>10.99</td>
<td>1.09</td>
<td>1.21</td>
<td>4.04</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 11</td>
<td>10.49</td>
<td>1.10</td>
<td>1.30</td>
<td>3.97</td>
<td>8.53</td>
</tr>
<tr>
<td>Year 12</td>
<td>10.49</td>
<td>1.11</td>
<td>1.32</td>
<td>4.04</td>
<td>8.53</td>
</tr>
<tr>
<td>Year 13</td>
<td>10.74</td>
<td>1.10</td>
<td>1.35</td>
<td>4.19</td>
<td>8.74</td>
</tr>
<tr>
<td>Year 14</td>
<td>10.99</td>
<td>1.10</td>
<td>1.45</td>
<td>4.33</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 15</td>
<td>10.99</td>
<td>1.11</td>
<td>1.53</td>
<td>4.39</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 16</td>
<td>10.99</td>
<td>1.11</td>
<td>1.52</td>
<td>4.45</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 17</td>
<td>10.89</td>
<td>1.12</td>
<td>1.58</td>
<td>4.48</td>
<td>8.86</td>
</tr>
<tr>
<td>Year 18</td>
<td>10.89</td>
<td>1.12</td>
<td>1.71</td>
<td>4.58</td>
<td>8.86</td>
</tr>
<tr>
<td>Year 19</td>
<td>10.99</td>
<td>1.07</td>
<td>1.73</td>
<td>4.71</td>
<td>8.94</td>
</tr>
<tr>
<td>Year 20</td>
<td>6.12</td>
<td>1.05</td>
<td>1.73</td>
<td>4.45</td>
<td>4.95</td>
</tr>
</tbody>
</table>

Source: WSP

* Quantities include runoff and treated sewage effluent from lower infrastructure site.

Pit water will comprise groundwater inflows to the pit and rainfall runoff generated within the pit (Table 8). During Years -2 to 2 surface runoff and groundwater inflows to the excavated area will be managed in sumps and will not be pumped to the process plant. From Year 3 onwards through mine life pit water will be pumped from the pit to the process water dam at the process plant. Pit water quality is expected to be acidic, metalliferous and to have elevated total suspended solids concentrations.

A sewage treatment plant (also see Section 4.7.4) planned at the upper plant site is expected to produce approximately 0.05 Mm³/year which will be discharged to the process water dam. All treated sewage effluent produced at the upper plant site and lower infrastructure site will meet EU standards and be re-used.

Table 8 presents estimated annual quantities of conserved pit water and effluent treated at the upper plant site. Groundwater inflows to the pit have been estimated using a 3D groundwater flow model. Direct rainfall on the sump, evaporation from the sump and runoff from the ROM pad are not included in Table 8, but the net effect is expected to be negligible.
### Table 8: Estimated annual volumes of conserved water from pit and treated sewage effluent from upper plant site

<table>
<thead>
<tr>
<th></th>
<th>Pit water</th>
<th>Plant site treated sewage effluent</th>
<th>Combined pit water and plant site treated sewage effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Runoff *</td>
<td>Groundwater *</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Mm³/yr</td>
<td>Mm³/yr</td>
<td>Mm³/yr</td>
</tr>
<tr>
<td>Year -2*</td>
<td>0.003</td>
<td>0.000</td>
<td>0.003</td>
</tr>
<tr>
<td>Year -1*</td>
<td>0.011</td>
<td>0.004</td>
<td>0.015</td>
</tr>
<tr>
<td>Year 1*</td>
<td>0.026</td>
<td>0.050</td>
<td>0.076</td>
</tr>
<tr>
<td>Year 2*</td>
<td>0.041</td>
<td>0.186</td>
<td>0.227</td>
</tr>
<tr>
<td>Year 3</td>
<td>0.048</td>
<td>0.205</td>
<td>0.253</td>
</tr>
<tr>
<td>Year 4</td>
<td>0.054</td>
<td>0.246</td>
<td>0.299</td>
</tr>
<tr>
<td>Year 5</td>
<td>0.057</td>
<td>0.257</td>
<td>0.314</td>
</tr>
<tr>
<td>Year 6</td>
<td>0.056</td>
<td>0.265</td>
<td>0.321</td>
</tr>
<tr>
<td>Year 7</td>
<td>0.056</td>
<td>0.262</td>
<td>0.319</td>
</tr>
<tr>
<td>Year 8</td>
<td>0.061</td>
<td>0.260</td>
<td>0.321</td>
</tr>
<tr>
<td>Year 9</td>
<td>0.062</td>
<td>0.267</td>
<td>0.329</td>
</tr>
<tr>
<td>Year 10</td>
<td>0.063</td>
<td>0.289</td>
<td>0.352</td>
</tr>
<tr>
<td>Year 11</td>
<td>0.067</td>
<td>0.347</td>
<td>0.414</td>
</tr>
<tr>
<td>Year 12</td>
<td>0.068</td>
<td>0.380</td>
<td>0.448</td>
</tr>
<tr>
<td>Year 13</td>
<td>0.071</td>
<td>0.355</td>
<td>0.426</td>
</tr>
<tr>
<td>Year 14</td>
<td>0.073</td>
<td>0.337</td>
<td>0.410</td>
</tr>
<tr>
<td>Year 15</td>
<td>0.073</td>
<td>0.343</td>
<td>0.416</td>
</tr>
<tr>
<td>Year 16</td>
<td>0.074</td>
<td>0.361</td>
<td>0.434</td>
</tr>
<tr>
<td>Year 17</td>
<td>0.074</td>
<td>0.405</td>
<td>0.478</td>
</tr>
<tr>
<td>Year 18</td>
<td>0.074</td>
<td>0.432</td>
<td>0.506</td>
</tr>
<tr>
<td>Year 19</td>
<td>0.074</td>
<td>0.432</td>
<td>0.506</td>
</tr>
<tr>
<td>Year 20</td>
<td>0.074</td>
<td>0.423</td>
<td>0.496</td>
</tr>
</tbody>
</table>

Source: WSP

* Runoff and groundwater inflows will be managed in sumps on the excavated area in Years -2 to 2.

The balance of the mine demand not met by the supply from the tailings pond, pit water and treated wastewater will be met from sources of fresh water that are external to the mine site.

**External sources of fresh water**

The main external source of fresh water supply will be Turija Reservoir. Turija dam is owned by the Government of Macedonia and operated by SPWMC. SPWMC has offered Euromax a supply of up to 7.884 Mm³/year in the first year of mine production and up to 4.38 Mm³/year in subsequent years from Turija reservoir with a minimum supply of 2.08 Mm³/year. Investigations of the reliability of a water supply from Turija reservoir are still underway. For the purposes of this project description it is assumed that water is transferred from Turija Reservoir via a pipeline and pumps to Ilovica reservoir. The pipeline route is assumed to follow the route of the existing Turija canal to Ilovica and to approach the reservoir from the south west. The proposed transfer will be operated by SPWMC. Figure 13 shows a schematic of the proposed water supply scheme from Turija and other external sources.

Other external sources of fresh water, such as groundwater, are under investigation and are not considered in this impact assessment. If groundwater and other sources of water prove to be a viable options for mine water supply an assessment of impacts will be made in an addendum to this ESIA.
Water from Turija reservoir and other external sources will be pumped into Ilovica Reservoir in order to support Euromax’s abstraction and maintain the reliability of water supplies of the other users. Strumichko Pole Water Management Company and Bosilovo Public Utilities Enterprise currently supply agricultural water and potable water respectively from Ilovica reservoir.

Euromax currently plans to use Ilovica Reservoir as a holding reservoir for water from Turija Reservoir. Water for mine supply will be pumped from Ilovica reservoir to the raw water storage facility at the process plant. It is planned to operate Ilovica Reservoir so that the typical baseline spill regime is preserved and a normal operating water level of less than 0.5 m below spillway crest is maintained so that a short-term (c. 2 week) emergency water supply is available. Ilovica Reservoir is not intended to be used as a drought mitigation measure.

Figure 13: Schematic of modelled mine make-up water supply system
Minor Sources of Water Supply

In line with Euromax’s strategy of conservation and recycling of site runoff and wastewater, the following minor sources of water supply located on the mine site will supplement the major water supplies previously mentioned.

- **Site runoff** – Areas that are expected to generate runoff are: the pit catchment during Years 2 to 2, haul roads, areas of hard standing at the upper plant site and lower mine infrastructure site. Quantities of runoff collected from the pit catchment have been included in Table 8. Runoff from haul roads in the TMF catchment will be captured in the TMF. Runoff from haul roads outside the TMF catchment will be captured in the seepage dam and pumped to the TMF, and are included in Table 8. Runoff from the upper plant site will drain to and be captured in the TMF. Runoff from the lower mine infrastructure site will be collected in a runoff pond below the mining infrastructure site and re-used for example for dust suppression. It is estimated that an average runoff volume of approximately 0.071 Mm³/year will be captured in the lower infrastructure site runoff dam and re-used.

The quality of site runoff is expected to be dominated by total suspended solids. The chemical composition of the water is likely to resemble rainwater for the most part as the water will not have had time to interact with material that could change its quality. All contact runoff and sediment up to the 1 in 100-year design storm will be retained in the ponds and will not discharge to the environment (assuming the ponds are empty at the start of the storm). All captured runoff will be re-used.

- **Sewage effluent** (also see Section 4.7.4) - Sewage treatment plants are planned at the upper plant site and at the lower mine infrastructure site. Effluent quantity is expected to be approximately 0.011 Mm³/year at the process plant site and 0.05 Mm³/year at the mining infrastructure site. All effluent will be treated to meet EU standards and re-used.

4.5.2 Power Supply

*Construction*

Temporary diesel generators will be used during construction until the Project is connected to the Macedonian high voltage (110kV) electricity transmission network (permanent power supply). The proposed route is shown in Figure 4-14.

Generators required during construction are:

- 1500 kVA to be installed in phases in accordance with the construction schedule for the mining complex, process plant, ROM area and other on-site facilities;
- One 10 kVA for road construction;
- One 10 kVA at TMF and surrounding area;
- One 10 kVA for boreholes and other offsite remote facilities; and
- One 20 kVA for the pit area (mining equipment assembly).

*Operations*

Electricity for the operations phase (permanent power supply) will be provided via a 110 kV connection to the national high voltage transmission network owned and operated by the Macedonian transmission network operator MEPSO. The yearly burden on the grid will be 440 000 MWh during operation.

The permanent power supply connection comprises a new 110/10 kV substation at the plant site (“Ilovica-Shtuka substation”), a new 10.5 km overhead transmission line (OHL) from the Ilovica-Shtuka substation to the existing MEPSO Sushica substation (“Sushica OHTL”), and a new 27 km OHL from the Ilovica-Shtuka substation to the existing MEPSO Berovo substation (“Berovo OHL”). Construction of the Sushica OHTL is expected to be completed first being a shorter line, with Berovo OHL to follow within a few months due to longer permitting and construction timeframes.
A medium (10 kV) and lower voltage (690 V and 400 V) distribution network within the plant site will supply grid power from the Ilovica-Shtuka substation to other site facilities.

A separate EIA in accordance with the Macedonian legislation will be prepared to address permitting requirements for the construction of the Berovo overhead transmission line, and an Environmental Elaborate for the Sushica overhead transmission line. Most aspects of the Sushica line are covered in this ESIA.

Once the lines and substations are built and placed into operation, ownership and responsibility for operations and maintenance will pass to MEPSO.

Diesel generators will be installed for the provision of emergency power during operations. Plant emergency generators are estimated at 3200 kVA comprised of several smaller units located in a single centralised location.

The backup diesel-driven fire water pumps and the backup emergency generators are the only diesel fuelled apparatus on the plant.

**Closure**

Ownership and management of the incoming power line will remain with MEPSO. No closure activities will be required.

**4.6 Transport**

Table 4-9 presents a summary of vehicle movements to and from the Concession and within the concession during operations and construction. In addition Table 4-4 presents the vehicle numbers within the pit.
Table 4-9: Summary of on-site and off-site traffic movements

<table>
<thead>
<tr>
<th>Arrival rates of vehicles</th>
<th>Operations</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport of personnel (per day)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onsite (accessing plant road)</td>
<td>8 – 10 trips of approx. 9 km each*</td>
<td>32 – 40 trips of approx. 9 km*</td>
</tr>
<tr>
<td>Offsite (arrival at site gate)</td>
<td>74 – 78 (50 light vehicles)</td>
<td>32 – 40 trips</td>
</tr>
<tr>
<td><strong>Transport of goods (per month)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onsite (accessing plant road)</td>
<td>692 – 780 trips of approx. 9 km each*</td>
<td>152 – 190 trips of approx. 9 km each between site entrance and laydown*</td>
</tr>
<tr>
<td>Offsite (arrival at gate)</td>
<td>346 - 450</td>
<td>84 - 115</td>
</tr>
</tbody>
</table>

Source: Amec Foster Wheeler, 2015w

(*) 9 km represents the approximate length of the onsite plant access road – between site entrance and plant entrance. The number of trips, as indicated, need no further adjustment for return trips as they already represent cumulative total trips, for example 8 – 10 trips means 4 – 5 arrivals and 4 – 5 departures.

4.6.1 Off-site Traffic Movements

4.6.1.1 Worker transportation

**Construction**

The majority of construction personnel will be housed in Strumica or local villages. All construction personnel will be bussed from accommodation to site on a daily basis. Estimates of these vehicle movements are presented in Table 4-9.

**Operations**

The vast majority of operations personnel are expected to live in the surrounding areas. It is expected that a bus service will be used to transport workers from the surrounding towns and villages:

- Number of offsite bus trips: 24 – 28 per day; and
- Number of personal vehicles used: 50 per day.

Within the site, traffic movements will be focused on the access road which runs between the gatehouse and the process plant (7 km each way).

4.6.1.2 Importation of materials

**Construction**

The vehicles will chiefly consist of multi-axle, articulated (engine and trailer) trucks. Goods will be predominantly carried either as break-bulk (structural steel, plate work, large equipment) or containerised transport shipments.

During the peak construction period:

- Deliveries of steelwork, piping and plate work will range between **19 and 39 trucks per month**. The total number of truck arrivals is estimated to be between 350 and 450 for the 2 year construction period; and
- Deliveries of equipment and packages will range between **65 and 76 trucks per month**. The total number of truck arrivals is estimated to be between 500 and 850 for the 2 year construction period.

In addition, throughout construction the following truck movements are expected:

- Between 2 and 4 diesel fuel tankers per day; and
- Between 2 and 5 food delivery trucks per week.
**Operations**

Delivery of reagents and fuel will form the largest portion of truck activity during operations:

- Estimated number of reagent delivery vehicles: 96 – 120 trucks per month;
- Estimated number of fuel tankers: 40 – 60 per month; and
- Additional deliveries of food, parts, laundry (daily), office supplies, waste streams for disposal off site, maintenance materials, estimated at 60-80 light vehicles a month.

A warehouse and laydown area will be located in Strumica, at an as yet undefined location. This will act as a transfer location and will not affect the total flow of traffic presented in Table 4-9.

**4.6.1.3 Export of product**

Estimated number of concentrate and gold trucks: 210 – 270 per month each way.

Copper concentrate will be exported from site to the Bulgarian border (and on to the smelter in Bulgaria), with the haulage contractor expected to use 30 tonne articulated trucks.

**4.7 Waste Management**

**4.7.1 Non-mining Waste Generation**

The Project will result in the production of hazardous, non-hazardous, recyclable and special waste during all project phases, including:

- Reusable materials such as glass and plastic bottles, non-contaminated containers, concrete blocks and wood;
- Dry non-combustible waste such as glass, plastic and concrete;
- Dry combustible waste such as cloth, wood trim, kitchen greases;
- Cardboard which cannot be shredded;
- Metal;
- Organic waste;
- Paper and cardboard;
- Sewage waste (treated effluent and sludge);
- Biomedical waste; and
- Hazardous waste in designated containers, such as drums, bags and pallets for containment of batteries, greases, oil filters, contaminated soils, fluorescent tubes and ink cartridges.

Waste at the Site will be managed in line with the Waste Hierarchy. Every effort will therefore be made to reuse, reduce, recycle and reclaim waste. As many waste streams as possible will be returned to suppliers, such as containers and waste oil. Waste will be separated at source and placed into the appropriate waste containers. Wastes from smaller bins shall be collected and placed in larger bins/wheelies or into the correct colour skip at the work area. Waste containers will be colour-coded and well-labelled to facilitate separation at source. Each Contractor is expected to provide adequate waste containers at their work areas.

**4.7.2 Waste Management Facilities**

The proposed waste management facility will be located off site. The off site waste management facility will be an existing licenced facility for waste streams which are produced throughout the project life-cycle (non-mineralised waste and general waste). Waste will be segregated and sorted at site and stored until sufficient quantities are available for removal to another facility. The following components will be located within the Plant area of the Project site:
Waste transition yard - for (a) hazardous materials and waste which are prohibited from being disposed in landfill sites and therefore require to be treated or disposed offsite; and (b) materials and waste which are being accumulated for recycling or reuse offsite. The cumulative size of the waste transition yard would have been 2,500 m² or 50 m x 50 m.

Waste management facility storage yard - for storage of empty vessels, waste bins and waste skips, plus a washing facility.

Salvage yard - for either temporary or permanent storage of scrap equipment or materials which do not represent an environmental threat due to degradation, corrosion or deterioration. The cumulative size of the salvage yard will be 5,000 m² or 100 m x 50 m.

A waste management contractor will be appointed to manage the waste disposal function for the project in compliance with all applicable project requirements, best practice and applicable legislation. All contractors and their sub-contractors and workforce are required to effectively implement all waste management programmes. Appropriate waste streams will be transported off site to a nearby licenced waste disposal facility.

4.7.3 Waste Streams and Volumes

Table 4-10 shows the expected waste streams and proposed waste management method, subject to local availability of management methods, of each resulting from construction and operation of the site during the 2 year construction and 20 year operation of the Project.

<table>
<thead>
<tr>
<th>Waste type</th>
<th>Location</th>
<th>Waste management method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used greases</td>
<td>Maintenance workshop</td>
<td>Incineration</td>
</tr>
<tr>
<td>Used batteries and power supplies</td>
<td>Site wide</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Soiled containers</td>
<td>Process plant</td>
<td>Return to suppliers, incineration</td>
</tr>
<tr>
<td>Soiled parts</td>
<td>Process plant</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Soiled rags</td>
<td>Process plant</td>
<td>Incineration</td>
</tr>
<tr>
<td>Used absorbents</td>
<td>Process plant</td>
<td>Incineration</td>
</tr>
<tr>
<td>Oil filters and hydraulic hoses</td>
<td>Maintenance workshop</td>
<td>Incineration</td>
</tr>
<tr>
<td>Used oil</td>
<td>Maintenance workshop</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Ink cartridges</td>
<td>Site wide</td>
<td>Recycle or incineration</td>
</tr>
<tr>
<td>Metallurgical laboratory waste (ore and waste rock samples)</td>
<td>Plant site</td>
<td>TMF or disposal via outside contractor</td>
</tr>
<tr>
<td>Potable water sanitation</td>
<td>Plant site</td>
<td>Discharge to process water system</td>
</tr>
<tr>
<td>Fluorescent tubes and bulbs</td>
<td>Site wide</td>
<td>Avoid use, disposal via outside contractor</td>
</tr>
<tr>
<td>Hydrocarbon contaminated soils</td>
<td>Site wide</td>
<td>Incineration</td>
</tr>
<tr>
<td>Obsolete electronics</td>
<td>Site wide</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Sewage waste</td>
<td>Site wide</td>
<td>Site sewage treatment plant</td>
</tr>
<tr>
<td>Medical waste</td>
<td>Clinic</td>
<td>Incineration</td>
</tr>
<tr>
<td>Special waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used filters of bags from baghouses</td>
<td>Process plant</td>
<td>Incineration</td>
</tr>
<tr>
<td>Recyclable waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrap copper, brass, aluminium, precious metals</td>
<td>Process plant</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Scrap iron, steel</td>
<td>Maintenance workshop</td>
<td>Recycle or disposal via outside contractor</td>
</tr>
<tr>
<td>Reusable waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean wood</td>
<td>Process plant</td>
<td>Reused</td>
</tr>
<tr>
<td>Waste type</td>
<td>Location</td>
<td>Waste management method</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Clean drums, containers, boxes</td>
<td>Site wide</td>
<td>Reused</td>
</tr>
<tr>
<td>Wooden pallets</td>
<td>Process plant</td>
<td>Reused</td>
</tr>
<tr>
<td>Packaging materials</td>
<td>Process plant</td>
<td>Reused</td>
</tr>
<tr>
<td>Plastic and glass</td>
<td>Site wide</td>
<td>Reused</td>
</tr>
<tr>
<td>Mechanical parts</td>
<td>Maintenance workshop</td>
<td>Reused</td>
</tr>
<tr>
<td>Hardware (e.g. tools, fastenings)</td>
<td>Maintenance workshop</td>
<td>Reused</td>
</tr>
<tr>
<td>Ducting</td>
<td>Process plant</td>
<td>Reused</td>
</tr>
<tr>
<td>Paint</td>
<td>Site wide</td>
<td>Reused</td>
</tr>
<tr>
<td><strong>Non-hazardous waste</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloth</td>
<td>Site wide</td>
<td>Incineration</td>
</tr>
<tr>
<td>Wood trims</td>
<td>Site wide</td>
<td>Incineration</td>
</tr>
<tr>
<td>Kitchen grease</td>
<td>Process plant</td>
<td>Incineration</td>
</tr>
<tr>
<td>Paper and cardboard</td>
<td>Site wide</td>
<td>Incineration</td>
</tr>
<tr>
<td>Concrete</td>
<td>Site wide</td>
<td>Landfill</td>
</tr>
<tr>
<td>Gypsum</td>
<td>Site wide</td>
<td>Landfill</td>
</tr>
<tr>
<td>Glass</td>
<td>Site wide</td>
<td>Landfill</td>
</tr>
<tr>
<td>Ashes</td>
<td>Incineration</td>
<td>Landfill</td>
</tr>
<tr>
<td>Dried paint containers</td>
<td>Maintenance workshop</td>
<td>Landfill</td>
</tr>
<tr>
<td>Plastics</td>
<td>Site wide</td>
<td>Incineration</td>
</tr>
<tr>
<td>Fiberglass</td>
<td>Maintenance workshop</td>
<td>Landfill</td>
</tr>
<tr>
<td>Kitchen waste</td>
<td>Accommodation</td>
<td>Compost</td>
</tr>
<tr>
<td>Sanitary sludge</td>
<td>Wastewater treatment</td>
<td>Compost</td>
</tr>
<tr>
<td>Shredded paper and cardboard</td>
<td>Site wide</td>
<td>Compost</td>
</tr>
</tbody>
</table>

Table 4-11 and Table 4-12 show the headline waste streams and estimated volumes. Municipal solid waste (MSW) estimates (Table 4-11) are based on standardised per-person waste generation volumes. Mining waste (Table 4-12) estimates are based on average usage per year.

**Table 4-11: Estimated municipal waste volumes**

<table>
<thead>
<tr>
<th>Municipal waste stream</th>
<th>No of staff/waste ratios*</th>
<th>Estimated MSW (kg/person/yr)**</th>
<th>Total per year (kg)</th>
<th>Project total (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>484</td>
<td>354</td>
<td>171,336</td>
<td>3,940,728</td>
</tr>
<tr>
<td>Putrescible waste</td>
<td>32%</td>
<td>-</td>
<td>54,828</td>
<td>1,261,033</td>
</tr>
<tr>
<td>Plastics</td>
<td>11%</td>
<td>-</td>
<td>18,847</td>
<td>433,480</td>
</tr>
<tr>
<td>Metals (ferrous &amp; non-ferrous)</td>
<td>3%</td>
<td>-</td>
<td>5,140</td>
<td>118,222</td>
</tr>
<tr>
<td>Glass</td>
<td>13%</td>
<td>-</td>
<td>22,274</td>
<td>512,295</td>
</tr>
<tr>
<td>Paper &amp; cardboard</td>
<td>22%</td>
<td>-</td>
<td>37,694</td>
<td>866,960</td>
</tr>
<tr>
<td>Textiles &amp; other materials</td>
<td>10%</td>
<td>-</td>
<td>17,134</td>
<td>394,073</td>
</tr>
<tr>
<td>Medical</td>
<td>1%</td>
<td>-</td>
<td>1,713</td>
<td>39,407</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
<td>-</td>
<td>13,707</td>
<td>315,258</td>
</tr>
</tbody>
</table>

**Notes and Assumptions:**

* Eurostat Database
** European Environment Agency Report, Managing Municipal Solid Waste, 2013
1. All staff based on site during construction phase
2. MSW generation is in line with average for FYR of Macedonia
3. MSW generation is the same whether staff are based on-site or in local towns
Table 4-12: Estimated mining waste volumes

<table>
<thead>
<tr>
<th>Mining waste stream</th>
<th>Unit</th>
<th>Total per year</th>
<th>Project total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction waste – timber</td>
<td>kg</td>
<td>16,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Construction waste - cement</td>
<td>kg</td>
<td>25,000</td>
<td>37,500</td>
</tr>
<tr>
<td>Construction waste - brickwork</td>
<td>kg</td>
<td>10,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Construction waste - glass</td>
<td>kg</td>
<td>1,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Construction waste - wiring</td>
<td>kg</td>
<td>10,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used greases</td>
<td>litres</td>
<td>386,604</td>
<td>8,891,897</td>
</tr>
<tr>
<td>Oil filters - trucks</td>
<td>filters</td>
<td>66</td>
<td>1,520</td>
</tr>
<tr>
<td>Oil filters - all other vehicles</td>
<td>filters</td>
<td>66</td>
<td>1,518</td>
</tr>
<tr>
<td>Used oil</td>
<td>litres</td>
<td>1,597,036</td>
<td>36,731,825</td>
</tr>
<tr>
<td>Vehicles</td>
<td>vehicles</td>
<td>5</td>
<td>115</td>
</tr>
<tr>
<td>Tyres - trucks</td>
<td>tyres</td>
<td>71</td>
<td>1,630</td>
</tr>
<tr>
<td>Tyres - all other vehicles</td>
<td>tyres</td>
<td>105</td>
<td>2,412</td>
</tr>
</tbody>
</table>

4.7.4 Sewage Treatment

Construction and Operations

Two sewage treatment plants will be constructed for the project: one at the plant site and one at the mine workshop. Both plants will treat effluent from facilities such as the change house, gate house, canteen, offices, outlying toilets, wash basins, kitchenettes and floor washdown from the workshops. Floor washdown will be pre-treated in grit and grease traps as necessary. Estimated sewage generation during the construction and operations phases is given in Table 4-13:

Table 4-13: Design parameters for sewage treatment plants

<table>
<thead>
<tr>
<th></th>
<th>(Litres per person per)</th>
<th>Number of Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annum Day</td>
<td>No. of personnel</td>
</tr>
<tr>
<td>Construction</td>
<td>76 650 150</td>
<td>1200 +/- 50</td>
</tr>
<tr>
<td>Operations</td>
<td>54 750 150</td>
<td>487 +/- 20</td>
</tr>
<tr>
<td>Estimated Waste Totals</td>
<td>1171.2 3.2</td>
<td></td>
</tr>
</tbody>
</table>

Source: Amec Foster Wheeler, 2015r

The treated effluent will be required to conform to the European Union’s Urban Wastewater Directive and Macedonian regulations for wastewater. All treated waste water will be re-used.

Closure

Subject to consultation, the sewage treatment plant at the mine workshop could remain in place for use by the households of Ilovica and Shtuka. Ownership and management would pass to the Municipality of Bosilovo and the Bosilovo Public Utilities Company.

Post-closure, the facilities would either have been removed or ownership/management passed to another party. No further activities/obligations are anticipated after the closure period.
### 4.8 Capital and Operating Expenditures

#### 4.8.1 CAPEX

The total capital cost of Project construction is preliminarily estimated at between €425 and €450 million including contingencies. The procurement of construction and mining equipment is expected to account for the majority of this expenditure. Labour, fuel and light vehicles will represent smaller, but still significant, capital costs during construction.

- Approximately €10 million (2%) of total capital expenditures will accrue to the LSA, with most of this spending occurring in Strumica on goods and services.
- Approximately €190 million (46%) of capital spending will occur in other parts of Macedonia (outside of the LSA).
- International procurement accounts for the remaining €225-€250 million (53% to 56%) with an estimated two thirds concentrated in Europe and the remainder from Asia, Africa, Australia and the USA.

#### 4.8.2 OPEX

Operational expenditures are expected to be approximately €95 to €100 million per annum. Mine operation, including equipment and labour, will account for nearly a third (€30 million) of total annual operational expenditures. Reagents and power represent a further third (€36 million) of annual operational costs, while consumables, maintenance materials, equipment and laboratory costs are anticipated to cost €16 million.

The remaining annual operational costs for the Project are in additional labour and administration expenses. The exact distribution of this spending within the Republic of Macedonia has not yet been determined. It is expected that a portion of these expenditures will be sourced locally. Consumables, maintenance materials and equipment, transportation services, real estate, and hospitality expenditures will represent a sizable portion (i.e. 10 to 15%) of average annual expenditures.

#### 4.8.3 Government Revenues

Fiscal benefits to the Republic of Macedonia will be in the form of Project-paid corporate taxes (10% of incremental profits), income taxes collected on employment income (10% of income), sales and excise taxes (taxes on products and net production taxes), and resource royalties (2% of net smelter returns). Resource royalties are derived directly from the Project and are split between the nation and the municipalities at a rate of 22% to the nation and 78% to the municipalities (Euromax, 2015b).

**Table 4-14: Project generated government revenues (€ million)**

<table>
<thead>
<tr>
<th>Revenue source</th>
<th>Construction (total)</th>
<th>Operations (average annual)</th>
<th>Operations (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taxes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal income tax</td>
<td>7.3</td>
<td>2.1</td>
<td>42.0</td>
</tr>
<tr>
<td>Corporate income tax</td>
<td>1.4</td>
<td>8.6</td>
<td>172.0</td>
</tr>
<tr>
<td>Sales and excise taxes</td>
<td>0.6</td>
<td>3.3</td>
<td>66.0</td>
</tr>
<tr>
<td><strong>Subtotal (taxes)</strong></td>
<td><strong>9.3</strong></td>
<td><strong>14.0</strong></td>
<td><strong>280.0</strong></td>
</tr>
<tr>
<td><strong>Royalties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National royalties</td>
<td>0.0</td>
<td>0.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Municipal royalties</td>
<td>0.0</td>
<td>2.8</td>
<td>56.0</td>
</tr>
<tr>
<td><strong>Subtotal (royalties)</strong></td>
<td><strong>0.0</strong></td>
<td><strong>3.6</strong></td>
<td><strong>72.0</strong></td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td><strong>9.3</strong></td>
<td><strong>17.7</strong></td>
<td><strong>354.0</strong></td>
</tr>
</tbody>
</table>

Source: AMECfw

Note: Some totals do not exactly reflect annual averages summed over the life of the Project due to rounding.
4.9 Employment

4.9.1 Number of Employees

During construction, peak workforce requirements will amount to about 1200 Full Time Equivalents (FTEs), of which are expected to be filled by Macedonian workers. Approximately 154 managerial and technical construction FTEs will be filled by expatriates as needed.

Similarly, the majority of operations phase FTEs are expected to be filled by Macedonians (469 positions or 96%), with a small number (18) of managerial roles being filled by expatriates during early mining activities. Expatriate managers will gradually be replaced by local managers mentored and trained during the early years of Project operation. Employment for the operations phase will commence during the final 12 months of the construction phase to enable adequate training for mobile mining plant and process plant operators who might not have any prior work experience.

Table 4-15: Direct employment (full time equivalents) by phase, skill level, and point of origin

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Local</th>
<th>Macedonian</th>
<th>Expatriate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction (peak)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>21</td>
<td>137</td>
<td>55</td>
<td>213</td>
</tr>
<tr>
<td>Professional</td>
<td>26</td>
<td>64</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Skilled</td>
<td>115</td>
<td>46</td>
<td>18</td>
<td>179</td>
</tr>
<tr>
<td>Semi-Skilled</td>
<td>169</td>
<td>68</td>
<td>26</td>
<td>263</td>
</tr>
<tr>
<td>Unskilled</td>
<td>285</td>
<td>115</td>
<td>45</td>
<td>445</td>
</tr>
<tr>
<td>Total (construction)</td>
<td>616</td>
<td>430</td>
<td>154</td>
<td>1200</td>
</tr>
</tbody>
</table>

Operations (average per annum)

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Local</th>
<th>Macedonian</th>
<th>Expatriate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>5</td>
<td>18</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Professional</td>
<td>36</td>
<td>85</td>
<td>42</td>
<td>9</td>
</tr>
<tr>
<td>Skilled</td>
<td>15</td>
<td>15</td>
<td>101</td>
<td>21</td>
</tr>
<tr>
<td>Semi-Skilled</td>
<td>34</td>
<td>15</td>
<td>226</td>
<td>46%</td>
</tr>
<tr>
<td>Unskilled</td>
<td>14</td>
<td>0%</td>
<td>94</td>
<td>19%</td>
</tr>
<tr>
<td>Total (operations)</td>
<td>104</td>
<td>18</td>
<td>487</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Euromax

Total direct labour income as a result of the Project’s two year construction period is expected to be over €63 million. During operation, the Project is expected to generate approximately €14 million in direct labour income annually. The total direct labour income as a result of the Project’s 20 year operational life is, therefore, estimated at over €280 million.

4.9.2 Shift Work

The mining and plant shifts will follow a 24 hour operating cycle consisting of three 8 hour shifts. Morning shifts could be expected to start at 06:00 each day, 7 days per week.

The number of processing plant and tailings operations personnel is expected to be 119. The ratio of shift workers to day workers is expected to be 40:60.

The number of mining operations personnel is expected to be 215. The ratio of shift workers to day workers is expected to be 40:60.

The number of administration personnel, falling neither under mining operations nor process plant operations directly, is expected to be 111. All of these personnel are expected to be day workers.

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15 A Full Time Equivalent (FTE) is the hours worked by a full-time employee, and is calculated based on Macedonian labour conventions, which suggest an eight hour work day, with five days of work per week. This amounts to a FTE of 2,080 hours per annum.
5.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS

5.1 Geomorphology, Terrain and Soils

The geomorphology, soils and land use capability impact assessment evaluates the expected changes to the landscape, land use capability and soil quantity/quality due to the construction, operations and closure of the Project. These changes are provided in the spatial context of the biophysical local study area (biophysical LSA).

5.1.1 Sources of Effects

The elements of the Project which have been identified as potential sources of change to the baseline state for geomorphology, terrain and soils include:

- Removal of vegetation and alteration of terrain on steep slopes, increasing the potential for erosion (construction and operations);
- Stripping of soils within the mine infrastructure footprint and exposure of bare soil as a source of deposited dust (construction);
- Stockpiling of soils within the mine infrastructure footprint, potentially affecting the quality of the soil (construction and operations);
- Activities in the pit (e.g. blasting, waste rock and construction materials handling) as a source of deposited dust (informed by the results of the soils baseline and geochemistry study results, air quality and dust assessments) (operations);
- Traffic on haul roads as a source of deposited dust and acidifying emissions\(^{16}\) (informed by the results of the soils baseline, the geochemistry study and the air quality impact assessments) (construction, operations and closure);
- Fine tailings from the tailings management facility (TMF) as a source of deposited dust (informed by the results of the geochemistry study results, air quality and dust impact assessments) (operations and closure); and
- Mine project infrastructure footprint reducing the land available for agriculture, grazing and forestry (construction, operations, closure).

5.1.2 Incorporated Environmental Measures

Golder produced an environmental and social engineering considerations document (described further in Section 4) which provided the DFS engineers with environmental measures which will be incorporated into project design to avoid or minimise environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following presents the environmental measures relevant to geomorphology, terrain and soils which have been incorporated into the project design:

- Erosion and sediment control:
  - Development of stable embankment slopes, installation of erosion control features, and prompt revegetation;
  - Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible;
  - Vegetation clearance will be minimised and areas only cleared immediately before work takes place, as far as possible;

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\(^{16}\) The term ‘acidifying emissions’ refers to the emission of nitrogen oxides (NO\(_x\)) and sulphur oxides (SO\(_x\)) which, when deposited directly or via rain water, have the potential to acidify the receiving environment (such as soils and watercourses).
Avoid removing vegetation adjacent to lakes, rivers and streams unless the waterway is to be removed or diverted;

Installation of physical erosion control features such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting to control erosion prior to the establishment of a protective vegetative cover;

As soon as practicable, temporarily disturbed areas will be graded, re-vegetated and reclaimed so that surface water run-off from these areas will be similar to natural or pre-mining conditions;

Storm water discharges to the environment will be managed to replicate natural variability associated with high and low flows;

Reclamation will be designed so that the site has runoff characteristics similar to pre-development runoff conditions; and

Reclamation will take place progressively where feasible. This includes ripping of compacted areas and revegetation as soon as disturbed areas are no longer in use. Revegetation will use vegetation representative of natural vegetation in the area using locally procured seeds as far as possible.

Dust and air emissions:

Dust suppression through spraying with a water truck and/or fixed sprinklers on roads, stockpiles, crusher, conveyor, material transfer points;

Reduce dust from transport by sealing roads with high traffic volumes, establishing speed limits around the site and near villages, and covering dusty loads where possible and when required;

Minimise drop heights and have sprayers/dust control at material transfer points (conveyors, dumping of waste rock);

Design the blasting of ore and waste rock to ensure that dust is minimised;

Use recent model vehicles and best available technology for emissions reduction/capture for generators, processing plant, boilers/furnaces, and other facilities; and

Regular schedule of vehicle and generator maintenance.

Contamination prevention:

Adequate storage facilities with secondary containment structures (to 110 % capacity) and bunding will be provided for the storage of oils, grease, fuels, chemicals and any other hazardous materials to be provided through all stages of the Project;

Any fuel or storage tanks to be bunded and stored on hard standing to prevent any spills from infiltrating to the underlying soil; and

Install and maintain oil and grease traps or sumps at refuelling facilities, workshops and fuel storage depots. Use drip trays in the plant and workshops.

5.1.3 Study Area and Receptors

The primary baseline data gathering for geomorphology, terrain and soils was completed within the baseline LSA presented in Section 1. Following completion of the baseline, the baseline study areas for all disciplines have been collated to produce the biophysical impact assessment area, which is also presented in Section 1, and will be referred to throughout this report as the local and regional study areas.

Receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust. The following receptors, presented in the way in which the project could affect them, are used within the geomorphology, terrain and soils effects analysis:
Agriculture and grazing land uses:

- The project footprint may reduce the spatial extent of land available for agriculture and livestock (pastoral) land uses; and
- Deposition of acidifying emissions and dust may affect soil quality in areas of agricultural production.

Forestry land use (fuel, timber):

- The project footprint may reduce the spatial extent of land available for forestry land use; and
- Deposition of acidifying emissions and dust may affect soil quality in areas of forestry land use through changes to soil chemistry or eco-toxic effects resulting from these changes.

Control of erosion/sediment loading:

- The removal of vegetation and the modifications of the terrain required to construct and operate the mine may increase the erosion potential of the landscape in the Jazga and Shtuka catchments.

Nutrient cycling:

- Soil disturbance and handling may change the rates and types of nutrient turn-over due to the disruption of soil ecology and changes to the oxygen levels in the soil stockpile;
- Soils on the reclaimed landscape may not have the same efficiency and rates of nutrient turn-over as the baseline soil conditions; and
- Changes to soil chemistry through acidifying emissions and dust deposition may affect nutrient cycling.

5.1.4 Considerations from Stakeholder Engagement

The following issues were identified during the stakeholder engagement process (described in Section 1) and are relevant to the impact assessment for geomorphology, terrain and soils:

- Impacts to soils (agricultural land and pastures) due to the Project, including dust and air emissions (Municipal Leaders Focus Group 26 March 2015; Open House 16 September 2015);
- Suspected use of illegal pesticides and herbicides, but no soil monitoring programs to verify (Municipal Leaders Focus Group 26 March 2015);
- What the level of protection is for citizens in terms of soil contamination (standards and thresholds) (Agricultural Representatives Focus Group 28 March 2015);
- Loss of grazing land for cattle (Open House 16 September 2015);
- Loss of forestry land for use as fuel wood (Open House 16 September 2015);
- Will the area for agricultural use be reduced?
- Will the forestry area be reduced?
- When will the grazing area be reduced?
- Will there be a negative impact on Strumica River course, i.e. pollution of the soils in the surroundings of Zubovo village?
- What is the radius of dust deposition?
- What will the impacts on soil acidity be?
- Is monitoring planned?
Euromax does the monitoring in all different fields. Does any other entity carry out additional control? and

Post consultation note: A Framework for land acquisition is under development by Euromax. Affected land owners and households will be consulted. The Framework will identify how compensation will be defined for economic displacement, where land acquisition is required.

5.1.5 Key Guidelines and Standards
The following are the key laws, guidelines and standards considered during the completion of the geomorphology, terrain and soils impact assessment:

- Macedonia Law on Environment, Article 13;
- Macedonia Law on Nature Protection, Article 11;
- Macedonia Law on Agricultural Land;
- Environmental Assessment of Soil for Monitoring Volume I: Indicators and Criteria (EC JRC, 2008); and
- Soil Remediation Circulars (Rijkswaterstaat Environment, 2009).

The EDC were established for soil and sediment quality and have been used to develop the magnitude criteria for this impact assessment. The EDC are provided in Annex 1 to the ESIA. The full list and descriptions of the relevant legislation, policy and standards is also provided in Annex 1.

5.1.6 Effects Analysis

5.1.6.1 Methods
The effects analysis was conducted using both quantitative and qualitative approaches to evaluate soil impacts to the receptors.

5.1.6.1.1 Soil quantity
The effects the Project may have on soil quantity were determined through a GIS-based analysis of land that would be directly affected by the Project in the LSA. The sources of spatial impacts to soil quantity include the following:

- Removal of vegetation and alteration of terrain on steep slopes;
- Stripping of soils within the mine infrastructure footprint; and
- Mine project infrastructure footprint reducing the land available for agriculture, grazing and forestry.

The Project footprint was overlain on the geomorphology, terrain and soils mapping in the soils LSA (Section 3, Annex 3). The spatial extent of the terrain attributes (i.e. slope %, elevation) and land use capabilities within these areas were initially determined to be ‘lost’ due to the Project. The application case (i.e. the maximum extent of operations at Year 20) information was then inserted into these areas to determine the net change due to the Project. As described above in Section 5.1.2, the process of progressive reclamation forms part of the incorporated engineering measures and engineering. Therefore reclamation during operations and reclamation at closure are considered in the effects analysis.

The closure landscape, including the processes described as incorporated environmental measures (Section 5.1.2), i.e. decommissioning, soil replacement and reclamation of Project infrastructure, was inserted into the spatial extent of the Project footprint and the residual effects of the project were determined.

The net changes due to the Project and the residual changes at post-closure for terrain attributes, soil erosion potential and land use capability were evaluated as absolute areal extents of change, and as spatial changes relative to the biophysical LSA. The change in the terrain attributes and land use capability ratings were used to generate the magnitude of effects for the impact classification.
5.1.6.1.2 Soil quality

Soil quality effects were determined through a combination of quantitative and qualitative analysis. The sources of potential soil quality impacts that were quantitatively analysed include the following:

- Activities in the pit (e.g. blasting, waste rock and construction materials handling) as a source of deposited dust;
- Traffic on haul roads as a source of deposited dust; and
- Fine tailings from the TMF as a source of deposited dust.

The baseline soil chemistry data was evaluated to determine sensitivity to acidifying emissions, including nitrates and sulphates (in kilo-equivalents [keq] per hectare [ha] per year [yr]), and to contamination by metal-containing dust from tailings waste rock, construction materials and/or ore. These sources of metal-containing dust were characterised in the geochemistry study from bench-scale geochemical characterisation of oxidised forms of waste rock (Annex 4).

The results of the air quality assessment were used to establish the spatial distribution and intensity of deposited acidifying emissions and metals-containing dust in the biophysical LSA. The modelled maximum annual rates of deposition through the construction and operations of the Project (year 12; air quality assessment, Section 5.6) were adopted as a worst-case scenario for use in the effects analysis. This worst-case scenario was compared against the sensitivities of LSA soils to acidifying emissions to determine whether detrimental changes to soil chemistry may occur.

As a conservative measure, the worst-case yearly deposition rate was replicated for each year throughout the 20 years of operation to provide a maximum cumulative dust deposition for the LSA. It was assumed that the deposition of dust and emissions is static; that is, deposited emissions and dust were assumed to be instantaneously and permanently incorporated into the surface soil layer, to immediately interact with the plant-available soil minerals, and that residual erosion, translocation, leaching or phyto-remediation is nil.

Calculated approximations of baseline and end-of-mine metal contents for highland and lowland soils were compared to the EDC to determine cumulative dust deposition (in grams [g] per square metre [m²]) and critical load exceedances for acidifying emissions (i.e. the threshold at which soil chemistry changes are expected to occur); to determine the magnitude of the effects and the extent of impacts to soil quality from dust deposition.

Qualitative effects analysis approaches (i.e. literature review and professional judgement) were used to evaluate effects to soil quality for the following sources:

- Stripping of soils within the mine infrastructure footprint; and
- Stockpiling and storage of soils within the mine infrastructure footprint, potentially affecting the quality of the soil.

Past international research on soil resilience to disturbance and stockpiling was reviewed to evaluate potential effects to soil quality (i.e. nutrient cycling) that are expected to occur as a result of soil stripping, stockpiling, and replacement at the end of the Project.

5.1.6.2 Results

The results of the effects analysis for impacts to soils with respect to their relevant receptors are summarised in this section. The detailed, tabulated results of the effects analysis, showing affected areas within each land use due to the different sources of affects, are provided in Annex 5A (Tables 1 to 5). Drawings 5-1 to 5-4, appended to the ESIA, present the results which are described in the following sections.

5.1.6.2.1 Agriculture and grazing land uses

In total, the area of suitable agricultural land which will be affected by the Project is predicted to be 8.1 ha (including the temporary access road), which forms <1% of the total agricultural area in the LSA. The area of suitable grazing land which will be affected by the Project is predicted to be 507 ha which forms 6% of the total grazing area in the LSA.
There is no loss of private garden land planned throughout the life of the Project due to ground disturbance. Therefore, all results in Table 2 in Annex 5A present cropland agriculture only. Table 2 in Annex 5A presents a detailed breakdown of the suitability of cropland agricultural land which is predicted to be affected by the Project. Drawing 5-1 presents the baseline land use map overlaid by the project layout.

**Ground disturbance**

During the construction and operational phases of the Project, it is expected that 8.1 ha of moderately or highly suitable land for cropland agriculture will be lost to ground disturbance due to mine access road and temporary access road. The moderately suitable and highly suitable lands which would be lost represent less than 1% of the biophysical LSA. Of these areas, 4.9 ha are expected to be recovered through reclamation of the mine buildings a and b, the temporary access road, and the remaining areas are planned to remain as permanent roads following the closure of the Project.

Table 3 in Annex 5A presents a detailed breakdown of the suitability of grazing land which is predicted to be affected by the Project.

Through the construction and operational phases of the Project, it is expected that 507 ha of suitable land for grazing (pastoral) will be lost. Of these suitable lands, 41.8 ha are considered highly or moderately suitable (Table 3, Annex 5A). The remainder was evaluated to be only marginally suitable.

These losses of highly or moderately suitable land for grazing are expected to be partially recovered through reclamation of the Project site, including up to about 5.8 ha of grazing land reclaimed during the closure phase of the Project on facilities such as the conveyor belt, buildings, the plant area and ROM Pad and workshop. The available topsoil volume planned to be salvaged during the construction phase of the Project is expected to be sufficient to reclaim these areas. Commitments to achieve this reclamation are presented in Section 6.1.

The construction of the TMF is expected to remove 272 ha of marginally suitable grazing land and 12 ha of highly suitable grazing land along the Shtuka River. Closure of the TMF will include the placement of a capping layer, which will enable vegetation to establish on the surface of the TMF while maintaining the integrity of the capping layer. Further detail is provided in Section 6.1.

**Dust Deposition**

Through the construction and operational phases of the Project, it is expected that cumulative dust deposition under the worst-case scenario (maximum deposition rate applied to all 21.5 years) will result in a measurable change to metal concentrations in limited areas near the project footprint (Drawing 5-2). These changes will not exceed the EDC for any of the indicator parameters, except for copper in the highlands area. However, soils in the highlands areas of the Project were determined to commonly exceed the EDC for copper at baseline (Section 3, Annex 3; Hadji-Petrushev, 2012).

The maximum predicted dust deposition rate is 96.0 g/m²/year, corresponding to a cumulative deposition over a 21.5-year period of 2,064 g/m². The maximum increase to the copper concentration in the highland surface soil is estimated to be 1.1 mg/kg, raising the average baseline concentration of 29.7 mg/kg (49% above the EDC) to 30.8 mg/kg (54% above the EDC) in the highlands (Table 5, Annex 5A). This concentration is within the range of natural variability for copper (Section 3, Annex 3; Hadji-Petrushev, 2012). In the lowlands, the maximum rate of deposition would raise the copper concentration on agricultural lands from 10.9 mg/kg (45% below the EDC) to 12.1 mg/kg (39% below the EDC), an increase of 1.2 mg/kg (Table 5, Annex 5A).

The above analysis provides an example of how small the relative change in metal concentrations are expected to be if the maximum expected worst-case scenario dust deposition rate occurred annually, and throughout the LSA for the duration of the project. Each of the metals respond in a similar manner under this deposition scenario, however, they each remain below the EDC and within the natural range of variation at baseline and throughout the duration of the Project phases.

During the operation of the Project, the maximum rates of dust deposition (evaluated in Section 5.6) occur in localised areas in the air quality modelling domain, and are limited to the Project footprint, particularly the TMF, the mine pit area and the plant site and associated haul and access roads (Drawing 5-2). The majority of the LSA will be exposed too much lower rates of dust deposition. The expected dust deposition rate on croplands
in the lowland zone are expected to be less than 10 g/m²/yr, which is 10% of the maximum dust deposition rate in the highlands (Drawing 5-2). A detailed summary of the changes expected for all other metals due to dust deposition is provided in Table 5 in Annex 5A.

**Acidifying Emissions**

The soils in the LSA are sensitive to acidifying emissions, including nitrates and sulphates (in kilo-equivalents [keq] per hectare [ha] per year [yr]), due to their mineralogy, degree of weathering, baseline pH, organic matter content, and base cation nutrient status. The critical loads for soils in the LSA were assessed to be between 0.15 and 0.2 keq/ha/yr (Umweltbundesamt, 2004).

The critical load represents the threshold of deposition rate of acidifying emissions that the soil cannot buffer against, resulting in a detectable change in soil chemistry that may have detrimental effects on ecosystems and agricultural productivity. The nature of changes in soil chemistry may include reduction in pH (affecting micro-nutrient availability or causing physiological stress to vegetation and soil biota), increased leaching of metals such as aluminium, and a reduction in the availability of base cation nutrients including calcium, magnesium, potassium and sodium.

Soils that are already strongly or extremely acidic, such as those in the LSA, are not so susceptible to further pH declines. They are however, highly sensitive to aluminium solubilisation, which can have toxic stress effects on vegetation productivity and immobilise phosphorus, an important soil nutrient. These soils are also highly sensitive to further losses of base cation nutrients. (Holowaychuk and Fessenden, 1987).

In the worst-case scenario year (year 12 of operations), there are widespread critical load exceedances in the highland zone in the LSA; however, these exceedances do not extend into the lowland zone around and to the west of Ilovica or Shtuka. The deposition model reports potential critical load exceedances in the area of Sushica and north of Novo Selo (Drawing 5-3). It is therefore expected that small but detectable changes to soil chemistry will occur between baseline and the end of the operational phase from acidifying emissions. Due to the relatively short duration of the project (i.e. 21.5 years of construction and operations), even if the worst case scenario were applied for each year of construction and operations, the models predict that the cumulative exposure of the soils to acidifying emissions will not cause a change in soil chemistry great enough to trigger a change in the distribution of land uses that occur at baseline in the LSA (i.e. cropland agriculture, grazing, or forestry).

Long-term (i.e. post-closure) productivity of cropland agriculture, forestry and forested/scrub habitat may experience perceptible but small declines. Therefore it would be prudent to ensure a programme of long-term soil monitoring is established. Effects due to acid deposition are generally considered reversible over the course of decades following cessation of acid deposition and soil amendments such as fertilisation and liming soils can limit impacts to productivity if necessary.

5.1.6.2.2 Forestry land use

Table 4 in Annex 5A presents a detailed breakdown of the suitability of forestry land which is predicted to be affected by the Project. Drawing 5-1 presents the baseline land use map overlaid by the project layout.

**Ground disturbance**

Through the construction and operational phases of the Project, it is expected that 465 ha of suitable land for forestry will be lost, which includes both forested (timber and fuel wood) and scrub habitat (fuel wood). Of these suitable lands, 201 ha are considered highly or moderately suitable (forested) and the remainder was evaluated to be marginally suitable (mostly scrub habitat). The moderately suitable and highly suitable lands lost represent 4% of the forestry land use resource base in the biophysical LSA. These losses are expected to be somewhat recovered through reclamation of the Project, including up to 52 ha of scrub or forested land reclaimed during the closure phase of the Project (that may also be used for grazing). Land reclamation will occur primarily on the workshop area, plant site and portions of the mine pit that have slope gradients low enough for application of reclamation soil (generally less than 30%).

The construction of the TMF is expected to permanently remove 269 ha of marginally to highly suitable land for forestry. The TMF will contain concentrations of copper, chromium, lead, zinc, mercury, nickel, and
cadmium that exceed the EDC (Annex 1) and, as such, will be unsuitable for forestry at closure. The capping layer included in project design will enable vegetation to re-establish, however deep-rooted trees should be prevented from establishing to maintain the integrity of the capping layer.

**Acidifying Emissions and Dust Deposition**

Long-term (i.e. post-closure) productivity of cropland agriculture, forestry and forested/scrub habitat may experience perceptible but small declines. Therefore it would be prudent to ensure a programme of long-term soil monitoring is established.

Dust deposition from the Project is not expected to result in a perceptible change to forestry, forested habitat or scrub habitat (Drawing 5-2).

Specific to forestry, dry deposition of nitrogen can cause physiological damage (e.g. defoliation and loss of soil biodiversity) to mixed deciduous/coniferous woodlands if the rate of deposition exceeds approximately 10 kg / ha / yr (Umweltbundesamt, 2004). In the worst case scenario (year 12 of operations), the maximum rate of nitrogen deposition is expected to be 7.3 kg/ha/yr, and is limited to the immediate vicinity of the project footprint (Drawing 5-3). This is below the threshold for concern, and therefore is not expected to result in measurable changes to forestry, forested habitat or scrub habitat.

### 5.1.6.2.3 Control of erosion/sediment loading

Drawing 5-4 presents two 3 dimensional images, one showing the baseline terrain, elevations and gradients and the other showing the terrain, elevations and gradients at closure.

**Ground disturbance**

Soil erosion adversely affects soil quality because erosion can remove fine soil particles and organic matter which reduces the overall nutrient content and water-holding capacity of the soil (Baldock and Broos, 2012). Losses of soil organic matter and subsequent increased susceptibility to erosion can be more pronounced in coarse-textured soils, such as those that are found in the LSA, because they lack the reactive surfaces to which the soil organic matter particles can be adsorbed (Baldock and Broos, 2012).

Erosion is a concern within the Project footprint during construction and operations because of the removal of the vegetation cover. Soil stockpiles maintained through operations will be susceptible to erosion due to factors such as lack of vegetation and root mat, steep slopes, and desiccation.

Table 1 in Annex 5A presents a breakdown of the terrain attributes in the LSA and how they may be affected by the Project.

Most soils in the Project area cleared during construction are rated as having moderate or higher erosion potential (Section 3, Annex 3), with the exception of areas with very low slope gradients (<15%) and exposed bare rock (Table 1, Annex 5A).

During construction of the Project, and possibly prior to mitigating sediment management structures being fully operational, areas with exposed fine earth at the surface with slope gradients >15% will result in increased erosion potential (e.g. the stripped pit areas, workshop and plant areas (pre-building) and the TMF embankment). The majority of the area that will be cleared during construction occurs on slope gradients prone to erosion (Table 1, Annex 5A). In areas of gullied or dissected terrain, the erosion potential increases especially along mine access roads and the conveyor route. Accelerated erosion related to project activities will be confined mainly to the project footprint, including the perimeters of earthworks built to support the plant site and workshop areas.

During operations, exposed areas will have been developed (e.g. plant, workshops) with drainage and sediment management in place. Associated sediment erosion potential will decrease in the mine pit area despite an increase in slope gradients due to the exposure of bare rock and the reduction in weathered soil deposits at the ground surface in these areas. Areas with exposed fine earth at the surface with slope gradients >15% will result in increased erosion potential (e.g. the TMF embankment), however sediment management will be in place.
Further analysis of the sediment transport during the construction phase is presented in the sediment impact assessment (Section 5.4).

**Acidifying Emissions and Dust Deposition**

Acidifying emissions and dust deposition is not expected to have a measurable effect on erosion potential in the LSA.

5.1.6.2.4 **Nutrient cycling**

**Ground disturbance**

In areas of direct soil disturbance, losses of soil organic matter through vegetation removal and stockpiling (e.g. increased temperature and aeration) are expected to degrade the nutrient cycling during the construction and operational phases of the Project. These changes result from stripping, possible admixing of topsoil with subsoil, and stockpiling during the construction phase of the Project (Abdul-Kareem and McRae, 1984; Baldock and Broos, 2012).

There is a decrease in soil microbial activity, microbial biomass and mycorrhizal fungi in the stockpiled soil expected following initial stripping of soils, as well as a change in soil meso-fauna community structure (Abdul-Kareem and McRae, 1984; Stark and Redente, 1987; Wick et al., 2009; Kundu and Ghose, 1997). The adverse effects on soil microbiological activities and mycorrhizal fungi will likely result in decreased rates of nutrient cycling and reduced nutrient availability while stockpiled and in the initial years following reclamation and closure.

Soil physical, chemical and biological quality indicators are expected to improve for salvaged and stockpiled soil during the closure and post-closure stages of the Project following soil replacement on reclamation areas. These soil quality indicators are expected to recover about 10 to 20 years after initial reclamation to be comparable to undisturbed soils in adjacent areas (Adeli et al., 2013; Nelson, 2004; Phillips et al., 2009; Clayton et al., 2009; Griffiths and Swanson, 2001). Although soil microorganism community size is expected to decline following disturbance, surviving generalist organisms are capable of maintaining a diversity of nutrient cycling functions. If some of the biodiversity in these functional groups changes as a result of disturbance, it does not mean the function of nutrient cycling is lost (i.e. other species responsible for this function would fill the role of those removed).

Seeding stockpiles is expected to enhance microbial populations in soil because plants and their seeds have evolved in association with a diversity of microorganisms. By planting vegetation, it is likely that the plant seeds would introduce their seed-associated bacteria to the soil and play a role in the modification of soil quality by stimulating the growth of their plant-associated bacteria (Nelson, 2004; Phillips et al., 2009). In addition, vegetation maintained on stockpiles tends to maintain aerobic microbial community population function over time in the rooting zone of the plants (Baldock and Broos, 2012; Ghose, 2001; Wick et al., 2009).

**Acidifying Emissions and Dust deposition**

The effects to nutrient cycling due to acidifying emissions are discussed in Section 5.1.6.2.1. Dust deposition from the Project is not expected to result in a perceptible change to nutrient cycling.

5.1.7 **Impact Classification**

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

5.1.7.1 **Magnitude of the effect**

Table 5-1 presents the parameters which will be used for the impact assessment for geomorphology, terrain and soils.
### Table 5-1: Impact assessment parameters for geomorphology, terrain and soils

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic Extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negligible</strong>&lt;br&gt;<strong>Quantity:</strong> No predicted soil quantity change from baseline.  &lt;br&gt;<strong>Quality:</strong> No changes to soil quality or metal concentrations from dust deposition and/or acidifying emissions change soil within the natural variation of soils in the biophysical LSA.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low</strong>&lt;br&gt;<strong>Quantity:</strong> Change from baseline, but no effect on land use within the biophysical LSA (less than 10% of land use resource within the LSA).&lt;br&gt;<strong>Quality:</strong> Metal concentrations from dust deposition and/or acidifying emissions change soil beyond the natural variation of soils in the biophysical LSA, but do not exceed EDC (unless exceedance occurs at baseline), nor induce a change to land use.</td>
<td>Local&lt;br&gt;Biophysical LSA</td>
<td>Short-term&lt;br&gt;Effect is reversible at end of construction</td>
<td>Infrequent&lt;br&gt;Effect occurs intermittently but not continuously over the assessment period</td>
</tr>
<tr>
<td><strong>Moderate</strong>&lt;br&gt;<strong>Quantity:</strong> Change from baseline by 10% to 20% of areal extent of the land use resource base within the biophysical LSA.  &lt;br&gt;<strong>Quality:</strong> Metal concentrations from dust deposition and/or acidifying emissions change soil beyond the natural variation of soils in the biophysical LSA, and exceed EDC affecting human or ecological health by less than 10%, but do not induce a change to land use.</td>
<td>Regional&lt;br&gt;Biophysical RSA</td>
<td>Medium-term&lt;br&gt;Effect is reversible at end of operations</td>
<td>Frequent&lt;br&gt;Effect occurs repeatedly or continuously over the assessment period</td>
</tr>
<tr>
<td><strong>High</strong>&lt;br&gt;<strong>Quantity:</strong> Change from baseline by &gt;20% of the land use resource base within the biophysical LSA.&lt;br&gt;<strong>Quality:</strong> Metal concentrations from dust deposition and/or acidifying emissions change soil beyond the natural variation of soils in the biophysical LSA, and exceed EDC affecting human or ecological health by more than 10%, and/or induce a change to land use.</td>
<td>Beyond regional – Transboundary</td>
<td>Long-term&lt;br&gt;Effect is reversible within a defined length of time or beyond closure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permanent&lt;br&gt;Effect not reversible</td>
<td></td>
</tr>
</tbody>
</table>

#### 5.1.7.2 Determination of impact

Using the decision matrix presented in Annex 1 and the receptors defined in Section 5.1.3, the impacts have been determined. Table 5-2 presents the classification of each impact. Table 6 in Annex 5A presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact.
Table 5-2: Assessment of impacts for geomorphology, terrain and soils

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Phase of the Project</th>
<th>Source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture land use</td>
<td>Construction</td>
<td>Spatial ground disturbance (construction of access road)</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td>Acidifying emissions</td>
<td>Low</td>
</tr>
<tr>
<td>Grazing land use</td>
<td>Construction, operations, closure, post-closure</td>
<td>Spatial ground disturbance of the project footprint.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td>Dust deposition</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acidifying emissions</td>
<td>Low</td>
</tr>
<tr>
<td>Forestry land use (fuel, timber)</td>
<td>Construction, operations, closure, post-closure</td>
<td>Spatial ground disturbance of the project footprint.</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td>Dust deposition</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acidifying emissions</td>
<td>Low</td>
</tr>
<tr>
<td>Control of erosion / sediment loading</td>
<td>Construction</td>
<td>Spatial ground disturbance of the project footprint.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Operations, closure</td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Nutrient cycling</td>
<td>Construction, operations, closure</td>
<td>Spatial ground disturbance of the project footprint.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td>Acidifying emissions</td>
<td>Low</td>
</tr>
</tbody>
</table>

Further detail of the evaluation of impacts is presented in Table 6 in Annex 5A.

Forestry land use was rated to have a high impact before taking into account additional mitigation beyond the project description and the incorporated environmental measures (Section 5.1.2). The high impacts assessed for these receptors are primarily due to the permanent loss of forested land in the Shtuka Valley for the TMF and the loss of forested land in the mine pit area. The quantity of loss relative to the forestry land use in the LSA is 6% (Table 4, Annex 5A) (low magnitude). It is the degradation of soil quality (high magnitude) of the land surface at closure that drives the high impact rating. The project design states that deep rooting trees should be prevented from establishing on the closed TMF to maintain the integrity of the capping layer planned for the TMF (due to the material contained within the TMF). This results in 284 ha of land previously suitable for forestry that will not be usable for forestry and will not support sustainable forested habitat.

Moderate impacts to grazing land use are also predicted in this area for the same reason. The impacts to grazing land use are rated moderate because the affected land in the TMF and mine pit area were rated as only marginally suitable (due to inaccessibility of the terrain for grazing) at baseline and so the relative loss of suitable lands is lower for grazing than it is for forestry.

Erosion at construction is rated as moderate impact due to the exposure of soil surfaces to erosive forces during construction of the haul road, access roads, the pre-strip area of the open pit, the TMF starter embankment and deforestation of the TMF starter area. As erosion controls are installed and active maintenance of roads occurs, erosion is expected to be reduced. During operations, the soil erosion impacts reduce to low as erosion control measures will be in place and the potential for additional erosion is limited to the active pit area, haul roads and access roads following intense precipitation events.

Effects to agricultural land use are limited to the direct loss of agricultural land due to the construction of the access road. The frequency of this effect is infrequent as each parcel of land is lost only once, albeit permanently, resulting in a moderate residual impact for agriculture land use before mitigation.
5.2 Water Quantity

This section describes the assessment of impacts of the proposed mine on surface water and groundwater quantity in the project area. Water quantity is important because public domestic and agricultural water supplies in Ilovica and Shtuka are obtained from intakes on the Jazga and Shtuka rivers and from groundwater wells and springs in the catchments in which the mine will be situated. In addition, seven other villages in Bosilovo Municipality rely on water supplies from Ilovica reservoir. Changes in flows can cause changes to the security of the village water supplies. Turija Reservoir, a major irrigation reservoir in the region, is the proposed main source of fresh water supply to the Ilovica-Shtuka mine. Supply of the mine from Turija Reservoir may cause changes in the reliability of irrigation water supplies.

Separate consideration is given regarding changes to the flood flow regime and how this may affect flood risk locally in Ilovica and Shtuka villages or at key infrastructure. In addition, the quantity of water (the flow) in the rivers affects the extent of aquatic habitat for aquatic fauna and flora. In this assessment the wetted perimeter of a river (the width of the river channel bed and banks in contact with the flow at any one time) has been used as an indicator for changes to aquatic habitat.

Impact assessment utilises the source-pathway-receptor concept. Water will usually flow from a source, such as an item of infrastructure, via a pathway, such as a river or river intake and distribution system, to a receptor, such as a community, which may be geographically separated from the source. Source-pathway-receptor diagrams for the tailings management facility (TMF), the open pit and run of mine (ROM) pad are presented in Annex 5B.

5.2.1 Sources of Effects Considered

5.2.1.1 Generic considerations

Effects on water quantity arise mainly as a result of changes in land cover and land use associated with mining infrastructure or activities (the source) such as:

- Pit excavation;
- Haul and access roads and drainage;
- Infrastructure for ore processing and workshop areas;
- Tailings and waste rock disposal;
- River diversion;
- Abstraction of water for mine water supply; and
- Mine water management, particularly the mine water supply and drainage systems.

The above activities can alter water flow pathways which in turn can modify:

- Surface water runoff;
- Groundwater recharge;
- Low, average and high flows in watercourses; and
- Groundwater–surface water interactions.

5.2.1.2 Key life of mine stages

The impact assessment below considers the following stages in mine life: construction, operation, closure, post-closure and post-pit lake formation. Post-pit lake formation is considered because some effects, such as spill from the pit lake, may have impacts on water quantity and quality. Table 5-3 lists the stages in the life of the mine (LoM) and a year which is considered to be representative of each stage. A description of the state
of development of the mine infrastructure is given for each stage. Effects on water quantity have been assessed for the stages and years in the LoM listed.

Table 5-3: Life of mine stages for which effects of the project are assessed

<table>
<thead>
<tr>
<th>Life of Mine (LoM) Stage</th>
<th>LoM (Year)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>-1</td>
<td>All roads in place. Process plant site and mine infrastructure services site in place. Shhtuka River diversion and Storm Water Dam (SWD) in place and operating. Pit excavation in process over an area of 0.22 km$^2$. ROM pad and conveyor to process plant stripped and constructed. Starter TMF dam stripped and part constructed. Mine water supply system under construction, comprising pipeline from Turija reservoir to Ilovica reservoir and pipeline from Ilovica reservoir to upper and lower infrastructure sites.</td>
</tr>
<tr>
<td>Early Operation</td>
<td>2</td>
<td>All roads in place. Process plant site and mine infrastructure services site in place and operating. Shhtuka River diversion, SWD and Seepage Collection Facility (SCF) operating. Pit excavation in process over an area of 0.73 km$^2$. ROM pad in place and operating. Starter TMF dam complete and in operation. Water supply scheme in full operation. Note – no stripping is proposed for the mid or final TMF deposition areas.</td>
</tr>
<tr>
<td>Mid Operation</td>
<td>6 / 13</td>
<td>All roads in place. Process plant site and mine infrastructure services site in place and operating. Shhtuka River diversion, SWD and SCF and operating. Pit deepening in process. ROM pad operating. Main TMF dam construction ongoing along with tailings deposition. Water supply scheme in operation. Note – no stripping is proposed for the mid or final TMF deposition areas.</td>
</tr>
<tr>
<td>Late Operation</td>
<td>20</td>
<td>All roads in place. Final year of operation of process plant site and mine infrastructure services site. Shhtuka River diversion, SWD and SCF operating. Final pit complete. ROM pad in final operations. Final TMF dam construction complete and tailings deposition near complete. Water supply scheme in operation.</td>
</tr>
<tr>
<td>Closure</td>
<td>27</td>
<td>Most roads and plant site removed. Mine infrastructure services area site modified and functional. Shhtuka River diversion operating, but in time will fall into disrepair. SWD decommissioned when inflow TSS concentrations meet TSS discharge standard. SCF operating. Pit closed. Pit lake is forming. TMF closed and associated drainage facilities including flood attenuation in place. Water supply scheme for mine decommissioned and residual modification for community water supplies operating. The site rehabilitated and re-vegetated.</td>
</tr>
<tr>
<td>Post Pit Lake Formation</td>
<td>&gt;110</td>
<td>Pit lake fully developed and spilling to the Jazga River. Modelling predicts that the pit lake will take approximately 90 years post closure to fully form and spill to the receiving Jazga River. SWD decommissioned. SCF in place.</td>
</tr>
</tbody>
</table>

5.2.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 1) which provided the DFS engineers with environmental measures which should be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following environmental measures relevant to water quantity have been incorporated into the project design:

- Provision of a comprehensive mine water supply scheme;
- Recycling of mine related wastewater streams for use at the mine plant during operations including:
  - Water reclaim from the TMF, SCF and pit;
  - Site runoff, and
  - Treated sewage effluent.
At initial construction the River Shtuka will be served by a new diversion channel, with a design capacity equivalent to the 100-year flood, so as to route river flows around the TMF throughout TMF construction and life of mine;

During operations the TMF (upstream of the embankment) will be engineered and operated so as to present zero discharge to the downstream surface water environment up to the Probable Maximum Flood (PMF);

Engineered separation of drainage from contact areas (areas that are stripped, mined, raised (as stockpiles or waste storage), entail mine process operations, constructed, or otherwise modified by the project) and non-contact areas;

Deployment of water collection systems for drainage from contact areas to protect the water environment, minimise flood risk and for use at the mine processing plant including:

- The SCF for delivery to the mine plant for process water use;
- Inflows to the pit sump, from rainfall-runoff and groundwater inflow plus routed drainage from the ROM pad, will be delivered to the mine plant for process water use; and
- Inflows to storm water ponds serving the plant site and mine infrastructure services area will be re-used in the mine plant for process water supply.

New or upgraded drainage systems will be engineered so as to convey peak flows with 25-year return periods (temporary structures) and 100-year return periods (permanent structures) to minimise issues associated with erosion or siltation;

Deployment of best practice drainage control measures during the execution of construction works; and

Deployment of best practice pollution prevention and control measures during the execution of construction works and mine operational activities.

5.2.3 Study Area and Receptors

The primary baseline data gathering for water quantity was completed within the baseline local study area presented in the water quantity section of the ESIA Baseline (Section 5, Annex 3). The extent of these study areas is translated into a catchment context and shown in Drawing 5-5 (appended to the ESIA).

Following completion of the baseline, the study areas for all disciplines have been collated to produce local and regional study areas for the impact assessment (equivalent to the potential area of influence of the project) for the biophysical environment and the social environment. The local and regional study areas for the biophysical impact assessments are presented in the water quantity section of the ESIA Baseline (Section 5, Annex 3) and will be referred to throughout this chapter as the local and regional study areas. Associated receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust.

Surface water and groundwater receptors were divided into ‘human’ receptors, such as rivers, wells or boreholes which are used by people for potable water supply or irrigation, and ‘water environment’ receptors, such as streams which support aquatic life. Key locations were identified for each receptor where changes might potentially be experienced first and therefore where effects and impact assessments should be focused, usually immediately downstream or in the vicinity of proposed mine infrastructure. The identified local study area surface water and groundwater ‘receptor’ locations are shown in Drawing 5-6 along with regional study area receptor locations and these are further outlined below.

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17 Within the local study area there is a small tributary to the Jazga River, known locally as the Treska River, which flows directly into Ilovica Reservoir. This small river system should not be confused with the much larger Treska River located within the Vardar catchment in west-central Macedonia.
5.2.3.1 Surface water receptors

The receptors of impacts and potential surface water impact-related issues are listed in Table 5-4 together with the locations at which the receptors are represented and the parameters that will be considered in the effects and impact assessments.

Table 5-4: List of adopted receptors of impacts on surface waters

<table>
<thead>
<tr>
<th>Category of receptor</th>
<th>Receptor and indicator location where relevant</th>
<th>Relevant water quantity parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human receptors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potable water supplies</td>
<td>Jazga River at intake (JZGS01)</td>
<td>Low flow (Q95)</td>
</tr>
<tr>
<td></td>
<td>Shtuka River at intake (STGS01)</td>
<td>Median flow (Q50) (security of supply)</td>
</tr>
<tr>
<td></td>
<td>Ilovica Reservoir (ILWT01)</td>
<td>Inflows (Q95, Q50)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reliability of yield</td>
</tr>
<tr>
<td>Watercourses and water bodies</td>
<td>Ilovica Reservoir (ILWT01)</td>
<td>Low flow (Q95)</td>
</tr>
<tr>
<td></td>
<td>Jazga River through Ilovica</td>
<td>Median flow (Q50)</td>
</tr>
<tr>
<td></td>
<td>Shtuka River at intake (STGS01)</td>
<td>Flood flow and level</td>
</tr>
<tr>
<td></td>
<td>Shtuka River through Shtuka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shtuka River at Sekirnik Road (STGS02)</td>
<td></td>
</tr>
<tr>
<td>Irrigated area in Turija irrigation scheme</td>
<td>Irrigated area upstream of Euromax’s proposed abstraction point on the proposed refurbished Turija pipeline at Ilovica</td>
<td>Temporal reliability (% of days with irrigation demand when the demand is unsatisfied)</td>
</tr>
<tr>
<td></td>
<td>Irrigated area downstream of Euromax’s proposed abstraction point on the proposed refurbished Turija pipeline at Ilovica</td>
<td>Volumetric reliability (% of demand volume that is unsatisfied)</td>
</tr>
<tr>
<td>Ecological receptors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic habitat in rivers</td>
<td>Jazga River downstream of potential loss of flow to pit (JZGS01)</td>
<td>Low flow (Q95)</td>
</tr>
<tr>
<td></td>
<td>Jazga River directly downstream of Ilovica Reservoir</td>
<td>Median flow (Q50)</td>
</tr>
<tr>
<td></td>
<td>Jazga River at Radovo Bridge (JZGS03)</td>
<td>Wetted perimeter at Q95 flow (at JZGS01 and STGS01)</td>
</tr>
<tr>
<td></td>
<td>Shtuka River (STGS01) downstream of TMF diversion outfall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shtuka River at Sekirnik Road (STGS02)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turija River at TJGS01 downstream of confluence of Jazga River</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strumica River at SMGS02 downstream of confluence of Shtuka River</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strumica River at Novo Selo gauging station</td>
<td></td>
</tr>
</tbody>
</table>

5.2.3.2 Groundwater receptors

The receptors of impacts and the potential groundwater impact-related issues – in all cases related to community water supply - are listed in Table 5-5 together with the locations at which the receptors are represented and the parameters that will be considered in the effects and impacts assessments.
Table 5-5: List of adopted receptors of impacts on groundwater

<table>
<thead>
<tr>
<th>Category of receptor</th>
<th>Receptor and indicator location where relevant</th>
<th>Relevant water quantity parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human receptors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community water supply wells in Ilovica and Shtuka</td>
<td>Potable groundwater supply for Ilovica (Wells IB19 and IB39)</td>
<td>Groundwater level (mean and minimum)</td>
</tr>
<tr>
<td></td>
<td>Potable groundwater supply for Shtuka (Well SB47 in Shtuka)</td>
<td></td>
</tr>
<tr>
<td>Community water supply wells on the Strumica plain</td>
<td>Potable groundwater supply for Ilovica (Well IB30)</td>
<td>Groundwater level (mean and minimum)</td>
</tr>
<tr>
<td></td>
<td>Potable groundwater supply for Shtuka (Well SB57).</td>
<td></td>
</tr>
<tr>
<td>Springs used for domestic water supply in Ilovica and Shtuka</td>
<td>Spring ISP41 in Ilovica</td>
<td>Groundwater level (mean and minimum)</td>
</tr>
<tr>
<td></td>
<td>Spring SSP49 in Shtuka.</td>
<td></td>
</tr>
<tr>
<td>Shallow aquifer used for irrigation in the Strumica plain</td>
<td>Irrigation groundwater supply between Ilovica and Turnovo (Borehole BH347).</td>
<td>Groundwater level (mean and minimum)</td>
</tr>
<tr>
<td></td>
<td>Additional monitoring borehole between Ilovica and Turnovo (Piezometer IC-15-113)</td>
<td></td>
</tr>
</tbody>
</table>

Baseline stream flows and groundwater levels at the receptor locations based on monitoring data and/or modelling are presented respectively in Section 2.2. Baseline water quality receptors and data are presented in Section 2.3.

### 5.2.4 Considerations from Stakeholder Engagement

Residents of Ilovica, Shtuka and Novo Selo had the opportunity to learn about the baseline studies and impact assessment, ask questions and voice concerns to project team members during ‘open house’ events held in Ilovica and Novo Selo on 16 and 17 September 2015 (baseline studies) and on 18 and 19 May 2016 (impact assessment) respectively. The stakeholder engagement process is described in Section 1.

The following issues identified during the open house events are relevant to the impact assessment for water quantity:

- The effect of mining activities on water quantity in rivers and Ilovica reservoir;
- The potential influence of the Jazga and Shtuka rivers on the Strumica River and Novo Selo;
- The effect of mining activities on drinking water quantity;
- The current water quantity in Ilovica and Shtuka;
- The number of days per year that the Shtuka’s water supply from the river has to be augmented by Ilovica water treatment works;
- What changes will occur in water supply after the mine starts operating;
- Whether the water distribution system network will be completely or partially refurbished;
- Further information regarding simultaneous inputs of water from both the Ilovica Reservoir and the Turija Reservoir to the Ilovica water treatment plant;
- Will water be pumped constantly;
- Whether the availability of water in Ilovica will decrease or improve;
- How the new water distribution system will affect the cost;
- Who will invest in the individual connections to the water supply network;
Who will provide funds for construction for the pipeline from Turija Reservoir to Ilovica Reservoir;

The length of time it will take to solve the problem with water supply with the relationship established between the Municipality of Bosilovo and Euromax;

Details on the diversion of Shtuka River;

Details on what will happen to the Mala Shtuka River which flows through the proposed TMF; and

How the groundwater under the TMF will be protected.

These concerns are addressed through the water quantity impact assessment and the mitigation and benefit enhancement measures presented in Section 6.2. Specific responses to each of the concerns raised are provided in Section 7.2.

5.2.5 Key Guidelines and Standards

5.2.5.1 Compliance

In general the proposed mining project is expected to conform with:

- Macedonian regulations:
  - Law on Environment;
  - Macedonian Law On Water and relevant directives; and
  - Decree for Classification of Water.

- Selected international standards:
  - WHO drinking water guidelines (2011);
  - EU drinking water guidelines (98/83/EC);
  - IFC EH&S Guidelines for Mining (2007);
  - EU Mine Waste Directive (2006/21/EC);
  - EU Dangerous Substances Directive (2006/11/EC);
  - EU Urban Waste Water Directive (91/271/EEC & 98/15/EC);
  - EU Groundwater Directive (2006/118/EC); and

The above have been considered as part of the Environmental and Social Engineering Considerations study and project specific Environmental Design Criteria\(^\text{18}\) (EDC) were formulated. The criteria summarised for the water environment comprehensively cover relevant water quality standards.

Macedonia has a strategy which aims to align all aspects of water resources management with the EU Water Framework Directive (WFD) by ~2040\(^\text{19}\). The proposed project area falls within the Strumica River Basin District (RBD).

At this stage we are not aware that individual water bodies have been demarked within the Strumica RBD and/or their present status defined. Therefore, we have not attempted to undertake assessments, in this document, strictly in accordance with the WFD. However, we have undertaken all water related assessments

\(^{18}\) Annex 1C of this ESIA document.

with regard to all other relevant EU Directives and IFC standards (Section 5.2.5.1 above). In addition, we have also considered quantity and quality impacts on a range of surface and groundwater bodies in the project study area which we expect will reasonably align with future delineations to be determined in accordance with the WFD.

5.2.5.2 Climate change

It is normal for ESIA s to have due regard concerning the possible implications of predicted climate change. In a mine project this should consider the LoM and extension into closure if relevant. Due to the following factors the predictive modelling for baseline and effects analysis during construction and operations do not consider the potential significance of climate change and associated impacts on water environment receptors, for the following reasons:

- The Life of Mine is relatively short.
- Available baseline hydrometric and water quality data for the receiving water environment are relatively short (~4 years) and this period has included a significantly wet period and represents atypical conditions.

In addition, reference to the Environment and Climate Change Policy Brief includes the following key projections for Macedonia:

- Projections from the International Panel on Climate Change (IPCC) show that average annual temperatures in southern Europe will warm by 2.2-5.1°C until year 2100. Results indicate warming of 1.6-2.1°C by 2050 and 2.7-5.1°C by 2100. The greatest changes are projected for the alpine and sub-alpine regions of the country and for the summer season. Climate models show good agreement that there will be a decrease in precipitation in the Mediterranean basin. Decreases for Macedonia are estimated to be -2 to -7% by 2050 and -5 to -21% by 2100. Heat-waves and droughts are likely to become more frequent, and the return period for extreme precipitation events will decrease.

Nevertheless, for potential impacts due to flood risk that extend into the long term post closure, a conservative approach has been taken to account for the possibility that climate change enhances flood risk. For these calculations, an increase of 10% to the present baseline design storm depth, has been adopted to account for potential effects of climate change in future scenarios. It should be noted that no equivalent increase has been added to the determination of the PMP, for estimation of PMF, in relation to the design of the TMF as this is not considered appropriate.

5.2.6 Effects Analysis

5.2.6.1 Methods

This section assesses predicted changes to the quantity regime at adopted water environment receptors. The detailed methods which were used to quantify effects on the water quantity regime include modelling assessments as summarised below. The classification of effects into categories of magnitude of change are also summarised below.

5.2.6.2 Modelling assessments

Modelling assessments have been undertaken to simulate the baseline condition and then predict the change from the baseline condition for a particular parameter at an indicator location representative of a receptor. Predictions of future conditions have been made by specific hydrological assessments for the life of mine stages in Table 5-3. Predictive modelling, described in Annex 5B, includes:

- Water balance modelling associated with the proposed mine construction and operation. This modelling is performed using GoldSim;
Surface water resource modelling associated with the mine scheme. This modelling is performed using HEC-HMS;

Groundwater resource modelling associated with the mine scheme. This modelling is performed using MODFLOW;

Flood risk modelling associated with the mine scheme. This modelling is performed using HEC-HMS and HEC-RAS for flood flow and flood level assessments respectively;

Security of water supply modelling applicable to river intake abstractions made from the Rivers Jazga and Shtuka serving the villages of Ilovica and Shtuka respectively; and

Modelling of the impact on reliability of irrigation water supplies from Turija Reservoir due to abstraction of water supply for the mine scheme. This modelling is performed using HEC-ResSim.

5.2.6.3 Classifying magnitude of effect

The criteria used to classify magnitude of effects on the quantity regime for various water environment and associated human receptors into the categories defined in Section 5.2.7.1 are presented in Annex 5B. Criteria defining changes to the following quantity regimes are as follows.

**River flow regime** - low flow (Q95) and median flow (Q50). It should be noted that any significant change to the river flow regime predicted to occur via groundwater systems, as changes to baseflow regimes, are accounted for.

**Wetted perimeter regime** – under low flow (Q95) conditions.

**Flow contribution** – under median flow (Q50) conditions.

**Security of supply from surface water abstractions** – related to low flow (Q95) and median flow (Q50).

**Security of supply from groundwater abstractions** (including wells and spring sources) – related to the groundwater level regime under both mean and dry conditions.

**River flood regime** – design flood flow and level conditions (under 100-year flood flow conditions and, for post-closure, considering potential climate change effects).

**Reliability of irrigation water supply from Turija Reservoir** – temporal and volumetric reliability of irrigation water supplies are calculated under the condition in which the mine is supplied with water from Turija Reservoir.

The actual criteria used to classify magnitude of effects, for the various regimes outlined above, are defined in Annex 5B. A simplified summary of these criteria is included in Table 5-21 (Section 5.2.7.1). Broadly, the magnitude of effect categories relevant to the quantity regime are grouped as follows:

**Negligible**  
No or very small (and unequivocally insignificant) predicted change from baseline quantity regime.

**Low**  
Small (and likely insignificant) predicted change from baseline quantity regime (which seldom proves unacceptable).

**Moderate**  
Moderate (and likely significant) predicted change from baseline quantity regime (which may prove unacceptable).

**High**  
Large (being unequivocally significant) predicted change from baseline quantity regime (which is very likely to prove unacceptable).

Summaries of preliminary effects (or predicted changes) to surface water and groundwater receptors are presented below.
5.2.6.4 **Summary of key results for surface water receptors**

5.2.6.4.1 **Predicted magnitude of changes to the Jazga River at intake (JZGS01)**

Predicted changes to the flow, water supply failure and wetted perimeter regimes at the Jazga River at intake (JZGS01) are summarised in Table 5-6.

It was assumed that once the pit lake spills, at year 110, the mitigation proposed under the water quality analysis (Section 6.3) is in place. i.e. once the pit lake spills, all pit lake discharge will be piped away for treatment prior to discharge to the environment at Ilovica Reservoir.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Flow (other)</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>Q95 (low flow) m³/s</td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>During construction, planned land cover changes (vegetation stripping and limited excavation) are insufficient to cause the Q95 at JZGS01 to change so there is a negligible effect on the baseline Q95 flow. During operations and closure before pit lake formation, in the worst case, groundwater modelling predicts almost complete loss of the Q95 flow to the pit. The reduction in flow is predicted to start in Year 5 when the base of the pit is excavated below the river bed elevation which establishes a hydraulic gradient between the pit base and the river. The loss is predicted to persist in closure until the rebounding water level in the pit reaches the elevation of the river bed around Year 110. After this time, a negligible effect on Q95 is predicted as flow from Jazga River will no longer be lost to the pit.</td>
</tr>
<tr>
<td>Q50 (median flow) m³/s</td>
<td></td>
<td>0.058</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td></td>
<td>-0%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>The comments on Q95 above apply also to the Q50, but a smaller proportion of the Q50 is lost to the pit during operations and closure, so the effects are low. There is negligible effect on Q50 after the pit lake water level rebounds at around Year 110, and the Jazga River no longer loses flow to the pit.</td>
</tr>
<tr>
<td>Supply failure Ave days/ year</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Scenario - Baseline (add. days)</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>Security of supply by the Ilovica intake is assessed on the average number of days per year that simulated flow is below 2 L/s, the threshold flow in the Jazga River below which augmentation of Ilovica water supply is required. During the construction period there is a negligible effect. During operations and closure, the effect on supply security of the decline in low flows is assessed as high due to catchment changes and losses to the pit, described above. From Year 110 when losses to the pit cease and the pit lake forms, the flow regime in the Jazga River is re-established, the number of days when augmentation is required reverts to baseline, with negligible effect. The modelling of supply failure at the village water supply intakes is described in Annex 3 (ESIA Baseline).</td>
</tr>
<tr>
<td>Wetted perimeter Q95 m</td>
<td></td>
<td>2.90</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
</tbody>
</table>
The lack of change in the Q95 flow during construction means no change in wetted perimeter in this period. Since groundwater modelling predicts an almost total loss of flow at the Q95 at JZGS01 during operations and closure (see above), the wetted perimeter is estimated to almost completely contract. There is negligible effect from around Year 110 when the pit lake completes its development as flow from the Jazga River will no longer be lost to the pit.

5.2.6.4.2 Predicted magnitude of changes to inflow to and level within Ilovica Reservoir (ILWT01)

Predicted changes to the flow regime into and level regime within Ilovica Reservoir (ILWT01) and associated flow related water supply failure or level related effect on ecology are summarised in Table 5-7.

This effects analysis assumed the following:

- It was assumed that once the pit lake spills at year 110, the mitigation proposed under the water quality analysis (Section 6.3) is in place. i.e. once the pit lake spills, all pit lake discharge will be piped to treatment. It is also assumed that the treated pit lake water will then be discharged into the Ilovica Reservoir.

- It has also been assumed that the mine water supply from Turija Reservoir to Ilovica Reservoir does not become operational until Year 1 of operations, and that Ilovica Reservoir provides water supplies for mine construction at the design rate while continuing to provide public water supplies to the seven villages plus Ilovica and Shtuka and agricultural water for Ilovica and Shtuka.

- It was assumed that local demands are limited to local agriculture; supply of water to Ilovica WTW for treatment and public supply will have been switched from Ilovica Reservoir to Turija Reservoir prior to start of operations.

Table 5-7: Predicted magnitude of changes at Ilovica Reservoir (ILWT01).

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Flow (other)</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>Q95 (low flow)</td>
<td>m³/s</td>
<td>0.006</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The magnitude of effect on the low flow regime is predicted by (conservative) groundwater modelling as high during operations and closure whilst the pit lake is still filling. This change to the flow regime translates into a high effect on water supply security at the Jazga river intake and a high effect on wetted perimeter.

The difference between Q95 at Ilovica Reservoir and Q95 at JZGS01 (Table 5-4) is that the Q95 at the reservoir includes a small contribution from the Treska catchment which is unaffected by mining. During construction, changes in land cover in the Jazga catchment (vegetation stripping and limited excavation) are insufficient to cause the Q95 at the reservoir to change significantly, so there is negligible effect on the baseline Q95 flow. In operations and closure, groundwater modelling predicts a severe loss of flow at the Q95 to the pit from Year ~5 when the pit base is excavated below river bed level.
Inflows to Ilovica Reservoir are restored after Year 110 when the treated pit lake water is discharged to Ilovica Reservoir. The predicted Q95 then slightly exceeds the baseline Q95 because the pit area produces more runoff than it did under baseline conditions.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td></td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Yr. 27</td>
</tr>
<tr>
<td></td>
<td>Yr. &gt;110</td>
</tr>
<tr>
<td>Construction</td>
<td>Operations</td>
</tr>
<tr>
<td>Closure</td>
<td>Post Pit-Lake</td>
</tr>
</tbody>
</table>

and therefore a high reduction in the Q95 into Ilovica Reservoir that cannot be offset by the contribution from the Treska catchment.

Supply failure

<table>
<thead>
<tr>
<th>Frequency</th>
<th>1 in 87yrs</th>
<th>1 in 1 yr</th>
<th>No Failure</th>
<th>1 in 10yrs</th>
<th>&gt; 1 in 87yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>-86 yrs</td>
<td>N/A</td>
<td>-77 yrs</td>
<td>&gt; 1 yr</td>
<td></td>
</tr>
<tr>
<td>(change in frequency)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>High</td>
<td>Negligible</td>
<td>High</td>
<td>Negligible</td>
<td></td>
</tr>
</tbody>
</table>

Comment:

As for the Q95, groundwater modelling predicts a reduction in Q50 due to reduced catchment and losses to pit during operations and in closure before pit lake formation. However, a smaller proportion of the Q50 is lost than for Q95, resulting in a low effect in operations and closure.

Inflows to Ilovica Reservoir are restored after Year 110 when the treated pit lake water is discharged to Ilovica Reservoir. The predicted Q50 then slightly exceeds the baseline Q50 because the pit area produces slightly more runoff than it did under baseline conditions.

Mean Res. Level

<table>
<thead>
<tr>
<th>masl</th>
<th>352.82</th>
<th>349.52</th>
<th>353.24</th>
<th>351.80</th>
<th>352.68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario - Baseline (m change)</td>
<td>-3.3</td>
<td>&gt;0.4</td>
<td>-1.02</td>
<td>-0.14</td>
<td></td>
</tr>
</tbody>
</table>
ILOVICA-SHTUKA ESIA

### Regime/Parameter

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (other)</td>
<td>Unit</td>
<td>Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
</tbody>
</table>

### Magnitude

<table>
<thead>
<tr>
<th></th>
<th>Constraction</th>
<th>Operations</th>
<th>Closure</th>
<th>Post Pit-Lake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q95 (low flow)</td>
<td>m³/s</td>
<td>0.003</td>
<td>0</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### Comment

During the construction stage a ‘high’ decrease in mean reservoir water level is predicted. This is a result of the imbalance between inflows and demand during this period.

During operations it is proposed to operate Ilovica Reservoir so that a freeboard of about 0.5m is maintained below spillway crest elevation (353.74 masl) by pumping water into the reservoir from Turija Reservoir. Since this water level is higher than the baseline mean water level, this is considered to have a negligible positive effect.

Following mine closure, mean reservoir level is predicted to drop by about 1m due to the imbalance between inflows (reduced due to losses to pit until pit lake formation is complete) and abstractions for local agricultural water supply.

After Year 110, when the pit lake is predicted to spill, the treated spilled water will reach Ilovica Reservoir, but the mean water level is predicted to revert to slightly lower than baseline due predominantly to the increased seasonal abstraction for irrigated agriculture in Ilovica and Shtuka (Details of the prediction of reservoir water level are presented in Annex 5B).

A range of indicators of effect have been used to assess the effect of mining activities on Ilovica Reservoir. Depending on the indicator, the magnitude of effect varies. During construction, high effects are predicted to reliability of supply and to mean reservoir water level, due to an imbalance between inflows and abstraction, principally caused by abstraction for mine construction and absence of pumped inflows from Turija Reservoir.

During operations a high effect is predicted to low flows flowing into the reservoir, but this does not translate into a high effect on the reservoir reliability since Euromax plans to pump water into Ilovica Reservoir from Turija Reservoir and maintain the mean reservoir level at about 0.5m below spillway crest level.

During closure, until the pit lake spills, a high effect is predicted to low flows flowing into the reservoir which this time translates into a high effect on the reservoir reliability because pumped inflows from Turija are assumed to cease at closure.

Once the pit lake spills, around Year 110, predicted effects are all negligible.

#### 5.2.6.4.3 Predicted magnitude of changes to the Jazga River downstream of Ilovica Reservoir

Predicted changes to the flow regime in the Jazga River directly downstream of Ilovica Reservoir and through Ilovica are summarised in Table 5-8.

### Table 5-8: Predicted magnitude of changes to the Jazga River directly downstream of Ilovica Reservoir

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (other)</td>
<td>Unit</td>
<td>Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td>Q95 (low flow)</td>
<td>m³/s</td>
<td>0.003</td>
</tr>
</tbody>
</table>

### Scenario - Baseline (% change)

<table>
<thead>
<tr>
<th>Scenario - Baseline (% change)</th>
<th>High</th>
<th>High (+)</th>
<th>Moderate</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100%</td>
<td>-66%</td>
<td>-33%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

### Comment

Under baseline conditions, the Q95 flow downstream of Ilovica Reservoir is a function of seepage through the dam embankment and not reservoir overflows via the spillway. Seepage through the dam is, in turn, assumed to be a function of the water level (head) in the reservoir.
During construction, it is predicted (Table 5-5) that the mean reservoir level will be over 3m lower than baseline. This decrease in reservoir water level is responsible for the prediction that the Q95 flow (seepage) will decrease virtually to zero, thus having a high effect during construction.

Since it is planned to operate Ilovica Reservoir with ~0.5m freeboard (Table 5-5) the higher mean water level will cause seepage and Q95 downstream to increase above baseline downstream of the reservoir during operations. A high positive effect is therefore predicted in operations.

On closure, the mean reservoir level is predicted to drop by about 1m (Table 5-5) as a result of abstraction from the reservoir and reduced inflows due to losses to the pit upstream. These factors will cause seepage and the Q95 downstream to reduce below baseline, causing a moderate effect.

When, around Year 110, the treated pit lake spill reaches Ilovica Reservoir, the baseline spill regime will be restored, with negligible effect.

Unlike Q95, under baseline conditions, the Q50 is a function of seepage and reservoir overflows via the spillway.

During construction, seepage is predicted to decrease (see above) and overflows are also predicted to decrease, resulting in a high effect on Q50.

During operations, as a result of the management of the reservoir with 0.5m freeboard, overflows at the Q50 flow are reduced to zero, causing the flow downstream to be due to embankment seepage alone, and causing a high effect. During closure, up to the time when the Ilovica Reservoir receives treated pit lake spill, owing to the decrease in mean reservoir level (Table 5-5), overflows at the Q50 flow are reduced (although not as much as in operations), consequently causing a moderate effect.

When, around Year 110, the treated pit lake spill reaches Ilovica Reservoir, the mean reservoir level will rise but will still be lower than baseline Reservoir overflows at the Q50 will increase but still be less than the baseflow regime and a low effect on Q50 is predicted.

Downstream of Ilovica Reservoir, the flow regime is largely a function of reservoir operation which affects seepage rates through the embankment and reservoir overflows. Effects are related to the mean reservoir water level and the way in which the reservoir is operated which in turn controls the regime of reservoir overflows which discharge water downstream.

### Predicted magnitude of changes to the flood regime for the Jazga River through Ilovica

Predicted changes to the peak 100-year design flood flow and level regimes for the Jazga River through Ilovica are summarised in Table 5-9. Flood risk analysis including an allowance for climate change has been completed only for the post-closure scenario and the baseline including climate change.

### Table 5-9: Predicted magnitude of changes to design flood flow and level regimes for the Jazga River through Ilovica

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present baseline Q100 m³/s</td>
<td>Year -1</td>
</tr>
<tr>
<td></td>
<td>20.3</td>
<td>20.8</td>
</tr>
</tbody>
</table>

Comment

Predicted changes to the peak 100-year design flood flow and level regimes for the Jazga River through Ilovica are summarised in Table 5-9. Flood risk analysis including an allowance for climate change has been completed only for the post-closure scenario and the baseline including climate change.
Landforms changes at construction negligibly exacerbate flood risk. During operations and during closure, prior to the pit lake filling, flood risk has a negligible change because of storm management in the pit.

In the longer term (post closure), although the pit lake spill will be piped to a treatment facility, it is assumed that under flood conditions the piped flow will be exceeded and the pit lake will spill into the Jazga and flow will contribute to the overtopping the Ilovica Reservoir spillway. It is assumed that the treated discharge to the Ilovica Reservoir will be equivalent to the piped discharge from the pit lake.

A spilling pit lake leads to a moderate level of effect to flood levels and this is similar with or without potential Climate Change uplift being taken into account.

**5.2.6.4.5 Predicted magnitude of changes to the Jazga River at Radovo (JZGS03)**

There is no contribution from the catchment downstream of Ilovica Reservoir during low and median flows. Effects are the same as those immediately downstream of Ilovica Reservoir (Table 5-8) and the explanation of effects presented in Section 5.2.6.4.3 holds true for the effects at Radovo.

**5.2.6.4.6 Predicted magnitude of changes to the Shtuka River at intake (STGS01)**

Predicted changes to the flow, water supply failure and wetted perimeter regimes at the Shtuka River at intake (STGS01) are summarised in Table 5-10.

**Table 5-10: Predicted magnitude of changes to the Shtuka River at intake (STGS01)**

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Flood flow Q; Flood level L</td>
<td>Unit</td>
<td></td>
</tr>
<tr>
<td>Present baseline L100</td>
<td>masl</td>
<td>289.65</td>
</tr>
<tr>
<td>Scenario - Baseline (m. increase)</td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
<td>Negligible (+)</td>
</tr>
<tr>
<td>Baseline Q100 + CC</td>
<td>m^3/s</td>
<td>27.3</td>
</tr>
<tr>
<td>Scenario - (Baseline + CC) (% change)</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>Magnitude</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Baseline L100 Includes CC</td>
<td>masl</td>
<td>290.02</td>
</tr>
<tr>
<td>Scenario - (Baseline + CC) (m. increase)</td>
<td></td>
<td>n/a</td>
</tr>
<tr>
<td>Magnitude</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

CC = Incorporating a 10% increase in design rainfall allowing for potential climate change effects.

L100 = is located at chainage 694m along the modelled reach downstream of the middle bridge in Ilovica where a cluster of in-river properties are located (see Annex 5B, Figure A8.2 therein).
During construction and operations the Shtuka River will be diverted around the TMF in the diversion channel and the diversion channel will discharge into the SWD (storm water dam). The Q95 will pass through the permeable SWD. Negligible effect on the Q95 flow at STGS01 during construction and operation is therefore predicted. Following closure, the project description states that the diversion may fall into disrepair therefore low flows generated in the section of the catchment upstream of the TMF will be lost to evaporation and infiltration on the surface of the TMF and will not be able to discharge downstream.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Year -1</td>
<td>Year 20</td>
<td>Year 27</td>
</tr>
<tr>
<td>Flow (other)</td>
<td></td>
<td>Construction</td>
<td>Operations</td>
<td>Post Closure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>During</td>
<td>during</td>
<td>Post Closure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>operation</td>
<td>or</td>
<td>the diversion channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td>the diversion channel will discharge into the SWD (storm water dam). The Q95 will pass through the permeable SWD. Negligible effect on the Q95 flow at STGS01 during construction and operation is therefore predicted. Following closure, the project description states that the diversion may fall into disrepair therefore low flows generated in the section of the catchment upstream of the TMF will be lost to evaporation and infiltration on the surface of the TMF and will not be able to discharge downstream.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q50 (median flow) m³/s</th>
<th>0.022</th>
<th>0.021</th>
<th>0.021</th>
<th>0.021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario - Baseline (%) change</td>
<td>-5%</td>
<td>-5%</td>
<td>-5%</td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>Normal and high flows including the Q50, increase in a downstream direction along the reach of the Shtuka river in the footprint of the TMF. Thus, following diversion at the river diversion dam, a small decrease is predicted in Q50 during operations due to the loss of catchment area draining to the TMF footprint. During construction and operations, it is assumed that the diverted Q50 will discharge into the SWD via the diversion channel and be able to pass through the permeable SWD with minimal attenuation, resulting in a negligible effect on the Q50 at STGS01. Following closure, the worst case has been assumed; that the diversion channel falls into disrepair. However, the objectives for closure and reclamation of the TMF are that it should minimise infiltration, therefore, while low flows will be lost to evaporation and infiltration, standing water will be minimised and the equivalent of the Q50 (median flows) will be discharged to the Shtuka River downstream of the SCF and upstream of STGS01.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supply failure</th>
<th>Av. No. summer days / year</th>
<th>55</th>
<th>56</th>
<th>56</th>
<th>56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario - Baseline (additional days)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>Security of supply by the Shtuka intake is here assessed on the average number of days per year that simulated flow is below 15 L/s, the threshold flow in the Shtuka River below which augmentation of Shtuka’s water supply is required from Ilovica WTW during the 54-year modelled period. During construction, operations and post-closure little change in the median flow regime from baseline is predicted at the intake (STGS01), even with loss of the Q95 post closure, so there is limited change in the number of days of augmentation from baseline, resulting in negligible effect in the worst case. The modelling of supply failure at the village water supply intakes is described in Annex 3 (ESIA Baseline).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wetted perimeter</th>
<th>m</th>
<th>2.37</th>
<th>2.37</th>
<th>2.37</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario - Baseline (%) change</td>
<td>0%</td>
<td>0%</td>
<td>-100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
<td>Negligible</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>Since wetted perimeter, an indicator of aquatic habitat, is calculated using Q95 and there has been negligible change in Q95 during construction and operations (above) there is negligible change in the wetted perimeter.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The magnitude of effect on the low flow regime of the Shtuka River at STGS01 (Shtuka's water supply intake) is predicted as negligible (or otherwise positive) throughout the mine scheme. However, post closure, low flows will not occur downstream of the TMF.

These changes to the flow regime translate into similar effects on water supply security in terms of water quantity at the river intake and on wetted perimeter (used as an indicator for aquatic habitat). These results assume that there will be no ponding, attenuation of flows or seepage losses below the Q50 at the SWD during operations, although following closure and reclamation of the TMF, low flows will be lost to evaporation and infiltration.

### 5.2.6.4.7 Predicted magnitude of changes to the flood regime for the Shtuka River through Shtuka.

Predicted changes to the peak 100-year design flood flow and level regimes for the Shtuka River at the upstream edge of and through Shtuka are summarised in Table 5-11. Flood risk analysis including an allowance for climate change has been completed only for the post closure scenario and the baseline including climate change.

**Table 5-11: Predicted magnitude of changes to design flood flow and level regimes for the Shtuka River through Shtuka**

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Baseline</th>
<th>Yr. -1</th>
<th>Yr. 13</th>
<th>Yr. 20</th>
<th>Yr. 27+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. -1</td>
<td>Yr. 20</td>
<td>Yr. 27+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction</td>
<td>Operations</td>
<td>End Operations</td>
<td>Closure / Post Closure</td>
<td></td>
</tr>
<tr>
<td>Present baseline Q100</td>
<td>m³/s</td>
<td>7.95</td>
<td>7.66</td>
<td>5.52</td>
<td>5.9</td>
<td>7.37</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td>-3.6%</td>
<td>-30.6%</td>
<td>-25.8%</td>
<td>-7.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible (+)</td>
<td>Moderate (+)</td>
<td>Low (+)</td>
<td>Negligible (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present baseline L100</td>
<td>masl</td>
<td>296.45</td>
<td>296.44</td>
<td>295.97</td>
<td>296.06</td>
<td>296.42</td>
</tr>
<tr>
<td>Scenario - Baseline (m. increase)</td>
<td>-0.01</td>
<td>-0.48</td>
<td>-0.39</td>
<td>-0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible (+)</td>
<td>High (+)</td>
<td>High (+)</td>
<td>Negligible (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Q100 + CC</td>
<td>m³/s</td>
<td>9.6</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>9.04</td>
</tr>
<tr>
<td>Scenario - Baseline (% change)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>-5.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>Negligible (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline L100 + CC</td>
<td>masl</td>
<td>296.57</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>296.56</td>
</tr>
<tr>
<td>Scenario - Baseline (m. increase)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>-0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnitude</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>Negligible (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>The bridge starts surcharging (running full) at 295.9m asl &amp; overtops at 296.2 m asl Overtopping occurs for all baseline and effected scenarios considered.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CC = Incorporating a 10% increase in design rainfall allowing for potential Climate Change effects.  
L100 = located at Section 22 upstream of the bridge by the village square in Shtuka (see Annex 5B, Figure A8.5 therein).

Magnitudes of effect on flood risk in Shtuka are **positive** (beneficial) throughout mine life. During operations the **positive** effect is **low to moderate** due to water management control afforded on the TMF. Flows, up to the 100 year design flood, generated by the whole catchment draining to the TMF are retained by the TMF or controlled by the diversion channel. The **positive** change is of **negligible** proportions both during the construction phase and in post closure. During construction and operations, attenuation to potential effects below the TMF is afforded via the Seepage Collection Facility and Storm Water Dam.

Post closure flood risk is managed, without or with potential Climate Change effects, so as to provide a **negligible positive** effect. This outcome arises due to the inclusion of extensive flood drainage control on the whole catchment draining to the restored TMF and partial attenuation of flood drainage from the TMF embankment/abutment via the SCF.

### 5.2.6.4.8 Predicted magnitude of changes to the flood regime for the Shtuka River at Sekirnik road bridge (STGS02)

Predicted changes to the peak 100 year design flood flow and level regimes for the Shtuka River at Sekirnik road bridge (STGS02) are summarised in Table 5-12. Flood risk analysis including an allowance for climate change has only been completed for the post closure scenario and the baseline including climate change.

#### Table 5-12: Predicted magnitude of changes to design flood flow and level regimes for the Shtuka River at Sekirnik road bridge (STGS02)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Baseline</th>
<th>Yr. -1</th>
<th>Yr.13</th>
<th>Yr.20</th>
<th>Yr. 27</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction</td>
<td>Operations</td>
<td>End Operations</td>
<td>Closure / Post Closure</td>
</tr>
<tr>
<td><strong>Flood flow Q</strong>; <strong>Flood level L</strong></td>
<td><strong>Unit</strong></td>
<td><strong>Present baseline Q100</strong></td>
<td>m³/s</td>
<td>8.55</td>
<td>8.26</td>
<td>6.12</td>
</tr>
<tr>
<td>Scenario v Baseline (% change)</td>
<td></td>
<td></td>
<td>-3.4%</td>
<td>-28.4%</td>
<td>-24.0%</td>
<td>-6.8%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td></td>
<td>Negligible (+)</td>
<td>Low (+)</td>
<td>Low (+)</td>
<td>Negligible (+)</td>
</tr>
<tr>
<td><strong>Present baseline L100</strong></td>
<td>masl</td>
<td>216.11</td>
<td>216.09</td>
<td>215.99</td>
<td>216.03</td>
<td>216.10</td>
</tr>
<tr>
<td>Scenario v Baseline (m. increase)</td>
<td></td>
<td></td>
<td>-0.02</td>
<td>-0.12</td>
<td>-0.08</td>
<td>-0.01</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td></td>
<td>Negligible (+)</td>
<td>Low (+)</td>
<td>Negligible (+)</td>
<td>Negligible (+)</td>
</tr>
<tr>
<td><strong>Baseline Q100 + CC</strong></td>
<td>m³/s</td>
<td>10.2</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>9.64</td>
</tr>
<tr>
<td>Scenario v Baseline (% change)</td>
<td></td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>-5.5%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>Negligible (+)</td>
</tr>
<tr>
<td><strong>Baseline L100 + CC</strong></td>
<td>masl</td>
<td>216.13</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>216.13</td>
</tr>
<tr>
<td>Scenario v Baseline (m. increase)</td>
<td></td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>0.00</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>Negligible (+)</td>
</tr>
</tbody>
</table>

**Comment:** The bridge starts surcharging (running full) at 215.6masl & overtops at 216.0masl. Therefore, a surcharged regime occurs for all baseline and effected scenarios considered and an overtopping (flooded) condition occurs
Regime/Parameter | Life of Mine stage
---|---
Flood flow Q; Flood level L | Baseline | Yr. -1 | Yr. 13 | Yr. 20 | Yr. 27
| Construction | Operations | End Operations | Closure / Post Closure
---|---|---|---|---

for all baseline and most effected scenarios considered with the exception being the operational period.

CC = Incorporating a 10% design rainfall uplift allowing for potential Climate Change effects.
L100 = located at Section 9 upstream of the road bridge (see Annex 5B, Figure A8.8 therein).

Magnitudes of effect on flood risk at Sekirnik road bridge are positive (beneficial) throughout mine life. The reasons for positive effects at Sekirnik road bridge throughout the mine project are the same as those given in relation to flood effects at Shtuka village (Section 5.2.6.4.7) which is located upstream of and on the same river as Sekirnik road bridge with both locations being subject to the same mine related effects on flood regime.

5.2.6.4.9 Predicted magnitude of changes to the Shtuka River at Sekirnik Road bridge (STGS02).

Predicted changes to the flow regime for the Shtuka River at Sekirnik Road bridge (STGS02) are summarised in Table 5-13.

Table 5-13: Predicted magnitude of changes to the flow regime for the Shtuka River at Sekirnik Road bridge (STGS02)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Flow (other)</td>
<td>Unit</td>
</tr>
<tr>
<td>Q95 (low flow)</td>
<td>m³/s</td>
</tr>
<tr>
<td>Scenario v Baseline (% change)</td>
<td>0%</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td>Since the mine scheme involves no change in flow regulation between STGS01 and Sekirnik Road Bridge, negligible change in Q95 is predicted at all stages of mine life. This is because flows at STGS02 are influenced by the groundwater system in the Strumica valley between Shtuka and STGS02.</td>
</tr>
</tbody>
</table>

Q50 (median flow) | m³/s | 0.015 | 0.015 | 0.015 | 0.015 |
| Scenario v Baseline (% change) | 0% | 0% | 0% | 0% |
| Magnitude | Negligible | Negligible | Negligible | Negligible |
| Comment | As for Q95 at STGS02, since the mine scheme involves no change in flow regulation between STGS01 and Sekirnik Road Bridge and the flow regime at STGS02 is influenced by the groundwater system in the Strumica valley between Shtuka and STGS02, negligible change in Q50 is predicted at all stages of mine life. |

The magnitude of effect on the low flow regime is predicted as negligible during all stages of the mine scheme. The corresponding magnitudes of effect to median flow conditions is similarly predicted as negligible during all stages of the mine scheme.

5.2.6.4.10 Predicted magnitude of changes to the Suchica River (SUGS01).

The Suchica River at gauging station SUGS01 was added as a human receptor location because of a possibility that construction of the TMF could cause groundwater flow to occur across the watershed from the Shtuka catchment to the Suchica catchment.
The groundwater modelling study identified that infilling of the Shtuka valley with low permeability tailings, and the consequent reduction or loss of the current discharge pathway along the Shtuka River could cause groundwater levels to rise in the upper Shtuka catchment as water becomes impounded against the tailings deposit. This is most likely to occur at the upstream margins of the TMF but could potentially also extend along its eastern and western flanks. This effect could cause groundwater to spill at the margins of the TMF and require drainage management.

Depending on the depth and extent of fracturing in the granite beneath the Shtuka/Suchica watershed and the elevation to which impounded groundwater levels may rise, there is potentially a very low risk of cross-catchment flow occurring. If cross-flow does occur, and if it carries supernatant from the TMF, there could be a possibility that this could affect water quality in the Suchica River. The likelihood that this would affect the Suchica village water supply is, however, considered to be low and therefore the magnitude of effects is categorised as negligible.

5.2.6.4.11 Predicted magnitude of changes to the Jazga River contribution to Turija River flow at TJGS01

Predicted changes to the contribution of the median flow (Q50) in the Jazga River to the median flow in the Turija River at gauging station TJGS01 downstream of the confluence of the Jazga River are summarised in Table 5-14. The Q50 was selected for analysis as it is a measure of average flow and therefore represents the flow regime in both rivers.

Table 5-14: Predicted magnitude of changes in the contribution of the Jazga River to flow in the Turija River at Turnovo (TJGS01)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Baseline</th>
<th>Yr. -1</th>
<th>Yr. 20</th>
<th>Yr. 27</th>
<th>Yr. &gt;110</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Flow (other)</td>
<td>Unit</td>
<td>Construction</td>
<td>Operations</td>
<td>Closure</td>
</tr>
<tr>
<td>Jazga Q50</td>
<td></td>
<td>m³/s</td>
<td>0.027</td>
<td>0.005</td>
<td>0.005</td>
<td>0.006</td>
</tr>
<tr>
<td>Change in Jazga Q50</td>
<td></td>
<td>m³/s</td>
<td>-</td>
<td>-0.022</td>
<td>-0.022</td>
<td>-0.021</td>
</tr>
<tr>
<td>Turija Q50</td>
<td></td>
<td>m³/s</td>
<td>0.422</td>
<td>0.422</td>
<td>0.422</td>
<td>0.422</td>
</tr>
<tr>
<td>Jazga to Turija (change in % contribution)</td>
<td></td>
<td></td>
<td>6 %</td>
<td>-5%</td>
<td>-5%</td>
<td>-5%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
| Comment          | The baseline contribution of the Jazga River as modelled at Radovo (JZGS03) to the Turija River (TJGS01) is 6% at Q50. Reductions of 5% of the baseline Q50 in the Turija River are predicted in the construction, operations and closure periods and of 1% following pit lake spill. The effect is ‘negligible’ in all cases. The analysis is based on modelled and measured data 1973-2008.

The magnitude of effect on flow contribution of the Jazga River to Q50 in the Turija River is negligible throughout construction, operations, closure and post-closure owing to the overall small baseline contribution of the Jazga River and the small changes predicted in each period.

5.2.6.4.12 Predicted magnitude of changes to the Jazga River and Shtuka River contributions to Strumica River flow at SMGS02

Predicted changes to the contribution of the median flow (Q50) in the Jazga River and Shtuka River to the median flow in the Strumica River at SMGS02 downstream of the confluence of the Turija and Strumica Rivers are summarised in Table 5-15.
### Table 5-15: Predicted magnitude of changes in the contribution of the Jazga River and Shtuka River to flow in the Strumica River at Sekirnik (SMGS02)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Unit</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yr. -1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Jazga Q50</td>
<td>m³/s</td>
<td>0.027</td>
<td>0.005</td>
</tr>
<tr>
<td>Change in Jazga Q50</td>
<td>m³/s</td>
<td>-</td>
<td>-0.022</td>
</tr>
<tr>
<td>Strumica Q50</td>
<td>m³/s</td>
<td>1.155</td>
<td>1.155</td>
</tr>
<tr>
<td>Jazga-Strumica (change in % contribution)</td>
<td></td>
<td>2 %</td>
<td>-2%</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td></td>
<td>Negligible</td>
</tr>
</tbody>
</table>

**Comment**

The baseline contribution from the Jazga River, modelled at Radovo (JZGS03,) to the Strumica River (SMGS02) is 2% at Q50. Reductions of 2% of the baseline Q50 in the Strumica River are predicted in the construction, operations and closure periods and of 0.3% following pit lake spill. The effect is 'negligible' in all cases. The analysis is based on modelled and measured data 1973-2008.

| Shtuka Q50%     | m³/s | 0.015    | 0.015 | 0.015 | 0.015 | n/a |
| Change in Shtuka Q50 | m³/s | -        | 0     | 0     | 0     | -   |
| Strumica Q50%   | m³/s | 1.158    | 1.158 | 1.158 | 1.158 | n/a |
| Shtuka-Strumica (change in % contribution) | | 1 % | 0% | 0% | 0% | n/a |
| Magnitude       |      |          | Negligible | Negligible | Negligible | n/a |

**Comment**

The Jazga River contributes 2% of the baseline Q50 flow in the Strumica River at Sekirnik (SMGS02), and the Shtuka 1% of the Q50 flow. No reductions in Q50 in Shtuka River are predicted, and so there is negligible effect on the Q50 in the Strumica River at Sekirnik. The analysis is based on modelled and measured data 1973-2008.

*The magnitude of effect on median flow contribution to the Strumica is negligible throughout the mine scheme and post closure.*

### 5.2.6.4.13 Predicted magnitude of changes to the Jazga River and Shtuka River contributions to Strumica River flow at Novo Selo gauge

Predicted changes to the contribution of the median flow (Q50) in the Jazga River and Shtuka River to the median flow in the Strumica River at Sekirnik (SMGS02) are presented in Table 5-15 above. The magnitude of effect on median flow contribution to the Strumica River at Novo Selo is similar and is negligible throughout the mine scheme and post closure.

### 5.2.6.4.14 Predicted magnitude of changes to the reliability of irrigation water supplies to the Turija irrigation scheme

This section assesses predicted changes to the reliability of irrigation water supplies from Turija Reservoir to the Turija irrigation scheme as a result of the mine scheme being supplied from Turija Reservoir. The mine water supply scheme will convey water from the Turija irrigation delivery pipeline to Ilovica Reservoir, which may have an effect on the reliability of irrigation supplies in the Turija irrigation scheme.
The reliability of water supplies to the mine and to irrigation was modelled. The calculated existing (pre-refurbishment) efficiency of the irrigation system adopted in the model was 30% (See Section 2.2). Following refurbishment of the canal into the pipeline it was considered that the efficiency of the irrigation system will increase to 45% irrespective of the proposed mine water supply system. The reliability of water supplies was defined by temporal reliability and volumetric reliability (see Section 2.2).

Assumptions regarding water supplies from Turija Reservoir during mine operations included:

- 1 Mm³ flood storage maintained in Turija Reservoir throughout year;
- 5 Mm³/yr supply to Strumica;
- 3.3 Mm³/yr environmental flow released;
- 0.59 Mm³/yr supply to Ilovica WTW;
- 2,500 ha irrigated area, distributed 80% upstream and 20% downstream of Euromax’s proposed abstraction point; and
- Irrigation scheme efficiency of 45%.

Modelled temporal and volumetric reliability results are presented in Table 5-16 for Year 1 of mine life when Turija Reservoir will be the main source of water supply to the mine, and for Years 2 to 20 when water accumulating on the TMF will be the main source of reclaim water and Turija will be the main source of fresh water supply. It is assumed that Turija Reservoir will not supply water to the mine during the construction and closure phases.

Table 5-16: Predicted magnitude of changes in irrigation water reliability in Turija irrigation scheme upstream and downstream of Euromax Resources’ proposed abstraction point at Ilovica

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Construction</th>
<th>Operations</th>
<th>Operations</th>
<th>Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Yr. -1</td>
<td>Yr. 1</td>
<td>Yrs. 2 to 20</td>
<td>Yr. &gt;20</td>
</tr>
<tr>
<td>Temporal and volumetric reliability of irrigation water supplies</td>
<td>Unit</td>
<td>22</td>
<td>22</td>
<td>19</td>
<td>12</td>
</tr>
<tr>
<td>Upstream Irrigation Area, temporal reliability</td>
<td>%</td>
<td>0</td>
<td>-3</td>
<td>-10</td>
<td>-12</td>
</tr>
<tr>
<td>Scenario - Baseline (change)</td>
<td>Magnitude</td>
<td>Negligible</td>
<td>Low (+)</td>
<td>Moderate (+)</td>
<td>High (+)</td>
</tr>
</tbody>
</table>

During the construction phase it is assumed that irrigation water supplies from Turija Reservoir will continue as per baseline conditions via the Turija canal, with negligible effect caused by the project on the irrigation area upstream of the proposed abstraction point.

During operations Year 1, when the Turija pipeline comes into operation, and Years 2 to 20, improvements in temporal reliability of irrigation supplies are predicted in irrigation areas upstream of the mine abstraction point. Any negative effect that the mine abstraction may have on reliability is more than offset by the higher irrigation scheme efficiency brought about by refurbishment of the Turija canal into a pipeline and by the irrigation area being situated upstream of the abstraction point, and thereby having ‘first call’ on available water.

At mine closure from Year 21 onwards, water supply to the mine will cease. At this time a high improvement in temporal reliability compared to baseline is predicted. This is due to the improved efficiency of the irrigation scheme over baseline imparted by the pipeline and also due to cessation of abstraction by the mine.
<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporal and</td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>volumetric</td>
<td>Unit</td>
</tr>
<tr>
<td></td>
<td>reliability of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>irrigation water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>supplies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>volumetric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reliability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario - Baseline (change)</td>
<td>0</td>
<td>-4</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
<td>Low (+)</td>
</tr>
</tbody>
</table>

**Comment**

As above, during construction, the mine water supply scheme is assumed to be not operational and therefore has negligible effect on volumetric reliability in irrigation areas upstream of the proposed abstraction point. During operations, improvements over baseline volumetric reliability are predicted for upstream irrigation areas, due to the higher irrigation scheme efficiency. At closure, when abstractions for mine supply cease, a further improvement in volumetric reliability is predicted, again due to the improved irrigation scheme efficiency imparted by the refurbished Turija pipeline and the cessation of abstraction for the mine.

<table>
<thead>
<tr>
<th>Downstream Irrigation Area, temporal Reliability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>22</td>
</tr>
<tr>
<td>Scenario – Baseline (change)</td>
<td>0</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

**Comment**

During construction it is assumed that irrigation water supplies from Turija Reservoir will continue as per baseline conditions via the Turija canal, with negligible effect caused by the project on the irrigation area downstream of the proposed abstraction point. During operations Year 1, when the Turija pipeline comes into operation, and Years 2 to 20, a moderate deterioration in temporal reliability of irrigation supplies is predicted in irrigation areas downstream of the mine abstraction point. This is due to the position of this irrigation area at the tail end of the water supply system. The temporal reliability in Years 1 and 2-20 exceeds the threshold that SPWMC considers acceptable (non-availability of irrigation supplies for 25% of the time). Following cessation of water supply to the mine at mine closure a high improvement in temporal reliability is predicted in downstream areas (equal to the temporal reliability for upstream areas). This is due to the improved efficiency of the irrigation scheme over baseline imparted by the refurbishment of the original Turija canal into a pipeline and also due to the cessation of abstraction by the mine.

<table>
<thead>
<tr>
<th>Downstream Irrigation Area, volumetric reliability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>24</td>
</tr>
<tr>
<td>Scenario – Baseline (change)</td>
<td>0</td>
</tr>
<tr>
<td>Magnitude</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

**Comment**

During construction, the mine water supply scheme is assumed to be not operating, and so there is negligible effect of the mine water supply on volumetric reliability of the supply of irrigation water. During operations, in Years 1 and 2-20, improved volumetric reliability of irrigation supplies are predicted for irrigation areas downstream, due to the higher irrigation scheme efficiency, although the level of reliability is lower than for upstream areas. This difference is due to the position of this irrigation area at the tail end of the water supply system. At closure, when abstractions for mine water supply cease, a high improvement in volumetric supply reliability is predicted (equal to the volumetric reliability predicted...
Overall, for irrigation areas upstream and downstream of the proposed mine water supply abstraction point, an improvement in volumetric reliability of irrigation supplies is predicted over baseline. This is due to the improved irrigation scheme efficiency resulting from conversion of Turija canal into a pipeline.

With respect to temporal reliability, it is predicted that the irrigation area upstream of the proposed abstraction point will experience improved reliability of supplies, but downstream areas are predicted to experience a moderate adverse effect on reliability in Year 1 and in Years 2 to 20 as a result of the abstraction of water for supply to the mine. Mitigation of this effect on temporal reliability in downstream irrigation areas is proposed in Section 6.

5.2.6.5 Summary of key results for groundwater receptors
5.2.6.5.1 Predicted magnitude of changes to groundwater levels and community water supplies in north Ilovica

Predicted changes to groundwater levels and community water supplies in north Ilovica nearest to the proposed mine are summarised in Table 5-17. Details of the modelled outputs used to conduct the assessments are described in Annex 5B.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. -1</td>
<td>Yr. 1</td>
<td>Yrs. 2 to 20</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>Operations</td>
<td>Operations</td>
</tr>
</tbody>
</table>

Table 5-17: Predicted magnitude of changes to groundwater levels and community water supplies in north Ilovica

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well IB19 (Environmental level assessment)
Modelled mean level: masl

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well IB19 (Water supply security assessment)
Modelled dry level: masl

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well IB39 (Environmental level assessment)
Modelled mean level: masl

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well IB39 (Water supply security assessment)
Modelled dry level: masl

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spring ISP41 (Environmental level assessment)
Modelled dry level: masl

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
<th>Regime/Parameter</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 6</td>
<td>Yr. 13</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td>Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 5.2.6.5.2 Predicted magnitude of changes to groundwater levels and the community water supply at IB30 in south Ilovica

Predicted changes to groundwater levels and community water supply at IB30 in south Ilovica are summarised in Table 5-18 below. Details on the modelled parameters used to conduct the assessments are described in Annex 5B.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. 6</td>
</tr>
<tr>
<td>GW Model Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modelled mean level</td>
<td>masl</td>
<td>278.20</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>No discernible change from baseline levels during mine life and post-closure</td>
</tr>
<tr>
<td>Spring ISP41 (Water supply security assessment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modelled dry level</td>
<td>masl</td>
<td>277.87</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>No discernible change from baseline levels during mine life and post-closure</td>
</tr>
</tbody>
</table>

There is no significant differentiation between the predicted changes to groundwater levels under mean or dry conditions at any receptors considered and similarly associated magnitudes are consistently assessed as **negligible** for all level regimes and Life of Mine stages considered.

### 5.2.6.5.3 Predicted magnitude of changes to groundwater levels and community water supplies in Shtuka

Predicted changes to groundwater levels and community water supplies in Shtuka are summarised in Table 5-19. Further details on the modelled outputs used to conduct the assessments are described in Annex 5B.

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Model Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modelled mean level</td>
<td>masl</td>
<td>306.27</td>
</tr>
<tr>
<td>Magnitude</td>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td>No discernible change from baseline levels during mine life and post-closure</td>
</tr>
<tr>
<td>Well SB47 (Environmental level assessment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modelled mean level</td>
<td>masl</td>
<td>306.27</td>
</tr>
</tbody>
</table>

Predicted changes to groundwater levels are greater under dry conditions compared to average conditions, but associated magnitudes are consistently assessed as **negligible** for all level regimes and Life of Mine stages considered.
<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Baseline</th>
<th>Life of Mine stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Model Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well BH347 (Environmental level assessment)</td>
<td>228.12</td>
<td>227.68</td>
</tr>
<tr>
<td>Modelled mean level masl</td>
<td>228.12</td>
<td>227.68</td>
</tr>
<tr>
<td>Magnitude Negligible</td>
<td>227.68</td>
<td>227.68</td>
</tr>
<tr>
<td>Comment</td>
<td>227.67</td>
<td>227.67</td>
</tr>
<tr>
<td></td>
<td>228.10</td>
<td></td>
</tr>
</tbody>
</table>

**3.2.6.5.4 Predicted magnitude of changes to groundwater levels between Ilovica and Turnovo**

Predicted changes to groundwater levels between Ilovica and Turnovo resulting from mining activities in the upper Jazga and Shtuka catchments (not from groundwater abstraction in the Strumica valley) are summarised in Table 5-20. Details on the modelled parameters used to conduct the assessments are described in Annex 5B.
At well BH347 predicted changes to groundwater levels are greater under dry conditions compared to average conditions, but associated magnitudes are consistently assessed as negligible for all level regimes and Life of Mine stages considered. At monitoring borehole IC-15-113 predicted changes to groundwater levels are only considered under mean conditions and associated magnitudes are consistently assessed as negligible for all Life of Mine stages considered.

5.2.7 Impact Classification

5.2.7.1 Magnitude of the effect

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1. Table 5-21 presents the parameters which will be used for the impact assessment for water quantity. Further details and explanation of the magnitude parameters is presented in Annex 5B.

Table 5-21: Impact Assessment Parameters for Water Quantity

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic Extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>No predicted or otherwise small and insignificant changes relative to baseline values.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>River flow: 0 - 10 % reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wetted perim. 0 - 20 % reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>River intake supply security: 0 - 10 % reduction or &lt; 5 days per year additional average connection to Ilovica WTW.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temporal reliability &amp; volumetric reliability of Turija Reservoir: 0 – 2 % change</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood flow: 0 - 10 % increase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood level: 0 - 0.05m increase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GW level (regime(a)): 0 - 25 % reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Modest/small changes relative to baseline values not considered significant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>River flow: 11 - 30% reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wetted perim. 21 - 50% reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>River intake supply security: 11 - 30% reduction or 6-15 days/year additional average connection to Ilovica WTW.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temporal reliability &amp; volumetric reliability of Turija Reservoir: 3 – 5 % change</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood flow: 11 - 20% increase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood level: 0.06 - 0.15m increase.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GW level (regime(a)): 26 - 50 % reduction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The resulting determinations of magnitude of impact are shown in Section 5.2.7.2 along with the determination of impacts.

### 5.2.7.2 Determination of impact

Using the decision matrix presented in Annex 1 and the receptors defined in Section 5.2, the impacts have been determined. Annex 5B (Appendix D) presents the route to the classification of the impacts, describing the magnitude, geographic extent, duration and frequency for each impact. Table 5-22 summarises those impacts that are classified as Moderate or Major which require mitigation (Section 6).

#### Table 5-22: Assessment of Impacts for Water Quantity

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Regime/Parameter</th>
<th>Project phase (construction, operations, closure, post-closure)</th>
<th>Key source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jazga River at intake (JZGS01)</td>
<td>Q95 flow</td>
<td>Operations (Yr 20)</td>
<td>Change in Q95 flow due to induced loss of flow to pit and pit dewatering as pit is excavated below river bed level from Year ~5 onwards.</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closure (Yr 27)</td>
<td>Change in Q95 flow due to induced loss of flow until the pit lake fills up</td>
<td>Major</td>
</tr>
<tr>
<td>Receptor</td>
<td>Regime/Parameter</td>
<td>Project phase (construction, operations, closure, post-closure)</td>
<td>Key source of impact</td>
<td>Impact classification</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------</td>
<td>-------------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to elevation of river bed in Year ~110.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operations (Yr 20)</td>
<td>Change in number of days per year Ilovica village would need to be supplied by Ilovica WTW as a result of reduced flow at water supply intake from Year ~5 onwards.</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closure (Yr 27)</td>
<td>Change in number of days per year Ilovica village would need to be supplied by Ilovica WTW as a result of reduced flow at water supply intake until the pit lake fills up to elevation of river bed in Year ~110.</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operations (Yr 20)</td>
<td>Change in wetted perimeter due to induced loss of flow represented by Q95 due to excavation of pit below river bed level and pit dewatering from Year ~5 onwards.</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closure (Yr 27)</td>
<td>Change in wetted perimeter due to induced loss of flow to pit is predicted to continue until the pit lake fills up to the elevation of the river bed in Year ~110.</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operations (Yr 20)</td>
<td>Change in Q95 inflow due to induced loss of water from Jazga River during excavation of the mine pit below river bed level and pit dewatering from Year ~5 onwards.</td>
<td>Major</td>
</tr>
<tr>
<td>Ilovica</td>
<td>Q95 (Jazga inflow)</td>
<td></td>
<td>Change in Q95 inflow due to induced loss of water from Jazga River to pit lake until the pit lake fills up to the elevation of the river bed in Year ~110.</td>
<td>Major</td>
</tr>
<tr>
<td>Reservoir</td>
<td></td>
<td></td>
<td>Change in frequency of failure due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply</td>
<td>Moderate</td>
</tr>
<tr>
<td>(ILWT01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptor</td>
<td>Regime/Parameter</td>
<td>Project phase (construction, operations, closure, post-closure)</td>
<td>Key source of impact</td>
<td>Impact classification</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>scheme is under construction.</td>
<td></td>
</tr>
<tr>
<td>Closure (Yr 27)</td>
<td>Mean reservoir water level</td>
<td>Change in frequency of failure due to reduced Q95 inflows caused by induced loss of water from Jazga River to pit until the pit lake fills up to the elevation of the river bed in Year -110.</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction (Yr -1)</td>
<td>Change in mean water level due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply scheme is under construction.</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Jazga River downstream of Ilovica Reservoir and Jazga River at Radovo (JZGS03)</td>
<td>Q50 flow</td>
<td>Change in Q50 flow from Ilovica Reservoir via the spillway due to management of reservoir water level with 0.5m freeboard.</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Jazga River through Ilovica</td>
<td>L100 flood level</td>
<td>Spilling pit lake exacerbates flood risk in Ilovica both with and without potential Climate Change effects</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Shtuka River at intake (STGS01)</td>
<td>Q95 flow and wetted perimeter</td>
<td>Following the diversion channel falling into disrepair, low flows will be lost to evaporation and infiltration on the surface of the TMF and will not discharge downstream causing change to Q95 and wetted perimeter</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Turija irrigated area downstream of proposed Euromax abstraction point on refurbished Turija irrigation pipeline</td>
<td>Percentage of time that irrigation demand is not satisfied</td>
<td>Change in percentage of time that demand is not satisfied by water supplies from Turija Reservoir.</td>
<td>Moderate</td>
<td></td>
</tr>
</tbody>
</table>
The impact on river channel wetted perimeter (a proxy for extent of aquatic habitat) during Operations and following closure are both assessed as **Major**. Classification of the impact on aquatic ecology is presented in Section 5.8.

### 5.3 Water Quality

This section describes the assessment of impacts of the proposed mine on surface water and groundwater quality in the local and regional study areas. Water quality is important because public, domestic and agricultural water supplies in Ilovica and Shtuka are obtained from intakes on the Jazga and Shtuka rivers and from groundwater wells in the catchments in which mining activities will be undertaken. Changes in water quality can affect the security of the water supplies. In addition, changes to the quality of water in the rivers may affect the habitat for aquatic fauna and flora.

Impact assessment utilises the source-pathway-receptor concept. Water will usually flow from a source (e.g. an item of infrastructure) via a pathway (e.g. a river or river intake and distribution system), to a receptor (e.g. a community or habitat) which may be geographically separated from the source. Source-pathway-receptor diagrams for the Tailings Management Facility (TMF), the open pit and Run of Mine (ROM) pad are presented in Annex 5B.

#### 5.3.1 Sources of Effects

##### 5.3.1.1 Overview

Effects on water quality arise mainly as a result of changes in surface water and groundwater flows and exposure of material which could release contaminants, associated with activities such as:

- Pit excavation;
- Creation of stockpiles;
- Ore processing;
- Tailings and waste rock disposal; and
- Mine water management, particularly the mine water supply and drainage systems.

The above activities can expose material and alter water flow pathways which in turn can modify:

- Runoff and groundwater recharge (discussed in Section 5.2);
- Groundwater–surface water interactions (discussed in Section 5.2);
- Low, average and high flows in watercourses (discussed in Section 5.2);
- The leaching of contaminants (acid rock drainage (ARD), metals or processing chemicals) from exposed rocks, mine wastes and ore stockpiles, and entry to the water environment including:
  - Seepage containing cyanide residues, sulphate and metals leaching from the tailings pore water held in the TMF and discharging to ground;
  - ARD, sulphate and metals leaching from the TMF embankment seepage to groundwater or surface water;
  - ARD, sulphate and metals leaching in runoff in contact with the TMF embankment;
  - Surface runoff containing ARD, sulphate and metals from the exposed open pit shell;
  - Groundwater seepage containing ARD, sulphate and metals in the exposed open pit shell; and
- A discharge containing ARD, sulphate and metals from the lake that will form following closure in the final excavated open pit void.

- Sediment mobilisation and increased total suspended solids (TSS) in the surface water environment from roads, stockpiles, the TMF waste embankment as well as stripped and exposed areas. These effects are covered in Section 5.4.

5.3.1.2 Key life of mine stages

The impact assessment below considers the following four stages in mine life: construction, operation, post-closure, and post-pit lake formation. Post-pit lake formation is considered because some effects, such as spills from the pit lake, are predicted some 90 years after the mine is closed.

The key life of mine (LOM) stages for the water quality effects analysis, including LOM year and relevant project description are presented in Table 5-23. The impact of the activities listed on water quality has been assessed collectively for each stage. The mine layout is shown in Figure 4-3.

The water quality results that are assessed as representing the worst case scenarios are presented in this chapter.

Results are presented for the construction phase (LOM year -1) as runoff from the pre-strip pit will affect downstream surface water quality (Section 5.2) in the Jazga River. No direct discharges of poor quality water from mine activities will occur in the Shtuka River in the construction phase as the SWD will be in place prior to embankment construction.

For the Jazga catchment, no results are presented for early operations (LOM year 1 - 6) and mid-operations (LOM year 7 - 19) as these were found not to be the worst case scenario for the water quality effects and impact analysis. The impact during operations will be at its greatest in the final operational year (LOM year 20) when the pit is at its deepest extent. Following closure, the worst case scenario will occur approximately 90 years after the end of mining operations (LOM year 110), when groundwater in the pit has fully rebounded and the resulting pit lake begins to overflow to the Jazga River.

In the Shtuka catchment, the contaminant load from the TMF (as poor quality seepage and runoff) will be at its greatest at the end of operational mine life (LOM year 20) when the tailings footprint and the TMF embankment both reach their greatest extent. In the post-closure phase, the worst case scenario will occur 200 years after closure (LOM year 220), when the seepage quantity and contaminant load from the TMF will be high but has leveled off to an equilibrium, where there is minimal change in the contaminant plume at the receptor locations. The tailings seepage will decrease following closure as the tailings consolidates and no new tailings mass is added, but seepage from the embankment will remain as high as at the end of operations. A scenario for soon after closure (LOM year 21) has also been included as once water collected by the SCF is no longer recycled within the process plant, the SCF will fill and discharge to the Shtuka River.

The full water quality effects analysis is presented in Annex 5B, including additional results of source term and contaminant transport modelling through LOM.

Table 5-23: Life of mine stages at which impact assessments were conducted

<table>
<thead>
<tr>
<th>LOM stage</th>
<th>LOM (year)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>-1</td>
<td>All roads in place. Process plant site, mine infrastructure services site in place. Shtuka River diversion and Storm Water Dam (SWD) in place and operating. Pit excavation in process over an area of 0.22 km². ROM pad and conveyer to process plant stripped and constructed. Starter TMF dam stripped and part constructed. Water supply system comprising pipelines from Turija reservoir to Ilovica reservoir and pipeline from Ilovica reservoir to upper and lower infrastructure sites constructed and supplying water for construction works.</td>
</tr>
<tr>
<td>Late operation</td>
<td>20</td>
<td>All roads in place. Final year of operation of process plant site, mine infrastructure services site. Shtuka River diversion, Seepage Collection Facility (SCF) and SWD operating. Final pit is complete and at the greatest extent, groundwater is being dewatered within the open</td>
</tr>
<tr>
<td>LOM stage</td>
<td>LOM (year)</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Post-closure (early)</td>
<td>21</td>
<td>Removal of haul roads and plant site infrastructure commenced. Mine infrastructure services area being modified. Shtuka River diversion operating. SWD being decommissioned. TMF closed and associated drainage facilities including flood attenuation being added. Water supply scheme for mine decommissioned and residual modification for community water supplies operating. The site undergoing rehabilitation and being re-vegetated.</td>
</tr>
<tr>
<td>Post- closure (pit lake formation)</td>
<td>&gt;110</td>
<td>All site rehabilitation and closure works complete. Shtuka River diversion is closed and Shtuka River will discharge to the closed TMF. The TMF surface has been rehabilitated. TMF seepage has decreased from operational volumes, and is now 45% of the seepage volume at LOM year 20. The seepage from the embankment is not predicted to decrease (Annex 5B, Source: Golder). The pit is closed and groundwater dewatering has ceased causing a rebound in groundwater levels and formation of a pit lake. The pit lake is fully developed and spilling to the Jazga River. Modelling predicts that the pit lake will take approximately 90 years post closure to fully form and discharge to surface water. Water supply scheme for mine decommissioned and residual modification for community water supplies operating. The site is rehabilitation and re-vegetated.</td>
</tr>
<tr>
<td>Post-closure</td>
<td>220</td>
<td>Seepage from the TMF and embankment has remained at a constant level since LOM year 110. This timing of this scenario was dictated by the contaminant transport model. The plume has migrated downgradient to a point where it no longer exponentially increases in size for contaminant concentration at receptor locations. As the source term is constant, the plume becomes a steady state and will not decrease in size from year 220 into perpetuity. All other facilities as described for LOM year 110.</td>
</tr>
</tbody>
</table>

### 5.3.2 Incorporated Environmental Measures

The engineering design considerations document (Annex 1C) defined the environmental measures which should be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following are the environmental measures relevant to water quality that have been incorporated into the project design:

- Recycling of mine related wastewater streams for use at the mine plant during operations including:
  - Supernatant water from the TMF pond;
  - Pit sump water collected in operations; and
  - Treated sewage effluent from plant site and mine services areas.
- During the initial construction period a new channel will be constructed to divert the Shtuka River around the TMF. Following mine closure the diversion channel will be closed and the Shtuka River will discharge across the closed TMF;
- During operations the TMF (upstream of the embankment) will be engineered and operated so as to attenuate flows up to the PMP/PMF before discharge of acceptable water quality to the Shtuka river;
- Engineered separation of drainage from contact areas (those that are stripped, mined, raised as stockpiles or waste storage, entail mine processes, constructed or otherwise modified by the project) and non-contact areas to ensure no mixing of potentially poorer quality water with clean water;
- Deployment of collection systems for drainage from contact areas to protect the water environment and for re-use at the mine processing plant including:
The SCF, receiving seepage to ground from the TMF and runoff from the TMF embankment face, for delivery to the mine plant for process water use;

Inflows to the pit sump, receiving runoff and groundwater inflow plus routed drainage from the ROM pad, will be delivered to the mine plant for process water use; and

Inflows to storm water ponds, serving the plant site and mine service area will be delivered to the mine plant for process water use.

Best practice pollution prevention and control measures will be employed during the construction and operational periods;

Following mine closure, surface water discharges requiring treatment will be treated prior to discharge to the environment;

Sewage will be treated and treated effluent will be incorporated into the plant process water system and will not discharge to the environment. Treated effluent will be required to conform to the relevant Macedonian waste water regulations and European Union’s Urban Wastewater Directive; and

Fuel and chemical storage and usage areas will be demarcated, sealed and bunded with stormwater directed around these areas. The bunded areas are designed to hold 110% of the largest expected spillage event in a specific area.

5.3.3 Study Area and Receptors

5.3.3.1 Overview

Gathering of primary baseline water quality data was undertaken within the local and regional study areas presented in Section 1. These study areas are also used within the impact assessments. The extent of these study areas is translated into a catchment context and shown in Drawing 5-5. The local and regional study areas for the impact assessment (equivalent to the potential area of influence of the project) represent both the biophysical environment and the social environment.

As described in Section 1, receptors have been identified across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts are robust.

Surface water and groundwater receptors were further divided into ‘human’ receptors, such as rivers, wells or boreholes which are used by people for potable water supply or irrigation, and ‘water environment’ receptors, such as streams which support aquatic life. Key locations were identified for each receptor where changes might potentially be experienced first and therefore where effects and impact assessments should be focused, usually immediately downstream or in the vicinity of proposed mine infrastructure. The identified surface water and groundwater receptor indicator locations are shown in Drawing 5-6 and these are further described below.

Aspects of the water quality environment that could be affected by the proposed mine are:

Jazga and Shtuka River water quality at the water supply intakes for Ilovica and Shtuka respectively and therefore the security of the village water supplies. Changes in river water quality could affect the health of people who drink untreated river water or affect the suitability of untreated water for irrigation or livestock;

Ilovica Reservoir water quality. Reservoir water is treated prior to supply so public water supplies sourced from the reservoir are not as vulnerable to changes in water quality as the untreated supply systems. However, negative changes to water quality could increase the cost of treatment required. Untreated reservoir water is also used for irrigation and for livestock watering. Changes in reservoir water quality could affect the quality of the water for crops, livestock and poultry;

Groundwater quality at wells and springs in Ilovica and Shtuka used to obtain drinking water and irrigation water for gardens. Changes in groundwater quality at domestic water supply wells and springs could affect the health of people who drink untreated well or spring water and the suitability of groundwater use for garden irrigation; and
River water quality downstream of the proposed mine in the Jazga, Shtuka, Turija and Strumica rivers. Changes in river water quality could affect the aquatic ecology of the rivers.

For the purpose of impact assessment, receptors have been identified where changes in water quality may be experienced. Receptors of changes in water quality include, for example:

- The Jazga and Shtuka rivers at the village water supply intakes represent people who consume water from the two rivers because the water abstracted from the rivers is untreated and delivered to consumers in approximately the same quality as exists in the rivers. The same water is also used for irrigation of gardens and plots and consumed by livestock and poultry;
- Ilovica Reservoir has been selected to represent the source of treated water supplies. Untreated reservoir water is also supplied for irrigation purposes and livestock and poultry watering;
- Village wells in Ilovica and Shtuka located nearest the mine have been selected to represent people who use and consume groundwater from wells in the villages; and
- Gauging stations on the Jazga, Shtuka, Turija and Strumica rivers downstream of the proposed mine have been selected to be the locations where water quality changes affecting aquatic ecology will be assessed.

### 5.3.3.2 Surface water receptors

The receptors and potential surface water impact related issues are listed in Table 5-24 together with the locations at which the receptors are represented.

<table>
<thead>
<tr>
<th>Category of receptor and potential impact-related issue</th>
<th>Receptor and indicator location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable water supplies - change to water quality as a result of proposed mining activities upstream.</td>
<td>Jazga River at intake (JZGS01).</td>
</tr>
<tr>
<td></td>
<td>Shtuka River at intake (STGS01).</td>
</tr>
<tr>
<td></td>
<td>Ilovica Reservoir (ILWT01)</td>
</tr>
<tr>
<td>Aquatic habitat in rivers - change in water quality as a result of proposed mining activities upstream.</td>
<td>Jazga River downstream of potential discharge from the pit (JZGS01).</td>
</tr>
<tr>
<td></td>
<td>Jazga River at Radovo Bridge (JZGS03)</td>
</tr>
<tr>
<td></td>
<td>Ilovica Reservoir (ILWT01)</td>
</tr>
<tr>
<td></td>
<td>Shtuka River (STGS01) downstream of tailings facility diversion outfall.</td>
</tr>
<tr>
<td></td>
<td>Shtuka River at Sekirnik Road (STGS02)</td>
</tr>
<tr>
<td></td>
<td>Turija River at TJGS01 downstream of confluence of Jazga River.</td>
</tr>
<tr>
<td></td>
<td>Strumica River at SMGS02 downstream of confluence of Shtuka River.</td>
</tr>
<tr>
<td></td>
<td>Strumica River at Novo Selo gauging station</td>
</tr>
</tbody>
</table>

### 5.3.3.3 Groundwater receptors

The receptors of impacts and the potential groundwater impact-related issues -- in all cases community water supply - are listed in Table 5-25 together with the indicator locations at which the receptors are represented.

<table>
<thead>
<tr>
<th>Receptor and potential impact-related issue</th>
<th>Receptor and indicator locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community water supply wells - change in water quality as a result of proposed mining activities up-gradient from Ilovica and Shtuka.</td>
<td>Potable groundwater supply for Ilovica Well IB39 and IB30.</td>
</tr>
<tr>
<td></td>
<td>Potable groundwater supply for Shtuka Well SB47.</td>
</tr>
</tbody>
</table>
Receptor and potential impact-related issue | Receptor and indicator locations
--- | ---
Springs used for domestic water supply in Ilovica and Shtuka - change in water quality as a result of proposed mining activities up-gradient from Ilovica and Shtuka. | Spring ISP41 in Ilovica  
Spring SSP49 in Shtuka.

Shallow aquifer used for irrigation in the Strumica plain - change in water quality as a result of proposed mining activities up-gradient from Ilovica and Shtuka. | Borehole BH347 between Ilovica and Turnovo.  
Piezometer IC15111 between Ilovica and Turnovo.

The baseline water quality at receptor locations, based on monitoring data and/or modelling, are presented in Section 2.3.

5.3.4 Considerations from Stakeholder Engagement

Residents of Ilovica, Shtuka and Novo Selo had the opportunity to learn about the baseline studies and impact assessment, ask questions and voice concerns to project team members during ‘open house’ events held in Ilovica and Novo Selo on 16 and 17 September 2015 (baseline studies) and on 18 and 19 May 2016 (impact assessment). The stakeholder engagement process is described in Section 1.

The following issues identified during the open house events are relevant to the impact assessment for water quality:

- The current water quality in Ilovica and Shtuka and the suitability of current water supplies (village wells and springs, Ilovica Reservoir and river intakes) for potable use in terms of water quality;
- The current water quality in wells that provide drinking water for residents of Sushica and potential contamination of groundwater in the Sushica valley and the planned Sushica reservoir;
- The future use of water from the Shtuka intake as drinking water and the current quality of this water;
- The effect of the project on water quality;
- Observations of white-coloured water (TSS potentially caused by clay) in the rivers after recent heavy rainfall and the cause of this;
- The continuation of water quality monitoring at the wells and boreholes in Ilovica;
- The removal of the originally proposed ore stockpile;
- The potential influence of the Jazga and Shtuka rivers on the Strumica River at Novo Selo in terms of water quality; and
- How the groundwater under the TMF will be protected.

These concerns are addressed through the water quality impact assessment and the mitigation and benefit enhancement measures presented in Section 6.3. Specific responses to each of the concerns raised are provided in Section 7.3.

5.3.5 Key Guidelines and Standards

In general the proposed mining project is expected to conform with:

- Macedonian regulations:
  - Law on Environment;
  - Macedonian Law On Water and relevant directives; and
  - Decree for Classification of Water.
Selected international standards:
- WHO drinking water guidelines (2011);
- EU drinking water guidelines (98/83/EC);
- IFC EH&S Guidelines for Mining (2007);
- EU Mine Waste Directive (2006/21/EC);
- EU Dangerous Substances Directive (2006/11/EC);
- EU Urban Waste Water Directive (91/271/EEC & 98/15/EC);
- EU Groundwater Directive (2006/118/EC); and

The above have been considered as part of the Environmental and Social Engineering Considerations study and project specific Environmental Design Criteria (EDC). The criteria summarised for the water environment comprehensively cover relevant water quality standards.

Macedonia has a strategy which aims to align all aspects of water resources management with the EU Water Framework Directive (WFD) by ~2040. The proposed project area falls within the Strumica River Basin District (RBD).

At this stage we are not aware that individual water bodies have been demarked within the Strumica RBD and/or their present status defined. Therefore, we have not attempted to undertake assessments, in this document, strictly in accordance with the WFD. However, we have undertaken all water related assessments with regard to all other relevant EU Directives and IFC standards. In addition, we have also considered quantity and quality impacts on a range of surface and groundwater bodies in the project study area which we expect will reasonably align with future delineations to be determined in accordance with the WFD.

5.3.6 Effects Analysis

5.3.6.1 Methods

This section presents predicted changes to the quality regime at adopted water quality receptors. The detailed methods used to perform effects analysis include estimation of change from the baseline condition of key parameters at selected indicator locations that are representative of receptors (people or aquatic ecology). Predictions of future conditions have been made by specific hydrological and geochemical assessments for the life of mine stages (Table 5-23). Predictive modelling, described in Annex 5B, includes:

a) Hydrological and geochemical modelling of mine facilities as source terms of contamination, defined by mine design through LOM and following closure using mass balance and thermodynamic PHREEQC modelling codes; and

b) Downstream water quality assessment of effects from the mine facility source terms at downgradient receptor points using MT3D groundwater contaminant transport and thermodynamic PHREEQC modelling codes.

The hydrological inputs (predicted runoff and seepage from contact areas) to the source term geochemical modelling are based on the hydrological modelling described in Section 5.2 and Annex 5B. The chemistry inputs to source term models are based on long-term geochemical kinetic datasets, produced from field tests to estimate waste and ore leachate solutions. The chemistry inputs also include specific laboratory tests on tailings generated as part of the FS/FEED engineering design. The geochemical study is described in Annex 4.
The chemistries are scaled according to the mine plan. For example, the material exposed in the open pit is categorised and a chemistry is assigned to each material type. The proportions of material types are coupled with hydrological flows to produce a mass balance model. The results from the source term modelling are output as ranges. The source terms are used as chemical inputs to downstream receptor models. The surface water models are dilution mixing models, based on a range of modelled flow scenarios (Section 5.2) which predict a range of results.

The MT3D model uses a single seepage estimation for each annual time-step and a single chemistry (based on the modelled TMF seepage and runoff chemistry) and thus the result presented is a single output. The model is based on the groundwater model described in Section 5.2 and uses the same flow parameters. The confidence and sensitivity of the flow components of the model is discussed in Section 5.2 and Annex 5B.

A brief sensitivity analysis of the contaminant transport model is described in Annex 5B. Increasing the seepage rate from the TMF or the concentration of the TMF seepage by 10% was found to increase the maximum concentration within the plume, but the plume shape did not significantly differ. The key parameter that controlled the plume spread and shape was the hydraulic conductivity of the host granite rock. No changes in effects classification at receptor indicator locations were predicted by the changes made during the sensitivity analyses.

The results presented in Section 5.3 are the predicted maximums from the modelling described above, as these are the worst case scenarios. The full set of results and detailed methodology are presented in Annex 5B. The predicted results are compared against the measured baseline for each indicator location, which is the maximum recorded within the baseline. The exception to this is pH and alkalinity, where the minima are presented for both predicted results and measured baseline, as this is defined as the worst case scenario (Section 2.3).

The PHREEQC code allows the precipitation of iron hydroxides and other minerals if the water becomes oversaturated with the corresponding dissolved parameters (see Annex 5B for more information). This mainly occurs when pH is circum-neutral and the dissolved iron concentration is more than 0.5 mg/l. The dissolved iron concentration will then reduce as the iron is precipitated. The iron hydroxides also hold onto some trace metals such as copper and arsenic, adsorbed to the surface. Precipitated iron hydroxides can smother sediments and harm aquatic habitat. The adsorbed trace metals may be released, causing an increase in their concentration which may form a health hazard for people or ecology.

Ammonia contamination from mine blasting in the pit area has not been quantitatively modelled. The extent of this potential contamination is dependent on blasting technique and site practice. If standard industry practice is followed and ammonium-nitrate/fuel oil (ANFO) use is carefully managed there should be minimal residual ammonia remaining after blasting, and water management in the pit should contain and remove most residual ammonia during operations for re-use within the processing plant.

No modelling of changes in bacteriological parameters has been undertaken. From a project point of view there will be no increase in bacterial risk as sewage effluent will be treated and the effluent will be re-used for mine water supply. The main contaminants of concern are generally those produced by mine facilities such as ARD and metals.

### 5.3.6.2 Results

#### 5.3.6.2.1 Overview

The predicted effects have been assessed for the receptors described in Section 5.3.3. These are divided into surface water and groundwater receptors and summary results for each receptor location are given below in Sections 5.3.6.2.1 to 5.3.6.2.10. Effects are classified as follows:

- **Negligible:** No predicted change from baseline flow and quality for all parameters.
- **Low:** Quality exceeds baseline maximum but not EDC.
- **Moderate:** Quality exceeds EDC and baseline maximum, but not for parameters affecting human and ecological health.
**High**: Quality exceeds EDC and baseline maximum, for parameters affecting human and ecological health.

The main effects on water quality during the construction period is related to runoff from the starter TMF embankment draining into the Shtuka River and runoff from the pre-strip open pit areas which may drain to the Jazga River. The project description describes that sumps positioned to capture runoff from pre-strip pit areas will be allowed to drain onto the hillside in wide, horizontal shallow channels (not drainage lines). The overflow will be in the form of intermittent shallow ‘sheet flow’ after rainfall. This sheet flow should infiltrate to ground prior to reaching the Jazga River but a worst case scenario would be that the runoff in contact with a pre-strip pit will reach the Jazga River.

During operations, the main changes to the Jazga River flow is a reduction in baseflow next to and downstream of the pit down to the Ilovica reservoir due to loss of water into the developing open pit. This water is collected within the pit and re-used as process make-up water. The pit will form a depression which is expected to capture all runoff generated within the pit so there will be no direct discharge of contaminated water during operations.

During operations, the Ilovica Reservoir will also receive water from the Turija Canal for mine water supply. Water will be abstracted from the Ilovica reservoir for mine process fresh water supply, irrigation supply, and village water supply after treatment. The villages supplied will include Ilovica and Shtuka in addition to the 7 villages with existing water supplies. The inflow from the Turija Canal will be managed to ensure the Ilovica Reservoir stays above a water level of 353 masl to ensure security of the Ilovica Reservoir. The quality of the water from the Turija Canal has been found to be very similar to that of the current Ilovica Reservoir and therefore it is unlikely that there will be any water quality impact from storing Turija Canal water in the Ilovica Reservoir prior to mine process use (see Annex 5B for more information).

During operations, seeage to groundwater from the TMF embankment and tailings in the Shtuka valley will be able to impact the Shtuka River water quality as there will be a hydraulic connection between this groundwater pathway and surface water in the Shtuka River (Section 5.2).

Following closure, the main change in the Jazga catchment is the cessation of mine dewatering and recovery of groundwater levels in the pit. This will cause a lake to form in the pit. The lake is predicted to overflow into the Jazga River approximately 90 years after closure. The average flow from the pit lake into the Jazga River is estimated to be approximately 7 l/s. The water in the pit lake will be of poor quality (Annex 5B, Table 6-11), and the overflow will change the water quality in the Jazga River downstream of the pit and in the Ilovica Reservoir.

It is not currently anticipated for there to be excess water remaining on the TMF at the end of operations (i.e. a TMF pond). More information regarding the TMF water balance can be found in Annex 5B. For the water quality impact assessment it is assumed that the TMF pond will be managed to ensure there is no excess of water requiring management or discharge by the end of the operating mine life. Should there be an excess of water on the TMF at the start of the closure period, a mitigation measure for this scenario will need to be included in the mine design and planning.

During operations, seepage and runoff from the TMF embankment will accumulate in the SCF and be recycled. During storm events the SCF will overtop and excess water will be captured in the SWD. The SCF will be sized to ensure that the water quality of any overtopped water will be suitable for discharge to the environment.

In the Shtuka River surface water quality following closure is affected by TMF and embankment seepage. The surface water is also affected by a potential discharge from the SCF following closure which will still be collecting seepage from the tailings and seepage and runoff from the embankment. Water will not be removed from the SCF following closure and will be allowed to fill and discharge from the dam if of acceptable water quality.

Due to a commitment for the treatment of wastewater to meet the bacteriological quality guidelines in the EDC, project effects on bacteriological quality of the water supplies has been scoped out of the assessment.
Predicted changes to water quality in the Jazga River at intake (JZGS01)

Predicted changes to the Jazga River water quality at the Ilovica village intake (JZGS01) during the construction (LOM year -1) and post-closure (LOM year 110) periods are summarised in Table 5-26. The changes have been assessed relative to the environmental quality standards (EQS) and drinking water standards (DWS). Further description of the modelling and the results obtained is presented in Annex 5B.

Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-26.

The modelling work indicates that mining activities will have no effect on water quality at JZGS01 during the operations and early closure periods. These periods have therefore been scoped out of the water quality impact assessment.

During the construction period, runoff from the pre-strip pit shell will be managed using sumps positioned to capture runoff from pre-strip pit areas. These sumps will be allowed to drain onto the hillside (not drainage lines) in wide, horizontal shallow channels. The overflow will be expected to occur as intermittent ‘sheet flow’ after rainfall. It is anticipated that this sheet flow will infiltrate to ground prior to reaching the Jazga River,![](image) although under a worst case scenario runoff in contact with a pre-strip pit could potentially reach the Jazga River.

The runoff volume reaching the river from the pre-strip pit area is likely to be zero at the Q95 (Section 5.2 and Annex 5B). Under Q50 (median) flow conditions, the proportion of flow in the Jazga River that is directly drained from the pre-strip pit area will be very low, at around 0.1% of total flow. During extreme high flows, between 10 - 30% of the total flow in the Jazga River just downstream of the pit could originate as runoff from the pre-strip pit area.

The predicted water quality of runoff from the pre-strip pit at LOM year -1 is based on median flow conditions (Q50) where runoff from the pre-strip open pit equates to approximately 0.1% of flow in the Jazga River at JZGS01.

There will be no direct discharges from the mine to the Jazga River during operations. There may be a slightly reduced flow in the Jazga River at JZGS01 as around 8 l/s of flow is lost to the pit due to operational dewatering, although this is unlikely to impact the river water quality at this point.

Following closure there will be no direct or indirect discharges to the Jazga River from the closed pit until the formation of the pit lake is complete. The pit lake is predicted to overflow approximately 90 years after the cessation of pit dewatering (i.e. at LOM year 110). Therefore the scenarios described for immediate closure and post-closure prior to pit lake overflow are not included in the effects analysis in Table 5-26 as there will be no changes to water quality in the closure period until the pit lake spills.

### Table 5-26: Predicted water quality changes for the Jazga River at intake (JZGS01)

<table>
<thead>
<tr>
<th>Parameter/Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5 - 9.5</td>
<td>pH</td>
<td>6.2</td>
<td>6.1</td>
</tr>
<tr>
<td>Ag</td>
<td>0.00035</td>
<td>0.00035</td>
<td>mg/l</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Al</td>
<td>0.7</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.0007</td>
<td>0.0004</td>
</tr>
<tr>
<td>Alkalinity**</td>
<td>23</td>
<td>22</td>
<td>mg/l</td>
<td>0.0003</td>
<td>0.0004</td>
</tr>
<tr>
<td>As</td>
<td>0.0097</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Ba</td>
<td>Variable*</td>
<td>0.003</td>
<td>mg/l</td>
<td>0.0003</td>
<td>0.0004</td>
</tr>
<tr>
<td>Cd</td>
<td>0.001</td>
<td>0.001</td>
<td>mg/l</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Cu</td>
<td>0.009</td>
<td>0.005</td>
<td>mg/l</td>
<td>0.29</td>
<td>0.0001</td>
</tr>
<tr>
<td>Fe</td>
<td>4.8</td>
<td>4.8</td>
<td>mg/l</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Mg</td>
<td>0.35</td>
<td>0.35</td>
<td>mg/l</td>
<td>0.035</td>
<td>0.035</td>
</tr>
<tr>
<td>Mn</td>
<td>0.05</td>
<td>0.05</td>
<td>mg/l</td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>Mo</td>
<td>0.024</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Variable flow conditions
**Equilibrium conditions

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ILOVICA-SHTUKA ESIA

5.3.6.2.2 Predicted changes to water quality in the Jazga River at intake (JZGS01)
### Regime/Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Construction</strong></td>
</tr>
<tr>
<td><strong>NH3-N</strong></td>
<td>8.79</td>
<td>0.39</td>
<td>mg/l</td>
<td>0.205</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Ni</strong></td>
<td>0.02</td>
<td>0.02</td>
<td>mg/l</td>
<td>0.006</td>
<td>0.005</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>1.68</td>
<td></td>
<td>mg/l</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Pb</strong></td>
<td>0.0072</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.009</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>SO4</strong></td>
<td>250</td>
<td></td>
<td>mg/l</td>
<td>30.7</td>
<td>31.6</td>
</tr>
<tr>
<td><strong>Sb</strong></td>
<td>0.005</td>
<td></td>
<td>mg/l</td>
<td>0.0008</td>
<td>0.0008</td>
</tr>
<tr>
<td><strong>Se</strong></td>
<td>0.00168</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.0012</td>
<td>0.0012</td>
</tr>
<tr>
<td><strong>V</strong></td>
<td>0.074</td>
<td></td>
<td>mg/l</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Iron precipitation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Some, low amounts as discharge is small</em></td>
</tr>
</tbody>
</table>

### Preliminary effect

- **Moderate**
- **High**

### Comment

During construction the predicted changes to the baseline chemistry at JZGS01 is a slightly depressed pH below DWS and the minimum recorded baseline concentration and slightly depressed alkalinity below baseline concentrations. The minimum measured baseline pH is less than DWS. Cadmium and phosphorous are also elevated above project EQS and the maximum measured baseline. Sulphate is also predicted to be greater than baseline chemistry. The water quality model also predicts precipitation of iron hydroxides which could cause smothering in the stream bed. The water quality changes predicted during the construction phase are not as extreme as those in operations and closure. This is mainly due to a difference in the source term as the initial waste rock to be mined is much less reactive than material removed later in mine life.

The effects presented for the post-pit lake discharge closure scenario are the worst case scenario modelled and result in the most significant impact. The full range of the effects analysis results are presented in Annex 5B. The predicted water chemistry has a pH lower than EQS and DWS and predicts there will be no available alkalinity. Aluminium, cadmium, copper, iron, manganese, selenium and zinc are all predicted to be above either DWS or EQS and are all greater than baseline maxima water chemistry. Arsenic, cobalt, magnesium, nickel, sulphate and vanadium are also elevated above baseline concentrations. The water quality model also predicts precipitation of iron hydroxides which could cause smothering in the stream bed. The effect on water quality for this scenario is high.

- **Cd EQS** is dependent on hardness, see results in Annex 5B for more information.
- **Minimum values** given for baseline and predictive results rather than maximum.

A moderate effect on water quality in the Jazga River downstream of the pre-strip pit is predicted during construction due to the potential for runoff from the pre-strip pit shell to enter the Jazga River. A high effect on water quality is predicted once the pit lake starts spilling into the Jazga River from Year 110 onwards. The pit lake water is likely to be characterised by low pH and high concentrations of dissolved metals.

### 5.3.6.2.3 Predicted changes to water quality in Ilovica Reservoir (ILWT01)

The effect on the reservoir is presented here as an effect to the reservoir inflow from both the Jazga and the Treska catchments. It is assumed that water quality of the inflow is similar to that of the inflow to the water treatment works (as found in the baseline studies). Very limited water quality data is available for the Treska River so the baseline Treska River water quality used within the model is assumed to be the same as that of JZGS01.

Predicted changes at ILWT01 are presented only for LOM year 110 (post-pit lake formation). The other scenarios described in Table 5-23 are not presented, as no change to water quality is predicted for the following scenarios:

---

23 Within the local study area, there is a small tributary to the Jazga River, known locally as the Treska River, which flows directly into Ilovica Reservoir. This small river system should not be confused with the much larger Treska River located within the large Vardar catchment in west-central Macedonia.
The construction phase situation in the upper Jazga catchment is described in Section 5.3.6.2.1. Following further dilution from the River Treska and water within the reservoir the proportional volume of runoff from the project affected areas that may enter the Ilovica Reservoir will be so low that there will be no discernible variation in water quality from baseline. The predicted water quality of pit runoff during construction is presented in Annex 5B.

During operations, there will be no direct discharges from the pit and mine process within the Jazga catchment. However, the Ilovica Reservoir will be used as part of the mine water supply system. Water will be pumped from the refurbished Turija pipeline to the Ilovica Reservoir. The quality of the water from the Turija pipeline has been compared with the current Ilovica Reservoir water quality and was found to be very similar. It is therefore unlikely that any significant water quality variation will occur in the Ilovica Reservoir as a result of inflows from Turija Reservoir during operations (see Annex 5B for more information).

Following closure there will be no direct or indirect discharges to the Jazga catchment from the project-affected areas until the pit lake overflows to the Jazga River. The pit lake is predicted to overflow approximately 90 years after the cessation of pit dewatering. Therefore the scenarios described in Table 5-23 for immediate closure and post-closure prior to pit lake overflow are not included in the effects analysis as there will be no change to water quality.

Ilovica reservoir has a capacity of 356,000 m³. In the post-closure period (>110 year), on average 3% of flows entering the reservoir will originate from the pit lake overflow. Water quality has been predicted at the reservoir during post-closure by calculating the mixing proportions from the pit lake overflow against all other inflows into the reservoir, using the results of the surface water modelling described in Section 5.2 and Annex 5B. The impact on reservoir water quality will depend on the relative proportion of pit lake spill to inflows from the rest of the catchment.

The worst case (most likely) scenario for water quality entering the reservoir is when the pit lake discharge is equal to 5% of the total inflow to the Ilovica reservoir (Table 7-8, Annex 5B). Other scenarios have been modelled (Annex 5B) with higher % contributions from the pit lake, but the 5% scenario causes the same magnitude of effect as higher % contributions, but it is the more likely to occur.

The predicted (worst case) changes to reservoir water quality are presented in Table 5-27 for comparison against relevant EQS and DWS. Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-5. The DWS and EQS guidelines used for effects analysis are generally stricter than irrigation standards so it is assumed that using these guidelines will adequately assess risks to irrigation water quality.

Table 5-27: Predicted changes to water quality for Ilovica Reservoir (ILWT01)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5 - 9.5</td>
<td>pH</td>
<td>6.2</td>
<td>6.59</td>
</tr>
<tr>
<td>Ag</td>
<td>0.00035</td>
<td>0.0004</td>
<td>mg/l</td>
<td>0.0097</td>
<td>0.01</td>
</tr>
<tr>
<td>Al</td>
<td>0.2</td>
<td>1.3</td>
<td>mg/l</td>
<td>0.001</td>
<td>0.009</td>
</tr>
<tr>
<td>Alkalinity**</td>
<td>23</td>
<td>7</td>
<td>mg/l</td>
<td>0.003</td>
<td>0.0034</td>
</tr>
<tr>
<td>As</td>
<td>0.011</td>
<td>0.015</td>
<td>mg/l</td>
<td>0.0003</td>
<td>0.0034</td>
</tr>
<tr>
<td>Cd</td>
<td>Variable*</td>
<td>0.003</td>
<td>mg/l</td>
<td>0.001</td>
<td>0.009</td>
</tr>
<tr>
<td>Regime/Parameter</td>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
<td>Unit</td>
<td>Max. measured baseline</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>-----</td>
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<td>DWS</td>
<td>Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max.</td>
<td>baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
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</tr>
<tr>
<td></td>
<td>baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yr. 110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Post pit</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>lake</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
<td>Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>0.1</td>
<td>2</td>
<td>mg/l</td>
<td>0.009</td>
<td>0.98</td>
</tr>
<tr>
<td>Fe</td>
<td>4.22</td>
<td>0.2</td>
<td>mg/l</td>
<td>0.29</td>
<td>0.0</td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
<td></td>
<td>4.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Mn</td>
<td>0.72</td>
<td>0.05</td>
<td>mg/l</td>
<td>0.035</td>
<td>0.34</td>
</tr>
<tr>
<td>Mo</td>
<td>0.024</td>
<td></td>
<td></td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td>NH3-N</td>
<td>8.79</td>
<td>0.39</td>
<td>mg/l</td>
<td>0.205</td>
<td>0.38</td>
</tr>
<tr>
<td>Ni</td>
<td>0.02</td>
<td>0.02</td>
<td>mg/l</td>
<td>0.006</td>
<td>0.01</td>
</tr>
<tr>
<td>P</td>
<td>1.68</td>
<td></td>
<td>mg/l</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Pb</td>
<td>0.0072</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.009</td>
<td>0.003</td>
</tr>
<tr>
<td>SO4</td>
<td>0.0072</td>
<td>250</td>
<td>mg/l</td>
<td>30.7</td>
<td>88</td>
</tr>
<tr>
<td>Sb</td>
<td>0.005</td>
<td></td>
<td>mg/l</td>
<td>0.0008</td>
<td>0.0008</td>
</tr>
<tr>
<td>Se</td>
<td>0.00168</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.0012</td>
<td>0.0016</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td></td>
<td></td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>Zn</td>
<td>0.074</td>
<td></td>
<td>mg/l</td>
<td>0.03</td>
<td>0.36</td>
</tr>
<tr>
<td>Iron precipitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

**Comment**
The effects analysis results for the post-pit lake discharge at the Ilovica reservoir predict that zinc, manganese, copper, cadmium and aluminium will exceed either project EQS or DWS, as well as baseline maximum chemistry results. Sulphate, phosphorous, nickel, ammonia, magnesium, cobalt, barium and silver are also elevated above the maximum measured in the baseline results. Alkalinity is predicted to be lower than the measured baseline minimum, so less buffering capacity will be available. The water quality model also predicts precipitation of iron hydroxides, which could cause smothering in the stream bed. The preliminary effect for the closure scenario presented above is high for the Ilovica reservoir.

* Cd EQS is dependent on hardness, see results in Annex 5B for more information.
** Minimum values given for baseline and predictive results rather than maximum.

A high effect on water quality is predicted once the pit lake starts spilling into the Jazga River in LOM year 110. The pit lake water is likely to be characterised by low pH and high concentrations of dissolved metals. This change in water quality could potentially pose a risk to the aquatic ecology of the reservoir and to crops irrigated with reservoir water, and could cause water treatment costs in Ilovica Water Treatment Works to increase.

### 5.3.6.2.4 Predicted changes to water quality in the Jazga River at Radovo (JZGS03)

Predicted changes to water quality for the Jazga River at Radovo (JZGS03) are summarised in Table 5-28. The full results and methodology are presented in Annex 5B. A quantitative assessment of predicted water quality changes for the post-pit lake closure scenario (LOM year 110) is also presented. No other scenarios are presented.

Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-28.

Only very small volumes of water will be discharged during construction and no direct discharges will be made from the mine site during operations. Assuming the mitigation proposed in Section 6, to augment releases
from the reservoir to simulate baseline flows downstream, is put in place, there will be a negligible change to flows downstream of the Ilovica Reservoir, therefore anthropogenic effects will have no indirect effect as dilution will remain equivalent to baseline conditions.

During the closure period up to LOM year 110 there will be no direct discharges to the Jazga River from the closed pit, so no downstream impact on water quality will be expected to occur during this period.

The model results presented in Table 5-28 assume the same chemistry load as calculated for the Ilovica Reservoir, as the flow at JZGS03 is equal to the sum of seepage and overflows from the Ilovica reservoir. The results are compared against the original baseline chemistry for JZGS03 as the baseline chemistry is different at this point from the Ilovica reservoir described in Table 5-28. This is explained further in Annex 5B.

Table 5-28: Predicted changes for the flow regime for the Jazga River at Radovo (JZGS03)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
<th>Max. measured baseline</th>
<th>Yr. 110</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5</td>
<td>pH</td>
<td>6.52</td>
<td>6.59</td>
<td>Post pit lake</td>
</tr>
<tr>
<td></td>
<td>Ag</td>
<td>mg/l</td>
<td>0.00035</td>
<td>0.0004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al</td>
<td>mg/l</td>
<td>0.2</td>
<td>0.2</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alkalinity**</td>
<td>mg/l</td>
<td>95</td>
<td>7.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>As</td>
<td>mg/l</td>
<td>0.0019</td>
<td>0.0001</td>
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</tr>
<tr>
<td></td>
<td>Ba</td>
<td>mg/l</td>
<td>0.017</td>
<td>0.015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cd</td>
<td>mg/l</td>
<td>0.0003</td>
<td>0.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co</td>
<td>mg/l</td>
<td>0.001</td>
<td>0.009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cu</td>
<td>mg/l</td>
<td>0.0045</td>
<td>0.98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fe</td>
<td>mg/l</td>
<td>0.32</td>
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<tr>
<td></td>
<td>Mg</td>
<td>mg/l</td>
<td>6.89</td>
<td>6.14</td>
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</tr>
<tr>
<td></td>
<td>Mn</td>
<td>mg/l</td>
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<td>0.3</td>
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<td></td>
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<tr>
<td></td>
<td>Mo</td>
<td>mg/l</td>
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<td>0.005</td>
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</tr>
<tr>
<td></td>
<td>NH3-N</td>
<td>mg/l</td>
<td>0.0205</td>
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<tr>
<td></td>
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</tr>
<tr>
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<td>6.6</td>
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</tr>
<tr>
<td></td>
<td>Pb</td>
<td>mg/l</td>
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<td>0.003</td>
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<tr>
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<td>SO4</td>
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<td>88</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Sb</td>
<td>mg/l</td>
<td>0.0012</td>
<td>0.0008</td>
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<tr>
<td></td>
<td>Se</td>
<td>mg/l</td>
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<td>0.0016</td>
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</tr>
<tr>
<td></td>
<td>V</td>
<td>mg/l</td>
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<td>0.001</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Zn</td>
<td>mg/l</td>
<td>0.009</td>
<td>0.36</td>
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<tr>
<td></td>
<td>Dissolved oxygen**</td>
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<td></td>
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<tr>
<td>Regime/Parameter</td>
<td>Predicted maximum value and LOM stage</td>
<td></td>
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<tr>
<td>------------------</td>
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</tr>
<tr>
<td>Max. measured baseline</td>
<td>Yr. 110</td>
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<td></td>
<td></td>
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<td></td>
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron precipitation</td>
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<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preliminary effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>The closure scenario, post-pit lake spill, the water quality is predicted to be equivalent to that of the Ilovica reservoir as generally the flow at JZGS03 equates to the spills and seepage from the reservoir. The modelled effects include zinc, phosphorus, copper, cadmium and aluminium above either project EQS of DWS as well as baseline monitored chemistry at JZGS03. Sulphate, selenium, nickel, ammonia, molybdenum, cobalt and silver are also predicted to be above the maximum measured for each parameter at JZGS03 during baseline surveys. Alkalinity is predicted to be significantly less than monitored during baseline surveys, reducing the buffering capacity of the water. The water quality model also predicts precipitation of iron hydroxides, which could cause smothering in the stream bed. The preliminary effect modelled for JZGS03 is classified as high due to parameters exceeding project EQS and DWS.</td>
</tr>
</tbody>
</table>

A high effect on water quality in the lower Jazga River is predicted following commencement of spill by the pit lake some 90 years after mine closure. The pit lake water is characterised by low pH and high concentrations of dissolved metals.

5.3.6.2.5 Predicted changes to water quality at the Shtuka River intake (STGS01)

Predicted changes to the water quality in the Shtuka River at the Shtuka village intake (STGS01) during the operations (LOM year 20) and post closure (LOM year 220) periods are shown in Table 5-29. The relevant EQS and DWS values are included for comparison. Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-29. Further description of the modelling and the results obtained is presented in Annex 5B.

During the construction period no direct discharges to the Shtuka River will occur as a result of the mine project. During operations, the groundwater flow model and the contaminant transport model predict a hydraulic connection between the Shtuka River and underlying groundwater. The worst case scenario is predicted to occur during the final year of operations (LOM year 20) when the cumulative load of contaminants seeping from the tailings and the TMF embankment will be at its greatest. Seepage will affect the stream water quality at STGS01 as contaminants migrate into the stream between the SCF and STGS01. The groundwater and contaminant transport models predict that, in the absence of groundwater retention or control (e.g. a grout curtain), the SCF will capture more than 75% of the combined tailings and embankment seepage. The seepage into the SCF will be recycled (pumped) back to the mine processing plant for reuse, so the effects analysis (Table 5-29) will consider only the effect of the remaining seepage (i.e. the component of seepage that is not captured by the SCF) that discharges to the environment via groundwater flow paths.

By the end of operations the plume of seepage can be seen in the groundwater entering the stream below the SCF. However the concentrations are low, between 1% and 5% of the original seepage concentration. The volume of groundwater entering the Shtuka River between the SCF and STGS01 is estimated to be approximately equal to the Q50 STGS01 surface water flow of between 20 l/s and 25 l/s. The worst case scenario assumes that the water quality of this groundwater inflow to the Shtuka River is equal to the surface water quality at this point, so assumes no further dilution from natural runoff or interflow. The model assumes there is no other impact from the TMF and embankment during operations as runoff from the face of the embankment will discharge to the SCF and the SCF will be sized to ensure that overtopping during a storm event will only occur when dilution has lowered concentrations of contaminants to no worse than baseline concentrations. The SCF also captures more than 75% of contaminated groundwater and this is removed.
from the groundwater model. Water collected in the SCF during operations will be pumped back to the process plant for re-use and will not be discharged to the environment.

The SCF will also capture treated sewage discharges from the mine facilities during operations, but this water will be re-used during operations so will have no effect on water quality in the Shtuka River. In the last year of operational mine life, the water captured by the SCF will comprise, on average, 70% groundwater, 17% runoff from the embankment and 13% treated sewage water (105 m³/d).

During the post closure period (from LOM year 21) the SCF will still be in place and it is assumed that the pond will continue to capture a similar proportion of groundwater as in operations. During this period it is assumed that there will be no treated sewage discharging to the SCF as all building infrastructure will be removed. The volume of groundwater captured will be likely to decrease to around 1800 m³/day as the seepage rate from the tailings decreases over the first 50 years after the end of operations. Water captured in the SCF will no longer be recycled by the processing plant from the start of the closure period (Year 21) and will therefore be expected to discharge to the environment if unmitigated.

As the SCF fills, direct rainfall will dilute the chemistry of the pond and evaporation from the SCF surface will result in a small degree of concentration as water is removed but solutes will remain in the SCF pond. Water in the SCF will at times comprise up to 70% captured groundwater.

Following closure, and in the absence of diversion to treatment, the SCF is predicted to fill and discharge to the Shtuka River within a month of cessation of recycling water to the process plant. A spill record for the SCF in closure has been modelled and is described in Annex 5B. The median spill for the SCF post-closure is predicted to be around 21 l/s (~1800 m³/day) and is essentially equal to the groundwater inflow to the SCF. The chemistry of the SCF discharge at the median flow was therefore assumed to be that of the groundwater captured by the SCF (the chemistry of the runoff from the embankment was disregarded as runoff would contribute to flows higher than the median flow). The chemistry of the groundwater has been extracted from the contaminant transport model and is presented in Table 7-17 Annex 5B. The chemistry of discharge from the SCF is above project discharge standards for a number of parameters, including pH, copper, iron and zinc, so is not suitable for discharge without treatment.

As a complementary analysis to the discharge from the SCF which will need to be treated (see Section 7), the assessment of STGS01 focused on assessing the impact on river water quality of the component of seepage from the TMF that is not captured by the SCF (the remaining 25%). The post closure scenario (LOM year 220) in Table 5-29 assumes that only contaminated seepage enters the Shtuka River between the SCF and STGS01. No account is taken of spills from the SCF.

Seepage is made up of two major components, seepage from the TMF embankment and seepage from the tailings themselves.

The embankment will not be covered by inert crushed waste rock or soil, like the TMF surface, but will be hydromulched, hence rainfall will continue to infiltrate the embankment and seepage will continue to be produced. Therefore seepage from the embankment is predicted to remain constant at 498 m³/day following closure (Annex 5B) and contaminant load from the embankment will also remain the same. Contaminants that are mainly present due to embankment seepage, such as sulphate and metals, will therefore continue to increase with time in the post-closure period up to a point where they reach an estimated steady state, around 200 - 300 years post-closure. There will be no decline in these concentrations as the source is never removed.

Modelling indicates that seepage from the tailings will decrease from 1,130 m³/day at the end of mine life to 490 m³/day at 50 years post closure, as modelled by Golder (Annex 5B). As such, in contrast to seepage from the embankment, contaminants that mainly stem from the tailings seepage (such as cyanide) will increase until a peak is reached post-closure at LOM year 110. Concentrations will then begin to decline in line with the reduced seepage rate from the tailings following consolidation. These trends are shown in Figure 7.3, Annex 5B.

**Table 5-29: Predicted changes to water quality for the Shtuka River at intake (STGS01)**
<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>0.00035</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Alkalinity**</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>As</td>
<td>0.0013</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>0.0003</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>0.0045</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>0.115</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td>0.024</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>0.0015</td>
<td>0.05</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Ni</td>
<td>0.0015</td>
<td>0.02</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>0.0003</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO4</td>
<td>37.1</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sb</td>
<td>0.0008</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Se</td>
<td>0.0012</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>0.084</td>
<td>0.074</td>
</tr>
<tr>
<td>Total cyanide</td>
<td>0.0045</td>
<td>0.015</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preliminary effect</th>
<th>High</th>
<th>High</th>
</tr>
</thead>
</table>

**Comment**

During operations as a result of contaminated seepage entering the groundwater system and re-emerging downstream in the Shtuka River the predicted effect of the mine at the Shtuka river intakes is high. The predicted water quality at STG01 includes depressed pH below DWS, elevated iron above DWS and elevated zinc above EQS. A number of parameters are also elevated above baseline conditions including copper, cadmium, aluminium, sulphate and total cyanide.

Following closure, solely based on the change in water quality as a result of contaminated seepage entering the Shtuka River downstream of the SCF and ignoring any potential discharge from the SCF of contaminated water (as the SCF spill will be over project effluent standards so not suitable for environmental release), the change in water quality is classified as high. The pH of the water is predicted to decrease to less than DWS and EQS and aluminium, arsenic, cadmium, copper, iron, manganese, nickel, lead, sulphate, selenium and zinc are elevated above either or both the EQS and DWS. The water quality is assessed 200 years post-closure, but as the source term for the embankment seepage does not decrease it is likely to stay at this level through post-closure, as a conservative approach.

*Cd EQS is dependent on hardness, see results in Annex 5B for more information.

**Minimum values given for baseline and predictive results rather than maximum.

A high effect on Shtuka River water quality is predicted at the end of operations and 200 years post closure (LOM Years 20 and 220 respectively) as a result of seepage from the TMF embankment and tailings. A high effect on the Shtuka River water quality is also predicted for early closure (LOM year 21) should the discharge from the SCF be released to the environment unmitigated.
The analysis of the tailings supernatant did not include nitrogen species or phosphorous, and as a result these parameters have not been presented in the impact assessment for the Shtuka catchment. However, these should be included in monitoring and assessment in the environmental management plans and operational TMF management as current agricultural activities downstream of the mine mean these parameters are currently elevated in surface and groundwaters in the area (as presented in the baseline study, Annex 3).

5.3.6.2.6 Predicted changes to water quality in the Shtuka River at Sekirnik road bridge (STGS02)

Predicted changes to water quality in the Shtuka River at Sekirnik road bridge (STGS02) during the operational and post closure periods, relevant to the EQS, are summarised in Table 5-30. Further information on the water quality modelling and results obtained is presented in Annex 5B.

Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-30.

During the construction period no direct discharges to the Shtuka River will occur as a result of mining activities.

Water quality changes are predicted in late operations (LOM year 20) and in the post-closure scenario (LOM year 220) when discharges from the mining project will affect water quality at STGS02. During operations, contaminated seepage will generally be captured by the SCF, although an estimated 25% of seepage is predicted to emerge into the Shtuka River downstream of the SCF.

The closure scenario for the Shtuka River and the TMF is explained in the effects analysis for the Shtuka River at STGS01 (Section 5.3.6.2.4 above). The long-term case scenario presented in Table 5-30 is 220 years post-closure as the contaminant load from the TMF and embankment seepage is approaching steady state (i.e. a constant value). This scenario only takes into account contamination from TMF and embankment seepage and not any additional contamination from SCF spills.

Spills from the SCF have not been used in the water quality impact assessment at STGS02 for the same reasons as described for STGS01 assessment.

Water quantity modelling (Section 5.2) indicates that there will be no significant change in flow between STGS01 and STGS02. It is currently assumed that there are multiple losses and gains between groundwater and surface water along this stretch of the Shtuka River. As such as a conservative, worst case estimate it is assumed that the chemical load is conserved downstream, and that the dilution mixes are as the flow conditions at STGS01 and the baseline chemistry at STGS02. In practice, some mass is likely to be lost to groundwater if water is also lost. The change in water quality is presented in Table 5-30.

Table 5-30: Predicted changes to water quality for the Shtuka River at Sekirnik Road Bridge (STGS02)

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value and LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
</tr>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5</td>
</tr>
<tr>
<td>Ag</td>
<td>0.00035</td>
<td>mg/l</td>
</tr>
<tr>
<td>Al</td>
<td>0.05</td>
<td>mg/l</td>
</tr>
<tr>
<td>Alkalinity**</td>
<td>31</td>
<td>mg/l</td>
</tr>
<tr>
<td>As</td>
<td>0.0007</td>
<td>mg/l</td>
</tr>
<tr>
<td>Cd</td>
<td>Variable*</td>
<td>0.003</td>
</tr>
<tr>
<td>Co</td>
<td>0.001</td>
<td>mg/l</td>
</tr>
<tr>
<td>Regime/Parameter</td>
<td>Predicted maximum value and LOM stage</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max. measured baseline</td>
<td>Yr. 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operations</td>
</tr>
<tr>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
</tr>
<tr>
<td>Cu</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Fe</td>
<td>4.22</td>
<td>0.2</td>
</tr>
<tr>
<td>Mg</td>
<td>0.72</td>
<td>0.25</td>
</tr>
<tr>
<td>Mn</td>
<td>0.024</td>
<td>0.05</td>
</tr>
<tr>
<td>Mo</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Ni</td>
<td>0.0072</td>
<td>0.01</td>
</tr>
<tr>
<td>Pb</td>
<td>0.00168</td>
<td>0.01</td>
</tr>
<tr>
<td>SO₄</td>
<td>0.074</td>
<td>0.01</td>
</tr>
<tr>
<td>Total cyanide</td>
<td>0.015</td>
<td>0.05</td>
</tr>
<tr>
<td>Preliminary effect</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Comment: See comments in Table 5-7.

*Cd EQS is dependent on hardness, see results in Annex 5B for more information.

**Minimum values given for baseline and predictive results rather than maximum.

A high effect is predicted on water quality at Sekirnik road bridge during operations and following closure (LOM Years 20 and 220 respectively) as a result of seepage from the tailings and from the TMF embankment. A high effect is also predicted in the early closure period, LOM year 21, should the SCF discharge poor quality water to the Shtuka River.

5.3.6.2.7 Predicted changes to water quality in the Sushica River (SUGS01) and the Sushica boreholes (SUB01, SUB02 and SUB03)

The Sushica River (SUGS01) and Sushica water supply boreholes (SUB01, SUB02 and SUB03) has been included as a receptor in the ESIA in response to stakeholder concerns regarding the potential for groundwater throughflow from the TMF in the Shtuka valley to the neighbouring Sushica catchment.

The groundwater modelling study has identified that infilling of the Shtuka valley with low permeability tailings could cause groundwater to mound against the undersides of the tailings deposit, leading to a localized rise in groundwater levels in the shallow fractured granite surrounding and upstream of the TMF.

The modelled increase in groundwater levels (see Figure 5-10, Annex 5B) is relatively low, even assuming worst case conditions (i.e. low fracture permeability in the granite) and is unlikely to be sufficient to cause development of a hydraulic gradient toward the Sushica river valley. It is also highly unlikely that a suitable pathway(s) exists that would allow groundwater to flow from the Shtuka valley to the Sushica valley; thoughflow would need fracture flow over a distance of at least 1.5 km, and to occur at significant depth (>200 m) through...
the core of the granite hill that forms the watershed between the two catchments. Although no drilling or testing has been undertaken in this area, based on the VKD model that has been used for assessment of groundwater flow within the Shtuka valley, the granite at depth is likely to be unfractured and to have a very low permeability (e.g. less than $1 \times 10^{-9}$ m/s). The potential risk of thoughflow occurring from the TMF to the Sushica River is therefore likely to be negligible.

5.3.6.2.8 Predicted changes to water quality in the Turija River at TJGS01

Modelled water quality effects in the Turija River at TJGS01 downstream of the confluence of the Jazga River are summarised in Table 5-31. Further details supporting this work can be found in Annex 5B.

Predicted changes that exceed the water quality baseline maxima are highlighted in red in Table 5-31.

Changes in water quality at TJGS01 are predicted to occur for the post-pit lake closure scenario (LOM year 110) only. During the initial closure period there will be no direct discharges to the Jazga River from the closed pit, so no downstream impact is predicted to occur at this time.

The changes predicted in the Jazga catchment during closure were quantitatively modelled for the post-pit lake spill. The predicted water quality at TJGS01 will be a proportional mix of baseline water chemistry at TJGS01 and predicted closure water quality at JZGS03. The results presented below are for the median flow at TJGS01 and the median flow at JZGS03. The proportional flow mix equates to 8% of the flow as outflow from the JZGS03 and 92% of the flow as other flows at TJGS01. This is further explained in Annex 5B.

Table 5-31: Predicted changes to the water quality of the Turija River at TJGS01

<table>
<thead>
<tr>
<th>Regime/Parameter</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value LOM stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>EQS</td>
<td>DWS</td>
</tr>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5</td>
</tr>
<tr>
<td>Ag</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Alkalinity**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>As</td>
<td>0.0097</td>
<td>0.01</td>
</tr>
<tr>
<td>Ba</td>
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<tr>
<td>Cd</td>
<td>Variable*</td>
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</tr>
<tr>
<td>Co</td>
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<td></td>
</tr>
<tr>
<td>Cu</td>
<td>0.1</td>
<td>2</td>
</tr>
<tr>
<td>Fe</td>
<td>4.22</td>
<td>0.2</td>
</tr>
<tr>
<td>Mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>0.72</td>
<td>0.05</td>
</tr>
<tr>
<td>Mo</td>
<td>0.024</td>
<td></td>
</tr>
<tr>
<td>NH3-N</td>
<td>8.79</td>
<td>0.39</td>
</tr>
<tr>
<td>NO3-N</td>
<td>5.05</td>
<td>11.3</td>
</tr>
<tr>
<td>Ni</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>P</td>
<td>2.21</td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>0.0072</td>
<td>0.01</td>
</tr>
</tbody>
</table>
The predictive water quality models for the closure scenario suggest there will not be a major change in water chemistry at TJGS01. There is a small decrease in alkalinity predicted from the baseline minimum, but the pH remains very similar to baseline conditions. This suggests that there is enough buffering capacity in the Turija River to adapt to small changes in acidity. The model predicts small increases in aluminium, cadmium, copper and zinc concentrations above the maximum measured baseline, although not above any EQS or DWS guidelines. As there will be a small variation from baseline maxima the preliminary effect is assessed as low (as per Section 5.3.6.2).

*Cd EQS is dependent on hardness, see results in Annex 5B for more information.

**Minimum values given for baseline and predictive results rather than maximum.

'-' denotes parameter is not assessed.

A low effect on water quality in the Turija River at Turnovo is predicted during construction (LOM year -1), operations (LOM year 20) and post-pit lake spill (LOM year 110). This is a result of dilution of Jazga River water by Turija River water which has buffering capacity.

**5.3.6.2 Predicted changes to water quality in the Strumica River at SMGS02**

Predicted changes to water quality in the Strumica River at Sekirnik (SMGS02) are presented in Table 5-32 for the post-closure scenario. SMGS02 is downstream of the confluences of the Shtuka and Turija Rivers. Further details supporting this work can be found in Annex 5B.

Water quality parameters exceeding baseline maximums or EQS are highlighted in red.

No water quality changes are expected to occur in the Strumica River at SMGS02 during construction and operations or in the early closure period.

No direct discharges from the mine site are likely to affect the water quality at this location during operations. Although flows are expected to be reduced in the Jazga and Shtuka Rivers upstream of the Strumica River, the modelled Q50 flow at SMGS02 (Section 5.2) will not be reduced so it is assumed that water quality will not be affected by changes in flows. During initial closure conditions there will be no direct discharges to the Jazga River from the closed pit and no substantial discharges in the Shtuka catchment, so no downstream impact.
Water quality changes in the Strumica River are only predicted for the post-pit lake closure scenario and significant TMF seepage (LOM year 220) and have been modelled quantitatively.

The changes predicted in the Strumica River at Sekirnik during closure were quantitatively modelled for the post-pit lake spill. The predicted water quality at SMGS02 will be a proportional mix of baseline water chemistry at SMGS02 and predicted water quality following closure at JZGS03 and STGS02. The results presented below are for the median flow at SMGS02 and the median flow at JZGS03 and STGS02. This is further explained in Annex 5B. The proportional flow mix equates to 2% of the flow as outflow from the Jazga catchment, 1% as outflow from the Shtuka catchment and 97% of the flow as other assimilative flows at SMGS02. The model accounts for a discharge from the pit lake after 90 years post-closure, as well as a build-up of contaminant load from the TMF and embankment, as discussed in Sections 5.3.6.2.4 and 5.3.6.2.5. The post-closure year of 220 accounts for a settled but not decreasing seepage load entering the Shtuka catchment. The model does not take into account any direct discharge from the SCF into the Shtuka River as this is not suitable to discharge directly to the environment. This model assesses the residual effect of seepage not collected by the SCF, previously described in detail.

Table 5-32: Predicted changes to water quality at SMGS02

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EQS</th>
<th>DWS</th>
<th>Unit</th>
<th>Max. measured baseline</th>
<th>Predicted maximum value LOM stage</th>
<th>Post pit lake and TMF seepage</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH**</td>
<td>5.94 - 8.97</td>
<td>6.5</td>
<td>pH</td>
<td>6.77</td>
<td>6.28</td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>0.00035</td>
<td>0.00036</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td>0.2</td>
<td>0.05</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity**</td>
<td>86</td>
<td>84</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As</td>
<td>0.0097</td>
<td>0.01</td>
<td>mg/l</td>
<td>0.0025</td>
<td>0.00028</td>
<td></td>
</tr>
<tr>
<td>Ba</td>
<td>0.7</td>
<td>0.055</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>Variable*</td>
<td>0.003</td>
<td>mg/l</td>
<td>0.0006</td>
<td>0.0009</td>
<td></td>
</tr>
<tr>
<td>Co</td>
<td>0.001</td>
<td>0.001</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>0.1</td>
<td>0.0045</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>4.22</td>
<td>0.115</td>
<td>mg/l</td>
<td>0.143</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td>0.72</td>
<td>0.05</td>
<td>mg/l</td>
<td>0.139</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>0.024</td>
<td>0.0015</td>
<td>mg/l</td>
<td>0.003</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Mo</td>
<td>0.0018</td>
<td>0.0015</td>
<td>mg/l</td>
<td>0.0008</td>
<td>0.0018</td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>0.02</td>
<td>0.02</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>0.0072</td>
<td>0.003</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO4</td>
<td>250</td>
<td>40.2</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sb</td>
<td>0.005</td>
<td>0.0008</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Se</td>
<td>0.00168</td>
<td>0.0024</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>0.074</td>
<td>0.009</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyanide</td>
<td>0.015</td>
<td>0.0045</td>
<td>mg/l</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Iron precipitation | Potential |
A low effect on water quality in the Strumica River at Sekirnik is predicted at post-closure year 220. The assessment reflects the buffering capacity provided by dilution of Jazga and Shtuka river waters by Turija and Strumica river waters.

5.3.6.2.10 Predicted changes to water quality in Strumica River at Novo Selo (SMGS03)

A qualitative assessment has been undertaken of water quality effects in the Strumica River at the Novo Selo river gauging station (SMGS03).

The predicted effect on water quality in the Strumica River at the upstream monitoring point SMGS02 is low. With increased dilution and attenuation, the predicted change from baseline further downstream at the Novo Selo gauge will therefore be low to negligible.

5.3.6.2.11 Predicted changes to groundwater quality at community water supplies in Ilovica and Shtuka and at irrigation wells between Ilovica and Turnovo

The contaminant transport model has predicted that no significant change will occur to groundwater quality, relative to the maximum baseline or DWS, at any community water supply receptors in Ilovica or Shtuka villages during construction or operations.

No contaminated seepage is expected to arise during the construction period.

Seepage from the tailings and embankment will occur during operations. Although the plume underneath and just downstream of the TMF does begin to migrate during operations and the surface water quality in this area will be affected (see Section 5.3.6.2.4). The model predicts no increase in concentrations or plume at groundwater receptor points in Shtuka village (SB47 and SSP49), which are located more than 2 km downstream of the TMF and SCF and the plume does not extend this far.

At LOM year 220 the plume will increase the concentration of sulphate in the village by 0.0003%. The concentration remains constant from this point onwards to perpetuity, and as the TMF continues to produce seepage, and the source of contamination is not removed, it stays at approximately the same level. The contaminant transport model was run for 1000 years and the concentrations predicted in the village wells at 1000 years are essentially the same as at the LOM 220 year post-closure. This change in water quality is negligible. Although a large effect is seen in the groundwater body directly below the TMF, no effect is seen at the receptor locations in Shtuka village downgradient of the TMF as a result of dilution in the groundwater system. Further details on the modelled outputs and methodologies used to conduct the assessments are described in Annex 5B.
Due to a commitment for the treatment of wastewater to meet the bacteriological quality guidelines in the EDC, project effects on bacteriological quality of the water supplies has been scoped out of the assessment.

5.3.7 Impact Classification

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1C.

5.3.7.1 Magnitude of the effect

Table 5-33 presents the parameters which will be used for the impact assessment for water quality.

<table>
<thead>
<tr>
<th>Table 5-33: Impact assessment parameters for water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
</tr>
<tr>
<td>Negligible</td>
</tr>
<tr>
<td>No predicted change from baseline</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Quality exceeds baseline maximum but not EDC.</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Quality exceeds EDC and baseline maximum, but not for parameters affecting human and ecological health</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Quality exceeds EDC and baseline maximum for parameters affecting human and ecological health.</td>
</tr>
</tbody>
</table>

5.3.7.2 Determination of impact

Using the decision matrix presented in Annex 1 and the receptors defined in Section 5.3.3, the impacts have been determined. Table 5-34 summarises those impacts which are classified as moderate or major. Moderate or major impacts require mitigation (see Section 6.3). Table D10-3 in Annex 5B presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact.

<table>
<thead>
<tr>
<th>Table 5-34: Assessment of impacts for water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receptor</strong></td>
</tr>
<tr>
<td>Jazga River at Ilovica water supply intake (JZGS01)</td>
</tr>
<tr>
<td>Ilovica Reservoir (ILWT01)</td>
</tr>
<tr>
<td>Jazga River at Radovo (JZGS03)</td>
</tr>
</tbody>
</table>
### 5.4 Sediment

Mining projects typically result in disturbance of the existing landscape with a consequent increased risk of erosion of soils and elevated levels of sedimentation in watercourses downstream. Increased sediment mobility can also have implications for changes in the geochemistry of sediment and water quality in these water courses, further compounding the increased levels of erosion. This section presents an impact assessment of the mine development and its likely impact on the Jazga and Shtuka Rivers at selected assessment points for the periods of construction, operation and closure.

In undertaking the sediment impact assessment, it is assumed the magnitude of impacts is dependent on the degree and extent to which the various areas of the proposed mine result in changes to the water environment. These occur as a direct result of increased sediment loading within the river flows expressed as a change in total suspended solids (TSS). The magnitude of the sediment impact also depends on the degree and extent to which the Project modifies the local environment and as a result can vary dramatically in accordance with the project phase.

#### 5.4.1 Sources of Effects

The following activities are generally anticipated to result in sediment impact, particularly during construction of the proposed mine facilities when bulk earthworks are undertaken:

- Clearing and grubbing;
- Topsoil stripping;

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Regime/Parameter</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shtuka River at Shtuka water supply intakes (STGS01)</td>
<td>pH, SO₄, metals</td>
<td>Operations (Yr 20)</td>
<td>Change in water quality due seepage from the TMF and embankment during operations affecting water supply security and other receptors</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closure (Yr 21)</td>
<td>Change in water quality due to seepage from the TMF and embankment and poor quality overflow from SCF following closure affecting water supply security and other receptors</td>
<td>Major</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-Closure (Yr 220)</td>
<td>Change in water quality due to poor quality seepage from the TMF and embankment and poor quality overflow from the SCF following closure affecting water supply security and other receptors</td>
<td>Major</td>
</tr>
<tr>
<td>Shtuka River at Sekirnik road (STGS02)</td>
<td>pH, SO₄, metals</td>
<td>Operations (Yr 20)</td>
<td>Change in water quality due seepage from the TMF and embankment during operations</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Closure (Yr 21)</td>
<td>Change in water quality due to seepage from the TMF and embankment and poor quality overflow from SCF following closure</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Post-Closure (Yr 220)</td>
<td>Change in water quality due to poor quality seepage from the TMF and embankment and poor quality overflow from the SCF following closure</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Stockpiling (of topsoil or other material);
- Cutting and filling;
- Finish grading; and
- Rock placement.

Each of these activities carry associated erosion risks which are likely to require control measures. Additionally, it may be necessary to implement sediment removal measures in certain locations to reduce the concentrations of mobilised sediment to the downstream environment.

The elements of the Project identified as potential sources of change to the baseline sediment state are presented in Table 5-35:

<table>
<thead>
<tr>
<th>Mine stage</th>
<th>Potential source of sediment</th>
<th>Scenario summary</th>
<th>Additional notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Haul road</td>
<td>Assumes phasing of the construction of haul roads, access roads and associated road drainage in 100 m long work fronts. Temporary diversions will be developed to minimise runoff across exposed surfaces.</td>
<td>Drainage system, including Shtuka diversion, stilling basins and sediment ponds downgradient of the pit and haul and access roads, are assumed to be developed during early phases of construction to manage sediment. All areas of the mine served by such sediment management facilities have been scoped out of the effects analysis and impact assessment, with the exception of the TMF and associated infrastructure in the Shtuka valley.</td>
</tr>
<tr>
<td></td>
<td>On site access road</td>
<td>Based on stripping of pre-stripe area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open pit</td>
<td>Assumes stripping of TMF starter wall and deforestation of impoundment areas of TMF starter. The Storm water dam (SWD) downstream of TMF assumed to be developed prior to stripping</td>
<td>The Storm Water Dam (SWD) downstream of the TMF is designed to manage surface water runoff from the Shtuka catchment. All surface water runoff generated in the Shtuka catchment upstream of the TMF will be diverted to the SWD. The SWD will retain surface runoff from the upslope catchments to allow eroded material from this area to settle.</td>
</tr>
<tr>
<td></td>
<td>TMF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations</td>
<td>Mine site</td>
<td>All facilities in operation and site operating on a zero discharge basis. Pit water management, SWD and Seepage Collection Facility (SCF) fit for purpose and controlling TSS discharge to below the baseline values</td>
<td>Scoped out of the effects analysis and impact assessment</td>
</tr>
<tr>
<td>Closure</td>
<td>Mine site</td>
<td>Site re-vegetated. SWD and SCF decommissioned when discharge meets environmental protection criteria</td>
<td>Scoped out of the effects analysis and impact assessment</td>
</tr>
</tbody>
</table>

A summary of the elements and associated impacting areas is presented in Table 5-36.
Table 5-36: Summary of Approximate Mine Impacted Areas

<table>
<thead>
<tr>
<th>Mine infrastructure</th>
<th>Construction (ha)</th>
<th>Shtuka catchment</th>
<th>Jazga catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Pit</td>
<td></td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>TMF (downstream embankment)</td>
<td></td>
<td>43</td>
<td>0</td>
</tr>
<tr>
<td>Mine Workshop</td>
<td></td>
<td>7.4/7.4 a</td>
<td>0</td>
</tr>
<tr>
<td>Access Road</td>
<td></td>
<td>2.8</td>
<td>24</td>
</tr>
<tr>
<td>Haul Road</td>
<td></td>
<td>34/10 a</td>
<td>8.5</td>
</tr>
<tr>
<td>Upper Plant Site</td>
<td></td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Conveyor Belt</td>
<td></td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>ROM Pad</td>
<td></td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Diversion Dam and Diversion Channel</td>
<td></td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>109.2</strong></td>
<td><strong>92.5</strong></td>
</tr>
</tbody>
</table>

Note: a) Upstream SWD/Downstream SWD

5.4.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 4) which provided the DFS engineers with environmental measures to be incorporated into project design. These measures are aimed at minimising environmental impacts, thereby reducing the additional mitigation measures that could otherwise be required as a result of project impacts. The environmental measures relevant to erosion and sediment control that have been incorporated into project design include:

- Development of stable embankment slopes, installation of erosion control features (e.g. silt fences, ditches and berms, sediment ponds/sumps/traps, mats or netting), and prompt revegetation;
- Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible;
- Diversion channels will be constructed adjacent to the roads to convey upslope runoff to locations at which flow is conveyed under the roads via culverts to minimise the risk of surface flow across the haul and access roads;
- Vegetation clearance will be minimised and areas will only be cleared immediately prior to construction taking place, to the extent possible;
- Avoid removing vegetation adjacent to lakes, rivers and streams unless the waterway is to be removed or diverted;
- Installation of physical erosion control features such as silt fences, ditches/soakaways and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting to control erosion prior to the establishment of a protective vegetative cover;
- As soon as practicable, temporarily disturbed areas will be graded, revegetated and reclaimed so that surface water run-off from these areas will be similar to natural or pre-mining conditions;

---

24 Impacted areas for TMF, open pit and haul road are overestimated based on an early estimation of the footprint areas, and appear larger than the sources of impacts presented in the biodiversity analysis in Section 5.8 and soil quantity analysis in Section 5.1. This is considered to be a conservative approach to the assessment.
Storm water discharges to the environment will be managed to replicate natural variability associated with high and low flows;

Reclamation will be designed so that the site has runoff characteristics similar to pre-development runoff conditions (as described in Section 6.4 in the sediment baseline [Annex 3]); and

Reclamation will take place progressively where feasible. This includes ripping of compacted areas and revegetation as soon as disturbed areas are no longer in use. Revegetation will use vegetation representative of natural vegetation in the area utilising locally procured seeds as far as possible. Road cuttings and embankments will be physically stabilised and should not generate sediment over time.

5.4.3 Study Area and Receptors

Following completion of the baseline, the study areas for all disciplines have been collated to produce local and regional study areas for the impact assessment (equivalent to the potential area of influence of the project) for the biophysical environment and the social environment. The local and regional study areas for the biophysical impact assessments, as presented in Section 1.4, are referred to throughout this chapter as the local and regional study areas.

Receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts are robust. The following receptors are used within the sediment effects analysis:

- Jazga River - downstream of the open pit, upstream of the reservoir (JZGS01);
- Shtuka River - downstream of TMF and diversion (STGS01);
- Shtuka River - downstream of TMF and diversion (STGS02); and
- Strumica River – downstream of mine area (SMGS02).

5.4.4 Considerations from Stakeholder Engagement

The following issues were identified during the stakeholder engagement process (described in Section 1.3) and are relevant to the impact assessment for sediment:

- Whitish water observed after heavy rainfall in August or September 2015, claimed to be associated with drilling (Open House, September 2015).

5.4.5 Key Guidelines and Standards

The IFC EHS Guidelines for Mining (2007) Target TSS water quality for discharge from mine facilities is 50 mg/l for 95% of the time.

The EDC (Annex 1) presents the original project standard for TSS and was based on early baseline data, but also considers the Macedonian Law on Water (Official Gazette no. 87/2008, 6/2009, 161/2009, 83/10, 51/11, 44/12, 23/13, 163/13, 180/14 and 146/15) and relevant directives. There are no specific guidelines concerning drinking water and TSS in Macedonia.

The environmental surface water quality guideline adopted for the project based on baseline TSS is between 250 mg/l and 300 mg/l for 95% of the time, and 50 mg/l for 75% of the time. Therefore due to the availability of this in situ data in the upper catchment, the project standard for both the Shtuka and Jazga watercourses is 250 mg/l for 95% of the time.
5.4.6 Effects Analysis

5.4.6.1 Methods

Quantitative sediment analysis has been undertaken for construction activities while a qualitative approach was adopted for operations and closure. During operations, the site will operate on a zero discharge basis; and surface water runoff infrastructure is assumed to remain in place during closure and the establishment of vegetation.

Quantitative analysis for the construction period is focused on the pit, TMF, access road and haul road, mine workshop, process plant and conveyor and ROM pad. Sediment ponds and drainage for the remaining areas are assumed to be constructed early in the construction phase and therefore manage sediment generation.

Sediment generation and discharge to watercourses is subject to surface erosion, transport to watercourse and dilution in the watercourse. Where the runoff discharges into surface storages (e.g., water storage dam and Ilovica Reservoir), it is also expected that sediment will be deposited within the impoundment.

Impact magnitude was quantified on the basis of the factors listed above by applying the Modified Universal Soil Loss (MUSLE) equation to simulate sediment losses from the impacted areas and quantify overall changes in TSS concentrations at the nominated receptors. In the cases where quantification of impacts could not be carried out, professional judgment was used to describe in qualitative terms what the magnitude of impacts would be. This included, for example, excessive deposition of eroded sediments in any standing bodies of water.

Golder used conservative assumptions by adopting realistic “worst-case” scenarios. The purpose of using conservative assumptions is to ensure that impacts are not underestimated although it is noted that conservative assumptions can sometimes result in unrealistically high estimates of impact magnitude. In such instances, the use of professional judgment is essential to ensure that the results are conservative but not unrealistic.

The MUSLE (Modified Universal Soil Loss Equation) model has been adopted to estimate sediment generation on a daily basis. MUSLE is expressed by the following equation:

\[ Y = 11.8(Qq_p)^{0.56}KLSCP \]

Where:

- \( Y \) = sediment yield (tonnes)
- \( Q \) = volume of runoff (m\(^3\))
- \( q_p \) = peak flow (m\(^3\)/s)
- \( K \) = soil erodibility factor
- \( LS \) = slope length gradient factor
- \( C \) = cover management factor
- \( P \) = erosion control practice factor

Rainfall inputs are derived from the synthetic daily rainfall record and river dilution is based on the corresponding synthetic flow record produced for the baseline.

Though a specific rainfall event may generate localised surface water runoff, the rainfall intensity may not be sufficient to transport runoff to a watercourse. The SCS runoff curve number approach was adopted to estimate days on which surface water runoff occurred. A curve number of 86 was adopted as representative of the project area. In addition, when surface water runoff does discharge to a watercourse, a number of factors can also influence the amount of eroded sediment delivered to a watercourse, often referred to as the sediment delivery ratio (SDR). These factors include change in slope, surface depressions, vegetation cover, land use and catchment area.
In estimating the SDR, the Revised Universal Soil Loss Equation (RUSLE), which estimates surface erosion, has been reviewed against baseline sediment yield to Ilovica reservoir. This indicated a SDR of 16% (i.e. 16% of material eroded in the catchment is actually discharged to Ilovica Reservoir). This SDR value has been adopted in the assessment for the mine site where impacted areas are not in the vicinity of a watercourse (e.g. access roads, haul roads and pit). Given the proximity of the TMF to the Shtuka River, it would be expected that a greater proportion of eroded material is expected to be transported to the watercourse, therefore an alternative SDR value of 51% was estimated following Vanoni (1975), which is as follows:

$$\text{SDR} = 0.47 A^{-0.125}$$

Where A is the drainage area (sq km).

The TSS generated from the impacted area is then discharged to the watercourse where it is volumetrically diluted by the water already within the watercourse. Flow in the watercourse for each receptor, derived from the 54 year HEC-HMS baseline model, is assumed to have a constant TSS of 250 mg/l, before consideration of runoff from the impacted area (i.e. there is no variation in TSS with flow in the receiving watercourse). This was adopted from the baseline study, which concluded that prior to any mining exploration influences, baseline TSS concentrations in the Shtuka and Jazga Rivers are considered to be 250 mg/l or less for 95% of the time. Adoption of a constant value is a conservative approach but this may be updated when more baseline TSS data have been collected and a flow versus TSS relationship is developed for the receptors on the Jazga and Shtuka Rivers. Such a relationship would enable a more realistic estimate of TSS in the watercourses during high and low flows.

Management of sediment transport through the implementation of sediment fences, check dams and small sediment ponds is represented in the model by removing the coarse grain sediment (sand and silt). The finer grained clay fraction is assumed to be transported to the watercourse.

One function of the SWD (and Ilovica Reservoir) will be to allow incoming suspended sediment to settle. Settlement of small sediment particles (clays and silts) requires significant detention time, which can generally be provided by a long flow length through the storage. For these two storages this flow path length will be sufficient to allow settlement of particles larger than a medium silt size with settlement of smaller particles (fine silts and clays) requiring water to be retained within the storages for a lengthy period.

With no treatment within the storages, water released would be expected to have a visual impact immediately downstream, although this would reduce as runoff from the downstream contributing areas increases. Flocculation of the storages is therefore likely to be required, particularly following more significant storm events.

With the storages in place, treatment of the water using flocculation will therefore be implemented to reduce the discharge of the very fine sediment particles in the outflows. Two scenarios were considered, the first assuming flocculation removed 50% of the clay fines and the second assuming 60%, noting that the larger sediment particles are either retained by the sediment control infrastructure in the catchment or will settle naturally within the storages.

The potential TSS changes downstream of the mine site have therefore been assessed by considering:

- The effects of dilution;
- The removal of the coarser-grained sand and silts from the runoff discharging from the impacted areas via the proposed sediment control infrastructure (as outlined in Section 5.4.2); and
- Flocculation of water retained in the SWD as required.

### Results

5.4.6.2

The effects of potential increased erosion and resultant sediment entering nearby watercourses from the mining area have been assessed for the receptors listed in Section 5.4.3, after taking into account the proposed sediment mitigation measures.
5.4.6.2.1 Jazga River - JZGS01 and JZGS03

The primary source of sediment entering the Jazga River during construction will be from stripping of the pit area. During operations, the mine site will operate on a zero discharge basis; consequently erosion within the site will not affect the Jazga River and TSS in the watercourse will remain similar to baseline levels. During closure, the site will be revegetated to minimise erosion and act as a natural sediment trap.

The modelling results during the construction phase only are therefore summarised in Table 5-37.

Table 5-37: Construction phase – TSS results, Jazga

<table>
<thead>
<tr>
<th>River</th>
<th>Location</th>
<th>TSS concentration (mg/l) for 95%ile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Design criteria for discharge to environment</td>
</tr>
<tr>
<td>Jagza</td>
<td>JZGS02</td>
<td>250</td>
</tr>
<tr>
<td>Jagza</td>
<td>JZGS01</td>
<td>250</td>
</tr>
</tbody>
</table>

The pre-strip area of the pit, which is situated on the steep slopes along the ridge line between the Jazga and Shtuka River catchments, will be approximately 43 ha. Exposed surfaces will lead to increased erosion within the catchment, though the natural catchment between the stripping area and watercourse will act as a “buffer strip”; which will effectively act as a natural sediment trap. Exposed surfaces will lead to minor impacts in the Jazga River between the site and Ilovica Reservoir. Downgradient of the mine, Ilovica Reservoir will mitigate the increased TSS.

The predicted gross erosion rate from the pre-strip area of the open pit, in the absence of mitigation or best practices, is approximately 550 t/ha/yr. This is more than two orders of magnitude higher than the baseline value of 2 t/ha/yr.

The incorporated mitigation measures, including sediment fences, surface water diversions and minimising exposed surfaces, will manage erosion (and hence TSS loading) from haul roads and access roads as far as is practicable. In addition, the natural buffer between the roads and watercourse will also mitigate sediment reaching the watercourses. The estimated TSS level for the 95%ile that will flow into Ilovica Reservoir is around 289 mg/l.

5.4.6.2.2 Shtuka River – STGS01 and STGS02

The primary source of sediment entering the Shtuka River during construction will be from stripping of the TMF area. Direct rainfall on this area could lead to sediment laden surface water runoff entering the Shtuka River downstream. During operations, the mine site will operate on a zero discharge basis; consequently erosion within the site will not affect the Shtuka River and TSS in the watercourse will remain similar to baseline levels. During closure, the site will be revegetated to minimise erosion and act as a natural sediment trap.

The modelling results during the construction phase only are therefore presented in Table 5-38.

Table 5-38: Construction phase – TSS results, Shtuka

<table>
<thead>
<tr>
<th>River</th>
<th>Location</th>
<th>TSS concentration (mg/l) for 95%ile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Design criteria for discharge to environment</td>
</tr>
<tr>
<td>Shtuka</td>
<td>STGS01</td>
<td>250</td>
</tr>
<tr>
<td>Shtuka</td>
<td>STGS02</td>
<td>250</td>
</tr>
<tr>
<td>Strumica</td>
<td>SMGS02</td>
<td>250</td>
</tr>
</tbody>
</table>

Note: * includes discharge from upstream of the diversion channel, i.e. construction of the diversion channel has not yet been completed.
  † combined concentrations for Shtuka and Jazga catchments.
In its upper reaches, the Shtuka River will be diverted around the TMF area, discharging into the SWD. Planned engineering and environmental mitigation measures for the construction of the TMF starter wall will contain much of the coarser eroded sediment material. However, the fine grained sediments that are eroded will report to the Shtuka River. Sediment erosion modelling (and subsequent dilution) results indicate the TSS level for the 95%ile downstream of the SWD will increase from 250 mg/l to 588 mg/l where the Shtuka diversion discharges back to its natural channel.

Water quality in the Shtuka between STGS01 and STGS02 would be similar; with little or no dilution occurring downstream of STGS01. The predicted gross erosion rate from the TMF area during construction, in the absence of mitigation or best practice, is approximately 800 t/ha/y. This is more than two orders of magnitude higher than the baseline value of 2 t/ha/y, hence the need for the proposed mitigation measures (refer to Section 6.4).

The incorporated mitigation measures, including sediment fences, surface water diversions and minimising exposed surfaces, will manage erosion (and hence TSS loading) from haul roads and access roads as far as is practicable. In addition, the natural buffer between the roads and watercourse will also mitigate sediment reaching the watercourses.

5.4.6.2.3 Strumica River – SMGS02 (downstream of mine area)

In the absence of mitigation to control fine grained sediment generated by erosion during construction, there may be a small TSS increase in the Strumica River. In the vicinity of SMGS02 this is estimated to be around 262 mg/l for the 95%ile (see Table 5-37).

During operations, the mine site will operate on a zero discharge basis, consequently erosion within the site will not affect the Strumica River and TSS in the watercourse will remain similar to baseline levels. During closure, the site will be revegetated to minimise erosion and act as a natural sediment trap.

The modelling results for the SMGS02 receptor are presented in Table 5-37.

5.4.7 Impact Classification

The assessment of impacts utilises the results of the effects analysis and applies the impact assessment methodology described in Section Error! Reference source not found..

5.4.7.1 Magnitude of the Effect

Table 5-39 presents the parameters which will be used for the impact assessment for sediment. The impact classification considers the following:

- **Magnitude**: Quantifying deviation from current or baseline conditions;
- **Geographic extent/area of influence**: The sediment impact magnitude is directly related to the size of the area stripped during construction and proximity of the impacted areas to the receiving watercourses;
- **Duration**: Magnitude of sediment impacts is directly proportional to the lifespan of the project activity. TSS effects are often very short term, but excessive deposition in reservoirs and river systems can last for a long time; and
- **Project timing**: Project activities (especially construction) that occur during high precipitation periods will have greater impacts than at other times

<table>
<thead>
<tr>
<th>Table 5-39: Impact assessment parameters for sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnitude</strong></td>
</tr>
<tr>
<td>Negligible</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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## Determination of Impact

Using the decision matrix presented Annex 1 and the receptors listed in Section 5.4.3, the impacts have been determined. Table 5-40 presents the classification of each impact. Table 1 in Annex 5C presents the route to the classification of the impacts, outlining the magnitude, geographic extent, duration and frequency for each impact.

### Table 5-40: Assessment of impacts for sediment

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jazga River - downstream of the open pit, upstream of the reservoir (JZGS01)</td>
<td></td>
<td>Open pit</td>
<td>Low</td>
</tr>
<tr>
<td>Jazga River - downstream of Illovica Reservoir and Illovica village (JZGS03)</td>
<td>Construction</td>
<td>TMF</td>
<td>High</td>
</tr>
<tr>
<td>Shtuka River - downstream of TMF and diversion (STGS01)</td>
<td></td>
<td>TMF</td>
<td>High</td>
</tr>
<tr>
<td>Shtuka River - downstream of TMF and diversion (STGS02)</td>
<td>TMF &amp; open pit</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Strumica River – downstream of mine area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 5.5 Noise and Vibration

The proposed Project will introduce new sources of noise and vibration to the area, and therefore has the potential to affect existing noise and vibration levels. Elevated noise levels can cause annoyance, sleep disruption and affect speech intelligibility. Elevated vibration levels can give rise to annoyance, startle effects and cause damage to structures. This chapter considers the potential effects to existing sensitive receptors occupied by humans (refer to Section 5.5.3) arising from noise and vibration sources associated with the Project.

### Terms and Units

Noise is defined as unwanted sound. The Système Internationale d’Unités (SI) unit for measuring sound is the decibel (dB), which is measured on a logarithmic scale. The range of sound audible to humans is from 0 dB to 140 dB, from the threshold of audibility to the threshold of pain, respectively. Noise emissions from sources and noise levels in the environment have an associated frequency. The human ear does not respond to all frequencies in the same way. Mid-range frequencies are most readily detected by the human ear, while low and high frequencies are harder to hear. Environmental noise levels used in this assessment are
presented as dB(A), which incorporates the frequency response of the human ear. An increase of 3 dB(A) is normally just perceptible under normal conditions, while an increase of 10 dB(A) is equivalent to a doubling of the perceived loudness.

Vibration may reach receptors either via ground transmission (ground-borne vibration) or as a pressure wave travelling through the air (air overpressure). Ground-borne vibration is commonly assessed in terms of Peak Particle Velocity (PPV), the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position, expressed in millimetres per second (mm/s). Air overpressure is expressed as linear decibels (dBL).

5.5.1 Sources of Effects

The elements of the Project which have been identified as potential sources of change to baseline conditions for noise and vibration include:

- Noise from the mine pit, processing plant and tailings facility:
  - Site clearance and felling (construction);
  - Power generation (construction and operations);
  - Excavation (construction and operations);
  - Tipping of material (construction and operations);
  - Conveying (operations);
  - Crushing and milling (operations); and
  - Traffic movements on haul roads on on-site access roads (construction, operations and closure).
- Noise from traffic movements on off-site access road (construction, operations and closure);
- Noise from Project-related traffic movements on the regional highway M6 (transport route) (construction, operations and closure);
- Vibration from blasting in the mine pit (operations); and
- Vibration from blasting along the haul road and on-site access road (construction).

The assessment of noise also informs other impact assessments, including biodiversity and ecology (Section 5.8), cultural heritage (Section 5.10) and socio-economics (Section 5.12).

5.5.2 Incorporated Environmental Measures

Golder produced an Engineering Design Considerations document (described further in Section 4) which provided the Project engineers with environmental measures which should be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. No such noise and vibration mitigation measures have yet been committed to.

5.5.3 Study Area and Receptors

The primary baseline data gathering for noise and vibration was completed within the baseline LSA. Following completion of the baseline, the baseline study areas for all disciplines have been collated to produce a biophysical impact assessment area, which is also presented in Section 1 and will be referred to throughout this chapter as the local and regional study areas.

Receptors, which are further described in Section 1, can be defined as any receiving medium which could be affected by any change due to the Project. In the assessment of noise and vibrations, existing human receptors are defined as premises occupied by persons, where noise or vibration is received and include residences, hotels, schools, hospitals, places of worship and recreational areas.
Receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust. The following receptors are used within the noise and vibration effects analysis:

- Ilovica village;
- Shtuka village;
- Sekirnik village;
- Turnovo village;
- Novo Selo village;
- Samuilovo village; and
- Novo Konjarevo village.

Noise and vibration effects from the Project may affect the receptors above, depending on their proximity to Project components. Beyond a given distance from the source, noise and vibration levels will be undetectable. The potential for effects from specific Project components is identified by receptor in Table 5-41.

**Table 5-41: Potential effects of the Project on receptors**

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Mine noise (pit, processing plant and tailings facility)</th>
<th>Off-site access road noise</th>
<th>M6 transport route noise</th>
<th>Blast vibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>●</td>
<td>●</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Shtuka</td>
<td>●</td>
<td>●</td>
<td>-</td>
<td>●</td>
</tr>
<tr>
<td>Turnovo</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Novo Selo</td>
<td>-</td>
<td>-</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>Samuilovo</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Novo Konjarevo</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

● = potential effect  
- = no potential effect due to distance between source and receptor

### 5.5.4 Considerations from Stakeholder Engagement

The following issues/comments were expressed during the stakeholder engagement process (described in Section 1) and are relevant to the impact assessment for noise and vibration:

- Concern from Ilovica/Shtuka residents regarding vibration from the blasting at the mine (Ilovica Open House, 16 September 2015 and Stakeholder engagement round 3);
- Concern from Ilovica/Shtuka residents regarding the control of noise from the mine during its lifetime (Open House, 16 September 2015);
- Concerns that noise from the mine will drive away animals from the hills and reduce hunting opportunities (Bosilovo Hunters Association, 3 April 2015);
- The residents of Ilovica village expressed concern for whether the blasting process in the mine would produce increased vibration levels as they noticed damage to their properties from the vibrations of the blasting process during the construction of the dam in Ilovica (Stakeholder engagement round 3);
- A question on the type of mitigation measures that will be taken in order to reduce the noise caused by the off-site access road traffic (Stakeholder Engagement round 3); and
- A question on the kind of mitigation measures would there be related to the HGV movements on the M6 transport route in the area of Novo Selo and Novo Konjarevo (Stakeholder Engagement round 3).
5.5.5 Key Guidelines and Standards

5.5.5.1 Macedonian Legislation

Macedonia has legislation covering permissible noise levels in different types of receiving environment. The following legislation has been considered in defining the criteria for this impact assessment:

- The Law on Protection against Environmental Noise (Official Gazette of the Republic of Macedonia No. 79/07 and 124/10).
- Rulebook for limit values of noise in the environment (translated) (Official Gazette of the Republic of Macedonia No. 147/08).

5.5.5.2 International Guidance and Standards

In addition to the Macedonian legislation, the following international standards and guidance have been considered in defining the criteria for this impact assessment:

- Standards Australia Committee, Australian Standard AS 2187.2 Explosives: Storage and Use, Use of Explosives (AS, 2006).
- Department of Transport (United Kingdom), Calculation of Road Traffic Noise (DoT, 1988).
- International Society of Explosives Engineers (ISEE), Blaster’s Handbook (ISEE, 1998).

5.5.5.3 Project Standards

Noise

In the definition of the guideline limit values for the evaluation of impacts for human receptors, Golder, together with Euromax’s Macedonian noise specialists at the University of Goce Delchev (Shtip), considered both the Macedonian regulations and the IFC guidance and international standards. The Macedonian noise level limits and evaluation periods (daytime, evening and night-time) have been used to inform the impact assessment criteria. A reference period of one hour (rather than a period-average) has been adopted to enable short-duration, high-magnitude events to be evaluated.

The noise limits applicable to the identified receptors are provided in Table 5-42.

Table 5-42: Project noise criteria at existing human receptors

<table>
<thead>
<tr>
<th>Receptor Type</th>
<th>Noise Limit (dB L&lt;sub&gt;Aeq 1 hour&lt;/sub&gt;)</th>
<th>Reference Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural areas not exposed to intensive road traffic noise (&gt;100 m from major roads) (e.g. Ilovica, Shtuka, parts of Sekirnik and Turnovo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>40</td>
<td>Daytime (07:00 – 19:00)</td>
</tr>
<tr>
<td>Institutional</td>
<td>35</td>
<td>Evening (19:00 – 23:00)</td>
</tr>
<tr>
<td>Educational</td>
<td>35</td>
<td>Night-time (23:00 – 07:00)</td>
</tr>
<tr>
<td>Cultural</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Rural areas exposed to traffic noise (&lt; 100 m from major roads) (e.g. parts of Sekirnik and Turnovo, Samuilovo, Novo Konjarevo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>60</td>
<td>Daytime (07:00 – 19:00)</td>
</tr>
<tr>
<td>Receptor Type</td>
<td>Noise Limit (dB L&lt;sub&gt;Aeq 1 hour&lt;/sub&gt;)</td>
<td>Reference Period</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Institutional</td>
<td>55</td>
<td>Evening (19:00 – 23:00)</td>
</tr>
<tr>
<td>Educational</td>
<td>50</td>
<td>Night-time (23:00 – 07:00)</td>
</tr>
<tr>
<td>Cultural</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mixed residential and commercial areas (third level of noise protection) (e.g. Novo Selo)**

<table>
<thead>
<tr>
<th>Residential</th>
<th>Institutional</th>
<th>Educational</th>
<th>Cultural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime</td>
<td>60</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Evening</td>
<td>60</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>Night-time</td>
<td>55</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

**Vibration**

Neither the International Finance Corporation (IFC) Environmental, Health and Safety Guidelines (EHS) guidelines nor the Macedonian national standards provide criteria for the evaluation of vibration. Therefore, the British Standard BS5228 has been adopted for the assessment of vibration.

People exhibit a wide variation of tolerance to vibration, dependent upon social and cultural factors, psychological attitudes and the expected degree of intrusion. Therefore more conservative criteria have been used in this assessment levels which may actually cause disturbance in reality. Typical effects from increasing intensities of vibration, ranging from the threshold of perception up to the onset of structural effects are provided in Table 5-43.

**Table 5-43: Project vibration criteria**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Level</th>
<th>Potential Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground vibration</td>
<td>mm/s PPV</td>
<td>0.3</td>
<td>Vibrations might be just perceptible in residential environments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.0</td>
<td>It is likely that vibrations of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.0</td>
<td>Vibrations are likely to be intolerable for any more than a very brief exposure to this level in most building environments&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Air overpressure</td>
<td>dB Linear</td>
<td>115</td>
<td>Safe limit for 95% of blasts for protection of communities from adverse blast effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120</td>
<td>Level corresponding to an excess air pressure equivalent to that of a steady wind of 5m/s and is likely to be above the threshold of perception</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150</td>
<td>Poorly-mounted pre-stressed window may crack</td>
</tr>
</tbody>
</table>

Notes:

<sup>a</sup> The USBM threshold for the onset of structural damage arising from ground-borne vibration is 50 mm/s PPV. No such damage has been recorded in vibration studies at levels of less than 12.7 mm/s PPV.

Single or infrequent occurrences of the stated levels do not necessarily correspond to the stated effect in every case. Rather, the values give an indication of potential effects should such levels of vibration be routinely measured. Where vibration is transient (such as blast vibration), rather than continuous (such as that from operation of heavy machinery), the degree of disturbance will be less. The potential effects associated with the vibration levels set out in Table 5-43 have been used to derive the magnitude criteria set out in Section 5.5.7.

5.5.6 Effects Analysis

Effects analysis are quantitative analyses, e.g. numerical modelling, which provide a prediction of changes to the baseline situation due to effects of the Project. The results of the effect analysis inform the impact assessment (Section 5.5.7).
5.5.6.1 Methods

5.5.6.1.1 Noise Prediction

To determine the specific noise levels attributable to Project activities, a noise propagation (numerical) model was calculated in accordance with ISO 9613-2 using Datakustik’s CadnaA proprietary software. Noise propagation calculations were then undertaken and the calculated noise levels were compared with the measured noise levels at each noise-sensitive receptor.

The ISO standard propagation model provides for the prediction of sound pressure levels based on down-wind (i.e. worst-case) conditions and other conditions favourable to noise propagation. When the wind blows in the opposite direction (i.e. receptors are up-wind from the source), noise levels will be lower and the propagation model becomes inherently conservative.

The model calculates the predicted sound pressure level by taking the sound power level (SWL) or sound pressure level (SPL) at a distance for each noise source in separate octave bands and subtracting a number of attenuation factors for geometric divergence, atmospheric absorption, ground attenuation and barrier attenuation.

Source noise data were obtained, where possible, from published manufacturer sources, British Standards and measured levels of equivalent plant operating in-situ on similar sites.

To identify the worst-case scenarios for effects analysis, Golder reviewed details of the project’s use of plant and materials by year. Years with the greatest amount of plant in use and highest rate of use of materials were selected as the worst-case:

- For the construction phase, two scenarios have been considered:
  a. Construction of the permanent access road.
  b. Peak construction activities at the mine, including traffic on the temporary access road.
- For operations, Year 4 was selected as worst case due to high intensity of activities, the large numbers of mobile noise sources on site, the shallow pit depth and the limited amount of screening anticipated to be offered by the pit walls in this early stage of the development of the mine.

Each of the villages in the study area comprises many individual receptors. Of the multiple receptor properties, single residences have been selected within each village as representative existing human receptors for the evaluation of noise effects. The receptors for the impact assessment have been chosen based on generated preliminary noise isopleths and on their proximity to project components, meaning they represent the worst-case effect within the village. The selected locations are shown in Drawing 5-8.

The specific methods for assessing each component of the Project in the numerical model are described in the following sections.

Road Traffic Noise

Road traffic noise associated with the Project will arise from vehicle movements on the off-site access road to the M6 from the proposed mine and vehicle movements on the M6 transport route. Further details of the road layout are presented in Section 4.

The numerical model takes account of the specific calculation protocol for the Calculation of Road Traffic Noise (CRTN), as a representative traffic model, which is based on number of vehicle movements, percentage composition of heavy vehicles, speed of vehicles, road gradient and road surface type. The baseline used for evaluating the change in road traffic noise has been modelled using current traffic count data, rather than using measured baseline noise levels. This approach enables a direct comparison of the change in traffic noise levels due to the Project in preference to mixing predicted and measured traffic noise levels. Nevertheless, the predicted baseline noise levels using traffic count data are consistent with the measured baseline period-averaged noise levels for monitoring locations close to the M6.
HGV movements associated with the project, comprising fuel, reagent, food and equipment deliveries but excluding concentrate trucks travelling along the M6 to Bulgaria, will result in an increase of less than 5 percent above baseline hourly traffic flows, which results in less than 1 dB change in the noise level. HGV movements not including concentrate trucks have therefore been scoped out of this assessment, due to their negligible impact on traffic noise levels.

The copper concentrate will be transported to the smelter in Bulgaria via trucks along the M6 transport route. The proposed schedule of truck departures has not been confirmed, therefore a maximum of up to 5 HGV truck movements per hour have been assumed during the daytime, evening and night-time periods; this frequency has been assessed.

**Excavation and Pit Activities, Conveyors, Processing and Waste Disposal Activities**

Construction activities have been assumed to be confined to the daytime and evening periods only. During operation, predictions were based on assumed constant operation and assuming maximum processing operations.

Predictions of noise from excavating activities during construction and operations (e.g. operation of excavators, shovels, drills, mine trucks and processing activities, including screening, crushing, and loading of the conveyor in the pit area) were undertaken using the activities, work locations and equipment provided in the project description (Section 4).

Mining equipment was located according to site plans, where locations were available. Where locations are not yet fixed, equipment was assumed to be operating at an appropriate location within the concession according to its function. The predictions were based on assumed constant operation and assuming maximum processing operations. The contribution to total noise levels from light vehicles within the concession, such as pickups, buses and cars, will be negligible. These have therefore been screened out of the assessment.

The pit contours were obtained for the model to determine the screening effects afforded by pit walls and other topography. No screening has been assumed for the construction phase. In addition, as Year 4 is early in the pit life, no screening due to the mine pit walls has been assumed for the assessed operations phase during Year 4.

**Off-Site Access Road Construction**

There will be two off-site access road alignments, temporary and permanent, starting from the south of Shtuka to the M6 transport route. The temporary off-site access road is located west of Sekrinik, along existing tracks and will be upgraded and widened for the duration of the construction phase until the completion of the permanent access road. The permanent off-site access road is located to the east of Sekirnik and will be constructed during the construction phase of the Project. The permanent off-site access road will be used during operations. The temporary and permanent off-site access roads have the same alignment adjacent to the villages of Shtuka and Ilovica.

The construction of the permanent access road has been considered as a separate phase of construction. A typical assemblage of road construction plant has been assumed for construction of the permanent off-site access road. Source noise terms for a representative list of plant such as excavators, asphalt pavers and road rollers were obtained from published sources (BS 5228). Access road construction works have been assumed to occur throughout the daytime and evening periods only.

**5.5.6.1.2 Vibration Prediction**

Blasts have been assumed to be undertaken in the open pit area, key sections of the 25 m wide haul road, and possibly minor sections of the onsite access road. In all cases, the use of good blast design practice will be implemented to minimise excessive vibration.

Blast designs were provided for the open pit operations while construction blast designs considered appropriate for the haul and access roads have been assumed. These are described below:

- Open pit blasts will comprise production blasts, trim blasts and pre-split wall control blasts. Of the three types, production blasts implement the largest explosive loads and, thus, were used in the assessment.
Each blast hole will be loaded with a maximum of 200 kg of ammonium nitrate fuel oil (ANFO) mixture or an ANFO/Emulsion blend depending on the wetness of the blast holes. It is understood that each blast will be sequenced to detonate a maximum of one blast hole per 8 ms delay period. Around 2 to 3 blasts per week are anticipated during the construction phase, with a maximum of one blast per day during the operations phase.

- Haul road blasts will take place along key sections of the 25 m wide road. Since the blasting regime will be defined by the construction contractor, an appropriate blast design has been assumed. Blast holes will be loaded with a maximum of 54 kg of ammonium nitrate fuel oil (ANFO) mixture or an ANFO/Emulsion blend and sequenced to detonate a maximum of one blast hole per 8 ms delay period. All haul road blasts will be blanketed, to prevent flyrock. This will also have the effect of damping the noise.

- Although the amount or location of blasting required for the onsite access road is not currently known, a worst case for each receptor has been assumed. As with the haul roads, an appropriate blast design has been proposed. Blast holes will be loaded with a maximum of 16 kg of ammonium nitrate fuel oil (ANFO) mixture or an ANFO/Emulsion blend and sequenced to detonate a maximum of one blast hole per 8 ms delay period. All access road blasts will be blanketed, to prevent flyrock and dampen the blast-induced noise.

Predictions of ground-borne vibration and air overpressure have been calculated based on the smallest separation distance between the assumed blasting locations and sensitive receptors.

**Ground-borne Vibrations**

The assessment of ground vibrations considers the radiation of vibrations following a blast, and determines the point at which the intensity of vibrations declines to below levels of perception. The USBM established a method for predicting ground vibration propagation from quarry blasts and this method has been used to predict ground-borne vibrations from the Project. As no site-specific measurement data are available, a constant from AS 2187.2 has been used in the calculations. The USBM equation and the constant are provided in Annex 5D.

**Air Overpressure**

Air overpressure is less likely to cause damage than ground-borne vibration, however, it will provide noticeable disturbance. To minimise such disturbance, a limit expressed as the 95th percentile of linear peak measurement of 115 dBL has been used. The International Society of Explosives Engineers (ISEE) “Blaster’s Handbook” (ISEE, 1995) provides a formula for estimation of airblast overpressure for a confined blasthole charge with average burial, which has been used in the effects analysis (Annex 5D).

### 5.5.6.2 Results

Each of the villages in the study area comprises many individual receptors. Of the multiple receptor properties, single residences have been selected within each village for the evaluation of noise and vibration effects. Each selected receptor has been chosen based on its proximity to project components, and therefore represents the worst-case effect within the village. The receptors selected are shown in Drawing 5-8.

Vibration predictions were made using the separation distance between the assumed blasting locations within the concession and the receptor within each village. The selected receptors used in the vibration assessment are shown in Drawing 5-9.

Three Cultural Heritage receptors were reviewed for the vibration assessment. They are:

- Crkvishte (AR-04);
- Monastery of St. George (CH-03); and
- Shrine at the Monastery of St. George (RE-04).

The vibration effects results are discussed as part of the Cultural Heritage assessment in Section 5.10.
5.5.6.2.1 Ilovica

Noise

The Macedonian noise limits applied to Ilovica are those for rural areas not exposed to intensive road traffic noise. The limit has been applied across the entire village due to absence of commercial or industrial noise sources and its remoteness from the M6.

The closest project component to Ilovica is the temporary and permanent off-site access road (i.e., same alignment) which passes within approximately 430 m east of residential receptors in Ilovica. The receptor for the Ilovica village receptor is shown in Drawing 5-8. The worst-case predicted noise levels for the receptor are provided in Table 5-44.

Table 5-44: Predicted noise levels – Ilovica

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dB</th>
<th>Daytime</th>
<th>Evening</th>
<th>Night-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Baseline</td>
<td></td>
<td>42.5</td>
<td>46.1</td>
<td>38.8</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td></td>
<td>40</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Predicted noise level due to permanent off-site access road construction</td>
<td></td>
<td>37.5</td>
<td>37.5</td>
<td>n/a</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td></td>
<td>-</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>Predicted noise level due to mine construction activities, plus traffic on temporary off-site access road</td>
<td></td>
<td>39.3</td>
<td>39.3</td>
<td>n/a</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td></td>
<td>-</td>
<td>4.3</td>
<td>-</td>
</tr>
<tr>
<td>Predicted noise level due to operations, plus traffic on permanent off-site access road</td>
<td></td>
<td>36.1</td>
<td>36.1</td>
<td>35.1</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td></td>
<td>-</td>
<td>1.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Notes:

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

During the construction of the off-site access road, predicted noise levels in Ilovica are below the baseline levels but exceed the Macedonian noise limit during the evening period.

Mine construction activities within the concession, including traffic movements on the off-site access road, are predicted to be below the baseline levels. The predicted levels exceed the noise limit during the evening period. The dominant noise sources contributing to the predicted noise limit exceedances are drills and shovels working in the pit and the movement of waste trucks on the haul roads between the pit and the tailings dam.

Operations phase activities are predicted to be below the baseline levels but exceed the noise limit during the evening and night-time periods. The dominant contributor to the predicted evening and night-time exceedances at Ilovica is waste truck movements on the haul roads.

Blast Vibration

The predicted vibration levels at Ilovica from blasts within the open pit area as well as the haul road and onsite access road blasts are provided in Table 5-45.

Table 5-45: Predicted vibration levels – Ilovica

<table>
<thead>
<tr>
<th>Item</th>
<th>Ground-borne vibration, mm/s PPV</th>
<th>Air overpressure, dBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project vibration criteria</td>
<td>1.0</td>
<td>115.0</td>
</tr>
</tbody>
</table>
For open pit production blasts, the predicted ground-borne vibration intensity at Ilovica exceeds the guideline level which might be perceptible, but is below the level at which constant vibration may give rise to complaints (according to the guidelines in Section 5.5.5.3). For haul road and onsite access road blasts, the predicted intensity is below the guideline for the level of perception.

The predicted air overpressure level meets the safe limit for the protection of communities from adverse effects for open pit production, haul road and onsite access road blasts.

5.5.6.2.2 Shtuka

Noise

The Macedonian noise limits applied to Shtuka are those for rural areas not exposed to intensive road traffic noise.

The closest project component to Shtuka is the temporary and permanent access road (i.e. same alignment), which passes within approximately 45 m east of residential receptors in Shtuka. Shtuka will also receive noise from the mine. The two selected receptors for Shtuka village are shown in Drawing 5-8. The receptor on the eastern side of the village was selected for the evaluation of noise arising from the construction of the off-site access road. The receptor to the north of the village was selected for the evaluation of noise due to construction and operations noise from the mine.

The predicted noise levels for Shtuka are provided in Table 5-46.

### Table 5-46: Predicted noise levels - Shtuka

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dB L_{Aeq 1 hour}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Measured Baseline</td>
<td>40.9</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td>40</td>
</tr>
<tr>
<td>Predicted noise level due to permanent off-site access road construction</td>
<td>69.8</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>28.9</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>29.8</td>
</tr>
<tr>
<td>Predicted noise level due to mine construction activities, plus traffic on temporary off-site access road</td>
<td>44.9</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>4.0</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>4.9</td>
</tr>
<tr>
<td>Predicted noise level due to mine operations, plus traffic on permanent off-site access road</td>
<td>45.2</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>4.3</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Notes:
n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

During the construction of the access road, predicted noise levels at Shtuka exceed both the baseline level and the noise limit during the daytime and evening periods.

Mine construction activities within the concession, including traffic movements on the access road, are predicted to exceed the baseline during the daytime period. The predicted levels exceed the noise limits during the daytime and evening periods. The dominant contributors to predicted noise levels at Shtuka during the construction phase are truck movements on the access road.

Operations phase activities are predicted to cause exceedances of the baseline during the daytime and night-time periods. The predicted levels exceed the noise limits throughout the daytime, evening and night-time periods. The dominant noise source during the operations phase is truck movements on the off-site access road.

Blast vibration

The predicted vibration levels at Shtuka from blasts within the open pit area as well as the haul road and on-site access road blasts are provided in Table 5-47.

Table 5-47: Predicted vibration levels – Shtuka

<table>
<thead>
<tr>
<th>Item</th>
<th>Ground-borne vibration, mm/s PPV</th>
<th>Air overpressure, dBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project vibration criteria</td>
<td>1.0</td>
<td>115.0</td>
</tr>
<tr>
<td>Predicted level at closest approach, production open pit blasts</td>
<td>0.3</td>
<td>105.2</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, haul road blasts</td>
<td>0.2</td>
<td>103.3</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, onsite access road blasts</td>
<td>0.3</td>
<td>103.5</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For open pit production blasts and onsite access road blasts, the predicted ground-borne vibration intensity at Shtuka meet the guideline level which might be perceptible, but are below the level at which constant vibration may give rise to complaints. For haul road blasts, the predicted intensity is below the guideline for the level of perception.

The predicted air overpressure level meets the safe limit for the protection of communities from adverse effects for open pit production, haul road and onsite access road blasts.

5.5.6.2.3 Turnovo

Noise

The Macedonian noise limits applied to Turnovo are those for rural areas not exposed to intensive road traffic noise. Even though the M6 passes through the south of the village, much of the northern part of the village is distant from the M6. This is a conservative approach as the noise limits are lower for rural areas than for mixed commercial and residential areas, which would be the alternative categorisation for Turnovo.

The closest project components to Turnovo are the temporary and permanent off-site access roads, which pass approximately 825 m and 2,445 m to the east of the village at its closest approach, respectively.

The majority of daily truck movements associated with the Project would be concentrate trucks, which will travel to and from Bulgaria, and will therefore not pass through Turnovo. Noise from the M6 transport route has therefore been scoped out at Turnovo.
A single receptor has been considered for the evaluation of noise from the off-site access road and construction and operation of the mine (Drawing 5-8). The worst-case predicted noise levels for the receptor in Turnovo are provided in Table 5-48.

### Table 5-48: Predicted noise levels - Turnovo

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dBAeq 1 hour</th>
<th>Daytime</th>
<th>Evening</th>
<th>Night-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Baseline</td>
<td></td>
<td>39.0</td>
<td>41.7</td>
<td>36.7</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td></td>
<td>40</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Predicted noise level due to permanent off-site access road</td>
<td></td>
<td>36.4</td>
<td>36.4</td>
<td>n/a</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>n/a</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td></td>
<td>-</td>
<td>1.4</td>
<td>-</td>
</tr>
<tr>
<td>Predicted noise level due to mine construction activities, plus</td>
<td></td>
<td>30.7</td>
<td>30.7</td>
<td>n/a</td>
</tr>
<tr>
<td>traffic on temporary off-site access road</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>n/a</td>
</tr>
<tr>
<td>Predicted noise level due to mine operations, plus</td>
<td></td>
<td>29.7</td>
<td>29.7</td>
<td>29.5</td>
</tr>
<tr>
<td>traffic on permanent off-site access road</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td></td>
<td>-</td>
<td>-</td>
<td>n/a</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td></td>
<td>-</td>
<td>-</td>
<td>n/a</td>
</tr>
</tbody>
</table>

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

During the construction of the permanent off-site access road, predicted noise levels at Turnovo are predicted to be lower than the baseline level but exceed the noise limit during the evening period.

Predicted noise levels due to construction phase activities within the concession, including traffic movements on the temporary off-site access road, are below the baseline and the noise limits during all periods.

Operations phase activities are below the baseline and noise limits in all periods.

### Blast vibration

The predicted vibration levels at Turnovo from within the open pit area as well as the haul road and onsite access road blasts are provided in Table 5-49.

### Table 5-49: Predicted vibration levels – Turnovo

<table>
<thead>
<tr>
<th>Item</th>
<th>Ground-borne vibration, mm/s PPV</th>
<th>Air overpressure, dBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project vibration criteria</td>
<td>1.0</td>
<td>115.0</td>
</tr>
<tr>
<td>Predicted level at closest approach, production open pit blasts</td>
<td>0.1</td>
<td>95.5</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, haul road blasts</td>
<td>0.03</td>
<td>92.2</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, onsite access road blasts</td>
<td>0.01</td>
<td>90.3</td>
</tr>
<tr>
<td>Exceedance of criterion</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For open pit production blasts, haul road blasts and onsite access road blasts, the predicted ground-borne vibration intensity at Turnovo are below the guideline for the level of perception. The predicted air overpressure
level meets the safe limit for the protection of communities from adverse effects for both high and medium blasts.

5.5.6.2.4 Sekirnik

Noise

Two noise limits have been applied to Sekirnik at three separate receptors. The selected receptor in a western area of the village far from the M6 and closest to the temporary off-site access road has been chosen to represent areas most affected by access road traffic during construction. The selected receptor in an eastern area of the village far from the M6 and closest to the permanent off-site access road has been chosen to assess noise from mine operations and permanent off-site access road traffic. The noise limit for rural areas has been applied at these two locations. A third receptor has been selected to represent the area of the village closest to the M6 at which the noise limit for “areas exposed to intensive road traffic” has been applied, as the dominant noise source here is road traffic on the M6. The three receptor locations are presented in Drawing 5-8.

The temporary and permanent off-site access roads lie 185 m to the west and 640 m to the east of the village at closest approach, respectively. The transport route along the M6 passes through the south of the village.

The worst-case predicted noise levels for receptors in Sekirnik are provided in Table 5-50.

Table 5-50: Predicted noise levels - Sekirnik

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dBA_{eq} 1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Measured Baseline (receptor for rural area)</td>
<td>37.9</td>
</tr>
<tr>
<td>Noise limit (for rural areas)</td>
<td>40</td>
</tr>
<tr>
<td>Predicted noise level due to permanent off-site access road construction</td>
<td>48.0</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>10.1</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>8.0</td>
</tr>
<tr>
<td>Predicted noise level due to mine construction activities, plus traffic on temporary off-site access road</td>
<td>36.9</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
</tr>
<tr>
<td>Predicted noise level due to mine operations, plus traffic on permanent off-site access road</td>
<td>34.5</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
</tr>
<tr>
<td>Predicted road traffic baseline (based on traffic counts) - receptor for traffic on M6</td>
<td>61.2</td>
</tr>
<tr>
<td>Noise limit (for areas exposed to intensive road traffic)</td>
<td>60</td>
</tr>
<tr>
<td>Operations phase predicted noise level due traffic on transport route</td>
<td>24.5</td>
</tr>
<tr>
<td>Exceedance of predicted baseline</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
</tr>
</tbody>
</table>

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

During the construction of the permanent off-site access road, predicted noise levels at Sekirnik exceed the baseline level and the noise limit during the daytime and the evening periods. The dominant contributors are the asphalt paver and road and vibratory rollers.
Predicted noise levels due to construction phase activities within the concession, including traffic movements on the temporary off-site access road, are below the baseline during all periods but exceed the noise limit during the evening period.

Predicted operations phase noise levels are below the noise limits during the daytime, evening and night-time periods. The predictions are below the baseline during the daytime and evening, and exceed the baseline during the night-time. The dominant contributor to the predicted night-time period exceedance is truck movements on the permanent off-site access road.

The predicted road traffic noise levels at the receptor for the M6 transport route are below the noise limits and the predicted baseline traffic noise levels during all periods.

**Blast Vibration**

The predicted vibration levels at Sekirnik from within the open pit area as well as the haul road and on-site access road blasts are provided in Table 5-51.

<table>
<thead>
<tr>
<th>Item</th>
<th>Ground-borne vibration, mm/s PPV</th>
<th>Air overpressure, dBL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project vibration criteria</td>
<td>1.0</td>
<td>115.0</td>
</tr>
<tr>
<td>Predicted level at closest approach, production open pit blasts</td>
<td>0.1</td>
<td>97.1</td>
</tr>
<tr>
<td><strong>Exceedance of criterion</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, haul road blasts</td>
<td>0.04</td>
<td>94.3</td>
</tr>
<tr>
<td><strong>Exceedance of criterion</strong></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predicted level at closest approach, onsite access road blasts</td>
<td>0.02</td>
<td>93.0</td>
</tr>
<tr>
<td><strong>Exceedance of criterion</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

For open pit production blasts, haul road blasts and onsite access road blasts, the predicted ground-borne vibration intensity at Sekirnik are below the guideline for the level of perception. The predicted air overpressure level meets the safe limit for the protection of communities from adverse effects for both high and medium blasts.

**5.5.6.2.5 Novo Selo**

Novo Selo is a larger settlement than the surrounding villages and is an administrative centre for the wider area featuring a market, restaurants and a higher level of commercial activity. The Macedonian noise limit for mixed commercial and residential areas (third level of noise protection) has therefore been applied at this receptor.

Novo Selo will be affected by noise from the transport route only. A single receptor has been considered for Novo Selo, the location of which is shown in Drawing 5-8. The predicted noise levels at Novo Selo are provided in Table 5-52.

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dBL_{Aeq 1 hour}</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daytime</strong></td>
<td><strong>Evening</strong></td>
</tr>
<tr>
<td>Predicted road traffic baseline (based on traffic counts)</td>
<td>51.2</td>
</tr>
<tr>
<td>Noise limit (for mixed commercial and residential areas)</td>
<td>60</td>
</tr>
<tr>
<td>Operations phase predicted noise level due traffic on transport route</td>
<td>40.2</td>
</tr>
</tbody>
</table>
Exceedance of baseline | - | - | -
Exceedance of noise limit | - | - | -

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

The predicted transport route noise levels at Novo Selo are below the predicted baseline traffic noise levels and the noise limits during all periods.

5.5.6.2.6 Samuilovo

The Macedonian noise limit adopted for Samuilovo is that for rural areas exposed to intensive road traffic noise. Samuilovo will be affected by noise from the transport route only. A single receptor has been considered for Samuilovo, the location of which is shown in Drawing 5-8. The predicted noise levels at Samuilovo are provided in Table 5-53.

Table 5-53: Predicted noise levels – Samuilovo

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dBL Aeq 1 hour</th>
<th>Daytime</th>
<th>Evening</th>
<th>Night-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted road traffic baseline (based on traffic counts)</td>
<td>52.4</td>
<td>52.4</td>
<td>47.5</td>
<td></td>
</tr>
<tr>
<td>Noise limit for areas exposed to intensive road traffic</td>
<td>60</td>
<td>55</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Operations phase predicted noise level due traffic on transport route</td>
<td>41.5</td>
<td>41.5</td>
<td>41.5</td>
<td></td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

The predicted transport route noise levels at Samuilovo are below the predicted baseline traffic noise levels and the noise limits during all periods.

5.5.6.2.7 Novo Konjarevo

The Macedonian noise limit adopted for Novo Konjarevo is that for rural areas exposed to intensive road traffic noise. The M6 passes through the centre of the village.

Novo Konjarevo will be affected by noise from the transport route only. A single receptor has been considered for Novo Konjarevo, the location of which is shown in Drawing 5-8. The predicted noise levels at Novo Konjarevo are provided in Table 5-54.

Table 5-54: Predicted noise levels – Novo Konjarevo

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dBL Aeq 1 hour</th>
<th>Daytime</th>
<th>Evening</th>
<th>Night-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted road traffic baseline (based on traffic counts)</td>
<td>61.2</td>
<td>61.2</td>
<td>56.3</td>
<td></td>
</tr>
<tr>
<td>Noise limit – areas exposed to intensive road traffic</td>
<td>60</td>
<td>55</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Operations phase predicted noise level due traffic on transport route</td>
<td>50.3</td>
<td>50.3</td>
<td>50.3</td>
<td></td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
<td>-</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

n/a: Noise levels are not predicted for this time period as Project activities are not proposed to occur within this time period and therefore no change to baseline noise levels is expected.

The predicted transport route noise levels at Novo Konjarevo are below the predicted baseline traffic noise levels and the noise limits during all periods, with the exception of marginally exceeding the noise limit during the night-time period.
### 5.5.7 Impact Classification

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

#### 5.5.7.1 Magnitude of the Effect

The parameters which will be used for the impact assessment for noise and vibration are presented in Table 5-55.

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Predicted noise level &lt; baseline</td>
<td>Local - Biophysical local study area</td>
<td>Short-term - Effect is reversible at end of construction</td>
</tr>
<tr>
<td>Low</td>
<td>Predicted level &gt;0 dB and &lt;3 dB above baseline and meets Macedonian noise limit</td>
<td>Regional - Biophysical regional study area</td>
<td>Medium-term - Effect is reversible at end of operations</td>
</tr>
<tr>
<td>Moderate</td>
<td>Predicted level &gt;0 dB and &lt;3 dB above baseline and exceeds Macedonian noise limit</td>
<td>Beyond regional – trans-boundary</td>
<td>Long-term - Effect is reversible within a defined length of time or beyond closure</td>
</tr>
<tr>
<td>High</td>
<td>Predicted level ≥3 dB above baseline</td>
<td></td>
<td>Permanent - Effect not reversible</td>
</tr>
</tbody>
</table>

#### Ground-borne vibration

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Predicted level &lt;0.3 mm/s PPV</td>
<td>Local - Biophysical local study area</td>
<td>Short-term - Effect is reversible at end of construction</td>
</tr>
<tr>
<td>Low</td>
<td>Predicted level ≥0.3, &lt;1.0 mm/s PPV</td>
<td>Regional - Biophysical Regional study area</td>
<td>Medium-term - Effect is reversible at end of operations</td>
</tr>
<tr>
<td>Moderate</td>
<td>Predicted level ≥1.0mm/s PPV, &lt;10 mm/s PPV</td>
<td>Beyond regional – trans-boundary</td>
<td>Long-term - Effect is reversible within a defined length of time or beyond closure</td>
</tr>
<tr>
<td>High</td>
<td>Predicted level ≥10 mm/s PPV</td>
<td></td>
<td>Permanent - Effect not reversible</td>
</tr>
</tbody>
</table>

#### Air overpressure

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Predicted level &lt;115 dBL</td>
<td>Local - Biophysical local study area</td>
<td>Short-term - Effect is reversible at end of construction</td>
</tr>
<tr>
<td>Low</td>
<td>Predicted level ≥115 dBL, &lt;120 dBL</td>
<td>Regional - Biophysical Regional study area</td>
<td>Medium-term - Effect is reversible at end of operations</td>
</tr>
<tr>
<td>Moderate</td>
<td>Predicted level ≥120 dBL, &lt;150 dBL</td>
<td>Beyond regional – trans-boundary</td>
<td>Long-term - Effect is reversible within a defined length of time or beyond closure</td>
</tr>
<tr>
<td>High</td>
<td>Predicted level ≥150 dBL</td>
<td></td>
<td>Permanent - Effect not reversible</td>
</tr>
</tbody>
</table>
Of the terms identified in Table 5-55, there are several which will either not apply to noise and vibration, or will remain constant. These are discussed further below:

- All noise and vibration effects will be local in their geographic extent. The propagation methods of noise and vibration are such that effects beyond the local study areas are not expected to occur. Regional and beyond regional effects are therefore not anticipated.
- Noise and vibration effects will cease as soon as project activities cease, therefore no long-term or permanent effects will occur.
- All noise effects are considered to be frequent, as activities are assumed to be continuous throughout the appropriate evaluation period, whether that period is throughout the day or through a 1-hour period during night-time (worst case).
- All vibration effects are considered to be infrequent, as the only vibration source is blasting, which is not continuous. Blasting is anticipated to occur only once per day, for a maximum of five days per week.

With regard to the receptor sensitivities provided in Section 1, this assessment considers human noise and vibration receptors, which are considered to be of high sensitivity.

5.5.7.2 Determination of Impact

Using the decision matrix presented in Annex 1 and definitions in Section 5.5.7.1, the magnitude of the effect at each receptor has been determined using the results of the effects analysis. Table 5-56 presents the classification of each impact. Annex 5D presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact. Only impacts which are classified as moderate or high (or those which require mitigation) are included in Table 5-56.

Table 5-56: Assessment of impacts for noise and vibration

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shtuka</td>
<td>Off-site access road construction</td>
<td>Off-site access road construction, daytime and evening periods</td>
<td>Moderate</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Mine construction</td>
<td>Truck movements on off-site access road, daytime period</td>
<td>Moderate</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Operations</td>
<td>Truck movements on off-site access road during daytime and night-time period</td>
<td>Major</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Off-site access road construction</td>
<td>Permanent off-site access road construction, daytime and evening periods</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Operations</td>
<td>Truck movements on permanent off-site access road during night-time period</td>
<td>Major</td>
</tr>
</tbody>
</table>

For the construction phase, moderate impacts have been identified at Shtuka and Sekirnik due to construction of the permanent off-site access road. The limited duration of road construction activity in close proximity to villages along the access road will limit the overall impact classification to moderate, despite the predicted high magnitude effects (exceedances of baseline levels and noise limits).

Further impacts during the construction phase have been identified as follows:
- Noise from the truck movements on the access road have been identified as dominant contributors to noise levels in excess of the baseline at Shtuka. The short duration of mine construction activities at the plant site will limit the associated impact classification to moderate; and
- Impacts due to noise sources operating within the concession have all been assessed as minor or negligible at all other villages in the study area.

During the operations phase, impacts have been identified as follows:
Truck movements on the permanent access road are predicted to have major noise impacts during the night-time period at Sekirnik;

At Shtuka, truck movements on the access road are predicted to have major impacts during the daytime and night-time periods;

The high predicted levels at Sekirnik and Shtuka are a consequence of the close proximity of the receptors to the access road, and the flow of heavy trucks during the night time period. The predicted impacts will occur for the lifetime of the Project; and

Predicted impacts as a consequence of mining activities or associated processing are minor or negligible.

Noise from project traffic on the transport route has been assessed as negligible based on noise levels due to the Project being less than baseline and limit values at all locations with the exception of Novo Konjarevo. At this location, the predicted Project noise level exceeds the limit value by 0.3 dB during the night-time and will result in an increase of less than 1 dB in the baseline level.

During both the construction and operations phases, ground-borne and air overpressure blast vibration impacts have been assessed and identified to be negligible at all receptors. The determination of the blast vibration impacts on the Cultural Heritage receptors are discussed in Section 5.10.

5.6 Air Quality

This section presents an assessment of the potential effects of the proposed Ilovica Shtuka Project (the Project) upon local ambient air quality. Potential impacts on human health, habitats and the potential loss of amenity due to gaseous emissions, dust deposition or odour have been considered. This impact assessment is based on the findings of a quantitative air dispersion model (ADM) (Section 1, Annex 5E) assessment, a qualitative emissions assessment of fugitive dust and odour emissions sources and a traffic combustion emissions (Section 2, Annex 5E).

5.6.1 Sources of Effects

The following activities have been identified as potential sources of change to the baseline state for air quality:

- Earthworks (causing ground disturbances) (construction);
- Building and infrastructure construction;
- Bulldozing and grading (construction);
- Drilling and blasting (construction and operations);
- Wind erosion of stockpiles (construction and operations);
- Ore processing (e.g. crushing) (operations);
- Carbon regeneration (operations);
- Smelting;
- Use of vehicles (heavy goods vehicles and total vehicles) along the access road and the highway towards the Bulgarian border (operations);
- Transfer of ore and waste rock (e.g. loading/unloading, conveyor belt transfers) (operations);
- Transfer of concentrate (loading) (operations);
- Use of generators for energy generation (construction and operations);
- Sewage treatment plant (construction and operations);
Traffic movements on unpaved roads (construction, operations and closure);

Use of vehicles and mobile equipment (construction, operations and closure); and

Reclamation activities (e.g. dismantling infrastructure, re-landscaping, profiling) (closure).

Section 5.6.3 also presents an evaluation of which elements of the Project will affect which receptors, allowing some potential effects to be scoped out due to a lack of pathway between source and receptor.

5.6.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Annex 1C) which provided the DFS engineers with environmental measures which should be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following presents the environmental measures relevant to air quality which have been incorporated into project design:

- Specification of recent model vehicles, with improved emissions profile, and best available technology for emissions reduction/capture for generators, processing plant, boilers/furnaces, and other facilities;
- Regular schedule of vehicle and generator maintenance to ensure optimal emissions performance;
- Ore and waste rock silt content is 10%;
- Water spraying during drilling;
- Water spray and dust suppressant on haul roads;
- Typical vehicle/plant speed of 25 km/hr;
- Water spray at major material transfer points such as loading or unloading of stockpiles;
- Scrubbing at primary crusher and processing plant;
- Water spray during all grading activities;
- All conveyors operate covered; and
- EURO 5 standard applied to diesel.

5.6.3 Study Area and Receptors

The primary baseline data gathering for air quality was completed within the baseline local study area presented in Section 1.

Following completion of the baseline, the baseline study areas for all disciplines have been collated to produce biophysical impact assessment area, which is also presented in Section 1 and will be referred to throughout this report as the local and regional study areas.

As described in Section 1, receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust. The following receptors are used within the air quality effects analysis:

- Ilovica;
- Shtuka;
- Turnovo;
- Sekirnik;
- Sushica;
- Novo Selo;
ILOVICA-SHTUKA ESIA

- Samuilovo;
- Novo Konjarevo; and
- Sensitive ecological habitats located within the local biophysical study area.

The villages of Ilovica and Shtuka are located within 1 km southwest of the mining concession and within 650 m and 140 m of the permanent access road, respectively.

The villages of Turnovo and Sekirnik are located to the south-west of the mining concession at a distance of approximately 4 km and 3 km, respectively. These villages are located at a distance of approximately 2 km and 650 m from the permanent access road, respectively.

The village of Sushica is located approximately 2 km to the south of the mining concession.

The villages of Novo Selo, Samuilovo and Novo Konjarevo are located in close proximity to the highway from the access road to the Bulgarian border.

Sensitive ecological habitats have been taken into account within the entire local biophysical study area. For the qualitative assessment exact receptor locations are provided in Annex 5E. For the quantitative assessment, effects were evaluated using the closest residential property within a village (the indicator) in relation to the emission source.

Human receptors are defined as “locations where public will be exposed to outdoor air over a period representative to the air quality standard averaging period” for example; residences, hotels, schools and hospitals when considering long term (annual average) standards or recreational areas when considering short term (hourly) standards. Receptors also include where a change in dust deposition levels and odour could cause disturbance or loss of amenity (the adverse effect on the quality of life of individuals).

Components of the Project will interact with different receptors, according to the length of the pathway between the source and receptor. The Project interactions between components and receptors are summarised in Table 5-57. All effects with no potential interaction have been scoped out of the study.

Table 5-57: Project sources affecting receptors

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Ilovica mine area</th>
<th>Off Site access road</th>
<th>Highway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>•</td>
<td>•</td>
<td>-</td>
</tr>
<tr>
<td>Shtuka</td>
<td>•</td>
<td>•</td>
<td>-</td>
</tr>
<tr>
<td>Turnovo</td>
<td>•</td>
<td>•</td>
<td>-</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>•</td>
<td>•</td>
<td>-</td>
</tr>
<tr>
<td>Sushica</td>
<td>•</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Novo Selo</td>
<td>-</td>
<td>-</td>
<td>•</td>
</tr>
<tr>
<td>Samuilovo</td>
<td>-</td>
<td>-</td>
<td>•</td>
</tr>
<tr>
<td>Novo Konjarevo</td>
<td>-</td>
<td>-</td>
<td>•</td>
</tr>
</tbody>
</table>

* potential interaction; - = no potential interaction (scoped out).

5.6.4 Considerations from Stakeholder Engagement

The following issues were identified during the stakeholder engagement process (described in Section 1) and are relevant to the impact assessment for air quality:

- The impact of blasting, truck movements, processing etc. on the air quality when the future mine starts operating (Open House 16 September 2015);
- In particular, the fear that wind will blow dust down into the villages and fear that a risk of cancer might increase as a consequence if the standards for environmental protection were not to be met (Open House 16 September 2015);
Concerns about the proximity of receptors in Ilovica and Shtuka to the future mine and requests whether the constitution of Macedonia could be amended to ensure that mining operations will be stopped if problems occur in the future (Open House 16 September 2015);

Concerns about the impact of air quality on local agriculture, in particular potential impacts on sales and on perceived product quality when the mine starts operating (Open House 16 September 2015);

Concerns about the exhaust gas management from trucks arriving at the Bulgarian/Macedonian border (Open House 16 September 2015);

Concerns that, in the past, mitigation was not implemented and monitoring results did not trigger additional mitigations (Stakeholder Engagement, Round 1);

Details on the baseline air quality monitoring including on monitoring schedule, instrument choice and choice of sub-contractor and laboratory (Open House 16 September 2015);

Future air quality monitoring when the mine starts operating (Open House 16 September 2015, Stakeholder Engagement, Round 1);

Concerns about increased dust levels caused by mining operations and associated carcinogenic impacts (Stakeholder Engagement, Round 3);

Concerns about general air pollution in specific locations i.e. Hamzali, a village in Bosilovo (Stakeholder Engagement, Round 3);

Clarification on air quality monitoring management (Stakeholder Engagement, Round 3); and

Clarification on what an impact on air quality constitutes (Stakeholder Engagement, Round 3).

5.6.5 Key Guidelines and Standards

The EDC adopted for the Project are based on air quality standards (AQS) and guidelines as detailed in the EDC (Annex 1). EDC for the assessment of human health and habitats are taken from Macedonian and EU limit values. The EDC for loss of amenity caused by dust deposition are taken from TA Luft as detailed below:

- Regulation on Limit Values for the Levels and Types of Pollutants in the Ambient Air and on Alarm Thresholds, Time Limits for Achieving the Limit Values, Limit Values Tolerance Margins, Target Values and Long-Term Goals (Official Gazette of the Republic of Macedonia no. 50/05);
- EU 2008 Directive 2998/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe; and

Where the EDC is defined by a number of exceedances of a specified limit, the evaluation of an impact is based on the appropriate assessment percentile (%ile). For example, the 24 hour average (daily average) $\text{PM}_{10}$ EDC states that the standard should be exceeded no more than 35 days per year, which equates to the 90.4 %ile (35/365).

Table 5-58 to Table 5-60 summarise the EDC adopted for human health, loss of amenity due to dust deposition and habitats. The EDC inform the definition of magnitude of an impact (Annex 1). EDC are applied to the evaluation of the impact according to the following:

- For human health: where human exposure to pollutants occurs over a specified period;
- For loss of amenity: where soiling by dust deposition may affect people; and
- For habitats: anywhere in the local biophysical study area.
### Table 5-58: EDC adopted for human health

<table>
<thead>
<tr>
<th>Emission</th>
<th>Time weighted average</th>
<th>Concentration (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1 hour</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>40</td>
</tr>
<tr>
<td>SO₂</td>
<td>1 hour</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>125</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>24 hours</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>40</td>
</tr>
<tr>
<td>PM₂₅</td>
<td>annual</td>
<td>20</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Abbreviations: %ile = percentile; µg/m³ = micrograms per cubic metre; CO = carbon monoxide; NO₂ = nitrogen dioxide; PM₂₅ = particulate matter less than or equal to 2.5 microns; PM₁₀ = particulate matter less than or equal to 10 microns; SO₂ = sulphur dioxide.

### Table 5-59: EDC adopted for dust deposition

<table>
<thead>
<tr>
<th>Emission</th>
<th>Time weighted average</th>
<th>Deposition (mg/m²/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP</td>
<td>annual mean</td>
<td>350</td>
</tr>
</tbody>
</table>

Abbreviations: mg/m²/day = milligrams per square metre per day; TSP = total suspended particles.

### Table 5-60: EDC adopted for habitats

<table>
<thead>
<tr>
<th>Emission</th>
<th>Time weighted average</th>
<th>Concentration (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂</td>
<td>annual</td>
<td>20</td>
</tr>
<tr>
<td>NOₓ</td>
<td>annual</td>
<td>30</td>
</tr>
</tbody>
</table>

Abbreviations: µg/m³ = micrograms per cubic metre; NOₓ = oxides of nitrogen; SO₂ = sulphur dioxide.


### 5.6.6 Effects Analysis

#### 5.6.6.1 Methods

The effects analysis was undertaken using both quantitative and qualitative assessments. The quantitative air quality assessment is based on air dispersion modelling (ADM) and is described in Section 5.6.6.2 below and in more detail in Section 1 of Annex 5E. The qualitative air quality assessment is described in Section 5.6.6.3 and in more detail in Section 2 of Annex 5E. Table 5-61 identifies the method used for each effects analysis of each assessed activity.

### Table 5-61: Assessment methods for effects analysis

<table>
<thead>
<tr>
<th>Phase</th>
<th>Source area</th>
<th>Activity/Process</th>
<th>Emission</th>
<th>Assessment methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Iloveca mine area</td>
<td>Earthworks/Soil Stockpiling</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drilling</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blasting</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traffic on unpaved haul roads</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Phase</td>
<td>Source area</td>
<td>Activity/Process</td>
<td>Emission</td>
<td>Assessment methodology</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------</td>
<td>---------------------------------------</td>
<td>---------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Off-site access road</td>
<td>Building and infrastructure construction.</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Road construction</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combustion emissions from traffic</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td>Highway</td>
<td>Combustion emissions from traffic</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Drilling</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blasting</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traffic on unpaved haul roads</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Material transfer (loading/unloading, conveyor belt transfers)</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wind erosion</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bulldozing</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grading</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ore processing</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbon regeneration</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smelting</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combustion emissions from vehicles and mobile equipment.</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Quantitative ADM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emergency generators$^1$</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sewage treatment$^2$</td>
<td>Odour</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td>Off-site access road</td>
<td>Combustion emissions from traffic$^4$</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td>Highway</td>
<td>Combustion emissions from traffic$^4$</td>
<td>TSP, PM$<em>{10}$, PM$</em>{2.5}$, NO$_2$, SO$_2$, CO</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td>Closure</td>
<td>Ilovica mine area</td>
<td>Ground disturbance</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td>Traffic on unpaved haul roads</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reclamation activities (e.g. dismantling infrastructure, re-landscaping, profiling).</td>
<td>Fugitive dust</td>
<td>Qualitative</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CO = carbon monoxide; NO$_2$ = nitrogen dioxide; PM$_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM$_{10}$ = particulate matter less than or equal to 10 microns; SO$_2$ = sulphur dioxide; TSP = total suspended particles.

Notes:
$^1$ Considered minor as intermittent use only.
$^2$ Considered minor as actively managed in accordance with sewage management plan.
$^4$ Considered minor based on initial traffic count assessment.
5.6.6.1.1 **Quantitative assessment**

Emissions concentration and deposition predictions are based on detailed ADM using AERMOD (ADM software, version 7.11.0.46). Modelled emissions from the Project include gases NO₂, SO₂, CO as well as PM₁₀, PM₂.₅ and total suspended particles (TSP).

The pathway by which emissions to air may impact upon sensitive receptor locations is through atmospheric dispersal. Emissions to air from the sources will be transported by the wind to potential downwind receptors. The distance and dilution of emissions dispersed, and potentially deposited, will be dependent on the prevailing meteorological conditions as further detailed in Annex 5E (Section 1).

Meteorological data was collected at the Ilovica EOX meteorological station for the period of June 2013 to June 2015. Data collection and quality assurance was undertaken by Euromax Resources DOO Skopje and an analysis of the data is provided in the climate baseline (Annex 3, Section 4). The data provided the necessary parameters used in ADM to calculate pollutant dispersal, however there were periods of low data capture. To get around this, and to minimise meteorological data processing an alternative dataset was obtained and utilised in the ADM. The closest meteorological station with appropriate data cover was identified to be Sandanski meteorological station in Bulgaria (41.55N, 23.27E), approximately 35 km to the east of the mining concession. The station records 3-hourly data which has been interpolated to hourly data for modelling purposes. The assessment is based on one year of meteorological data (1 June 2013 - 31 May 2014). The Sandanski station data was compared with the Sandanski windroses for 2011-2015. During this period the windroses show prevailing winds in the northwest to north directions with secondary winds from the southeast to south. The Sandanski station data used in this assessment has these same wind directions and as such is considered to be a typical meteorological year.

Data from the Ilovica EOX meteorological station indicates a different wind regime from Sandanski. Figure 5-15 compares the windrose from both stations. While both stations display a bimodal wind distribution, the prevailing wind direction appears to be shifted by approximately 180°. This shift may reflect a localised and site-specific channelling effect at the on-site meteorological station. The meteorological data from Sandanski represents a more conservative assessment scenario as the prevailing wind direction is from the north/north-west blowing towards the majority of sensitive human receptors located in the valley to the south and east of the mining concession. Using the meteorological data from the Ilovica EOX station, the prevailing south-easterly wind would disperse pollutants away from the majority of village locations and into the uninhabited mountainous area to the north of the mining concession.

![Windroses at Ilovica EOX and Sandanski meteorological stations (1 June 2013 to 31 May 2014)](image)

Ore and waste rock production rates are scheduled to peak in year 4 of operations (2022) with an annual ore production rate of 11 million tonnes per annum (Mt/yr) and an annual waste rock/low-grade ore production rate...
of 21.5 Mt/yr. The year of maximum production would cause the year of maximum emissions from the mine and associated activities. Therefore year 4 of operations was chosen for modelling of effects. Moreover, in order to take a conservative approach, the model duplicates the simulation of year 4 for each year throughout the operational life of the mine. This is conservative because emissions for all other years would have lesser effects due to lesser production rates and associated activities.

Project mining activities potentially causing major air emissions were identified, quantified, and combined into a single area sources for simulation in the ADM. The Ilovica mine area source comprises the extent of the concession area and includes the open pit mine, the processing plant, the tailings facility, haul roads and the coarse ore stockpile.

The ADM predicts the potential effect of emissions on air quality across the model domain (represented by a grid of points, which extends beyond the potentially affected area) and at sensitive human receptors (as defined in Section 5.6.3).

The ADM predicts the process contribution (PC) concentration from the source. The resulting ambient air PC concentration across the model domain is added to the baseline concentration, to calculate the predicted environmental concentration (PEC). At sensitive human receptors, background concentrations for NO₂, SO₂ and deposited dust were based on the results for the closest air quality baseline monitoring location. For particulate matter (PM₁₀ and PM₂.₅), estimated background concentrations were based on the results of dust monitoring at MKD3. CO was not monitored as part of the baseline study. For the habitats assessment, background concentrations for SO₂ and NOₓ were based on the monitoring results obtained at MKD2.

The PEC is then compared to the adopted Environmental Design Criteria (EDC) for the Project and an evaluation for the magnitude of the effect can be made using the criteria defined in Section 5.6.7.1. Where the EDC is defined by a number of exceedances of a specified limit, the ADM calculates the appropriate assessment percentile (%ile) of the exceedances.

For the assessment of habitats, the maximum ambient air PC concentrations for NOₓ and SO₂ predicted to occur anywhere in the modelled domain is added to the baseline concentration to calculate the PEC. The PEC is then compared to the adopted EDC for the Project. Effects on habitats caused by changes to the local air quality are further assessed in the biodiversity impact assessment (Section 5.8).

For the assessment of amenity loss through dust, the model is used to predict the maximum deposition to ground (based on TSP emissions) at the closest sensitive human receptors. The deposited dust quantity is added to the baseline deposited dust levels and then compared to the adopted EDC at each receptor. Effects on local heritage sites caused by changes to dust deposition are further assessed in the cultural heritage impact assessment (Section 5.10).

5.6.6.1.2 Qualitative assessment

The qualitative assessment addresses minor fugitive and combustion emission sources and activities. This includes short-term activities during construction and closure, as well as minor sources scoped out of the quantitative ADM assessment. A source-pathway-receptor assessment approach has been used to identify possible effects. This assessment method involves the following stages:

- Source characterisation: to identify the potential emission sources associated with the Project;
- Pathway: to show the manner in which potential emissions from the Project are transported to the receptor;
- Receptor evaluation: to review the receptors which could be affected by the potential emissions from the Project; and
- Impact assessment: to evaluate the risk of adverse effects from Project emissions and define any impact on the identified receptors.
Traffic assessment

The effect of road traffic emissions associated with the construction and operation phases of the proposed development are assessed in accordance with United Kingdom Design Manual for Roads and Bridges (DMRB) guidance on assessing air quality impacts (DMRB, 2007).

The assessment method allows for a screening assessment of road traffic emissions based on the percentage change in vehicle movements on any road to be considered. The DMRB assessment method provides screening and scoping criteria to assess the likely impact of changes to traffic flows on local air quality. The assessment identifies the following potential changes which are likely to have a significant impact on air quality, which could include:

- Road alignment changes by 5 m or more;
- Daily traffic flows changes of 1,000 (Annual Average Daily Traffic flow [AADT]) or more;
- Heavy Duty Vehicle (HDV) flow changes of 200 AADT or more;
- Daily average speed changes of 10 km/hr or more; and
- Peak hour speed changes of 20 km/hr or more.

Fugitive dust and odour assessment

Fugitive dust and odour emissions from the Ilovica mine area and the construction of the permanent off-site access road are assessed following guidelines provided by the Institute for Air Quality Management (IAQM) for the assessment of odour and dust from demolition and construction (IAQM 2014a, 2014b). The assessment establishes the source emission potential of each fugitive dust or odour emitting activity as well as the pathway effectiveness from sources to receptors in determining the magnitude of potential impacts.

5.6.6.2 Results

Key results relevant to the impact assessment are detailed for the assessed sensitive receptors and habitats below. Drawings 5-11 to 15 show contour plots for all pollutants where the predicted PC is more than 10% of the EDC for human health and loss of amenity in the local biophysical study area. Drawings 5-16 and 5-17 show the contour plots of the PEC plotted for pollutants (annual NO\textsubscript{2} and SO\textsubscript{2}) assessed for their impacts on habitats.

5.6.6.2.1 Ilovica

Based on the quantitative assessment, the PECs do not exceed the EDC for the protection of human health at Ilovica. The predicted PC exceeds 25% of the EDC for short-term (1 hour) NO\textsubscript{2}. However, for long-term (annual) NO\textsubscript{2} as well as all other substances and averaging periods, PCs are less than 25% of the EDC (Table 5-62).

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m\textsuperscript{3})</th>
<th>PEC (µg/m\textsuperscript{3})</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO\textsubscript{2}</td>
<td>1 hour</td>
<td>74.5</td>
<td>88.59</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>3.20</td>
<td>10.25</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SO\textsubscript{2}</td>
<td>1 hour</td>
<td>4.01</td>
<td>7.01</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>0.65</td>
<td>2.42</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>24 hours</td>
<td>9.81</td>
<td>23.81</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>3.12</td>
<td>14.98</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM\textsubscript{2.5}</td>
<td>annual</td>
<td>0.54</td>
<td>5.29</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>70.88</td>
<td>2070.88</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: % = percent; µg/m\textsuperscript{3} = microgram per cubic metre; CO = carbon monoxide; EDC = environmental design criteria; NO\textsubscript{2} = nitrogen dioxide; PC = process contribution; PEC = predicted environmental concentration; PM\textsubscript{10} = particulate matter less than or equal to 2.5 microns; PM\textsubscript{2.5} = particulate matter less than or equal to 10 microns; SO\textsubscript{2} = sulphur dioxide.
Based on the quantitative assessment, the PECs do not exceed the EDC for the avoidance of loss of amenity caused by deposited dust at Ilovica. The predicted PC does not exceed 25% of the EDC (Table 5-63).

**Table 5-63: Assessment results for loss of amenity from deposited dust in Ilovica**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (mg/m²/day)</th>
<th>PEC (mg/m²/day)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposited dust</td>
<td>annual</td>
<td>36.58</td>
<td>64.93</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: % = percent; EDC = environmental design criteria; mg/m²/day = milligram per square meter per day; PC = process contribution; PEC = predicted environmental concentration.

The qualitative assessment identified no significant combustion emission sources likely to affect Ilovica. Fugitive dust and odour emissions from the Ilovica mine area were identified as having a large source emission potential however the associated pathway was identified as ineffective. Fugitive dust emissions from the permanent off-site access road construction were identified as having a medium source emission potential however the associated pathway was identified as ineffective.

5.6.6.2.2 Shtuka

Based on the quantitative assessment, the PECs do not exceed the EDC for the protection of human health at Shtuka. The predicted PC exceeds 25% of the EDC for short-term (1 hour) NO₂. However, for long-term (annual) NO₂ as well as all other substances and averaging periods, PCs are less than 25% of the EDC (Table 5-64).

**Table 5-64: Assessment results for human health in Shtuka**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1 hour</td>
<td>76.42</td>
<td>86.32</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>3.57</td>
<td>8.51</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SO₂</td>
<td>1 hour</td>
<td>4.23</td>
<td>7.47</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>0.72</td>
<td>2.63</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>24 hours</td>
<td>10.69</td>
<td>24.69</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>3.48</td>
<td>15.34</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₂·₅</td>
<td>annual</td>
<td>0.61</td>
<td>5.36</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>73.89</td>
<td>2073.89</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: % = percent; µg/m³ = microgram per cubic metre; CO = carbon monoxide; EDC = environmental design criteria; NO₂ = nitrogen dioxide; PC = process contribution; PEC = predicted environmental concentration; PM₁₀ = particulate matter less than or equal to 2.5 microns; PM₂·₅ = particulate matter less than or equal to 10 microns; SO₂ = sulphur dioxide.

Based on the quantitative assessment, the PECs do not exceed the EDC for the avoidance of loss of amenity caused by deposited dust at Shtuka. The predicted PC does not exceed 25% of the EDC (Table 5-65).

**Table 5-65: Assessment results for loss of amenity from deposited dust in Shtuka**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (mg/m²/day)</th>
<th>PEC (mg/m²/day)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposited dust</td>
<td>annual</td>
<td>48.76</td>
<td>103.75</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: % = percent; EDC = environmental design criteria; mg/m²/day = milligram per square meter per day; PC = process contribution; PEC = predicted environmental concentration.

The qualitative assessment identified no significant combustion emission sources likely to affect Shtuka. Fugitive dust and odour emissions from the Ilovica mine area were identified as having a large source emission potential however the associated pathway was identified as ineffective. Fugitive dust emissions from the permanent off-site access road construction were identified as having a medium source emission potential, the associated pathway was identified as moderately effective due to the proximity of both permanent and
temporary off site access road, to Shtuka village. Nevertheless the resultant effects do not affect the amenity in the village.

**5.6.6.2.3 Turnovo**

Based on the quantitative assessment, the PECs do not exceed the EDC and the predicted PCs do not exceed 25% of the EDC for the protection of human health at Turnovo (Table 5-66).

### Table 5-66: Assessment results for human health in Turnovo

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1 hour</td>
<td>44.00</td>
<td>57.56</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>1.47</td>
<td>8.25</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SO₂</td>
<td>1 hour</td>
<td>1.78</td>
<td>4.41</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>0.45</td>
<td>2.00</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>24 hours</td>
<td>4.26</td>
<td>18.25</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>1.43</td>
<td>13.29</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>annual</td>
<td>0.25</td>
<td>5.00</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>58.44</td>
<td>2058.44</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Abbreviations:** % = percent; µg/m³ = microgram per cubic metre; CO = carbon monoxide; EDC = environmental design criteria; NO₂ = nitrogen dioxide; PC = process contribution; PEC = predicted environmental concentration; PM₂.₅ = particulate matter less than or equal to 2.5 microns; PM₁₀ = particulate matter less than or equal to 10 microns; SO₂ = sulphur dioxide.

Based on the quantitative assessment, the PECs do not exceed the EDC for the avoidance of loss of amenity caused by deposited dust at Turnovo. The predicted PC does not exceed 25% of the EDC (Table 5-67).

### Table 5-67: Assessment results for loss of amenity from deposited dust in Turnovo

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (mg/m²/day)</th>
<th>PEC (mg/m²/day)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposited dust</td>
<td>annual</td>
<td>8.77</td>
<td>96.61</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Abbreviations:** % = percent; EDC = environmental design criteria; mg/m²/day = milligram per square meter per day; PC = process contribution; PEC = predicted environmental concentration.

The qualitative assessment identified no significant combustion emission sources or fugitive dust and odour sources likely to affect Turnovo.

**5.6.6.2.4 Sekirnik**

Based on the quantitative assessment, the PECs do not exceed the EDC and the predicted PCs do not exceed 25% of the EDC for the protection of human health at Sekirnik (Table 5-68).

### Table 5-68: Assessment results for human health in Sekirnik

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1 hour</td>
<td>53.28</td>
<td>60.50</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>1.94</td>
<td>5.55</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SO₂</td>
<td>1 hour</td>
<td>1.97</td>
<td>5.22</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>0.51</td>
<td>2.42</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>24 hours</td>
<td>5.51</td>
<td>19.51</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>1.89</td>
<td>13.75</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>annual</td>
<td>0.33</td>
<td>5.08</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>67.53</td>
<td>2067.53</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Based on the quantitative assessment, the PECs do not exceed the EDC for the avoidance of loss of amenity caused by deposited dust at Sekirnik. The predicted PC does not exceed 25% of the EDC (Table 5-69).

**Table 5-69: Assessment results for loss of amenity from deposited dust in Sekirnik**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (mg/m²/day)</th>
<th>PEC (mg/m²/day)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
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<tbody>
<tr>
<td>Deposited dust</td>
<td>annual</td>
<td>13.06</td>
<td>39.65</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Based on the qualitative assessment, no significant combustion emission sources or fugitive dust and odour sources likely to affect Sekirnik.

5.6.6.2.5 Sushica

Based on the quantitative assessment, the PECs do not exceed the EDC for the protection of human health at Sushica. The predicted PC exceeds 25% of the EDC for short-term (1 hour) NO₂. However, for long-term (annual) NO₂ as well as all other substances and averaging periods, PCs are less than 25% of the EDC (Table 5-70).

**Table 5-70: Assessment results for human health in Sushica**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1 hour</td>
<td>76.02</td>
<td>95.95</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>annual</td>
<td>7.89</td>
<td>17.85</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SO₂</td>
<td>1 hour</td>
<td>4.26</td>
<td>6.91</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>0.94</td>
<td>2.50</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>24 hours</td>
<td>16.71</td>
<td>30.71</td>
<td>No</td>
<td>Yes</td>
</tr>
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<td></td>
<td>annual</td>
<td>7.70</td>
<td>19.56</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>annual</td>
<td>1.35</td>
<td>6.10</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>8 hours</td>
<td>77.65</td>
<td>2077.65</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Based on the quantitative assessment, the PECs do not exceed the EDC for the avoidance of loss of amenity caused by deposited dust at Sushica. The predicted PC does not exceed 25% of the EDC (Table 5-71).

**Table 5-71: Assessment results for loss of amenity from deposited dust in Sushica**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (mg/m²/day)</th>
<th>PEC (mg/m²/day)</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposited dust</td>
<td>annual</td>
<td>36.56</td>
<td>101.22</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The qualitative assessment identified no significant combustion emission sources or fugitive dust and odour sources likely to affect Sushica.
5.6.6.2.6 Habitats located within the local biophysical study area

Based on the quantitative assessment, (Table 5-72) the predicted PC does exceed 25% of the EDC for NO\(_x\) but not for SO\(_2\). An exceedance of the EDC for the protection of habitats is expected for annual NO\(_x\) at 50 locations on the modelled grid. No exceedances of annual SO\(_2\) are anticipated anywhere in the modelled domain. EDC for the protection of human health are higher than for habitats and no exceedances of the EDC for human health are predicted.

Drawings 11-6 and 11-7 show the contour plots of the PEC plotted for pollutants (annual NO\(_x\) and SO\(_2\)) assessed for their impacts on habitats.

Grassland species-richness and biodiversity value is generally found within the study area at heights above 800 asl (Annex 3, Section 10). The exceedances in annual NO\(_x\) occur in habitat areas dominated by sessile oak forest (Orno-Quercetum petreae) at lower altitudes. Much of the oak/hornbeam forest (Querco-Carpinetum orientalis) and sessile oak forest is modified by frequent and extensive clear felling through licenced and un-licenced operations. This habitat type is ubiquitous and generally fairly tolerant of anthropogenic pressure. Exceedances of PEC annual NO\(_x\) are fairly low with a percentage increase of 8% above the EDC. As such, it is considered unlikely that habitats, or indeed species of conservation concern will be affected by this exceedance in this relatively discrete area. Further comment and evaluation of the effects and need for mitigation and management related to this effect is presented in Section 5.7.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Time weighted average</th>
<th>PC (µg/m(^3))</th>
<th>PEC (µg/m(^3))</th>
<th>PC ≤ 25% of EDC</th>
<th>PEC &lt; EDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO(_x)</td>
<td>annual</td>
<td>25.44</td>
<td>32.52</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SO(_2)</td>
<td>annual</td>
<td>0.73</td>
<td>2.76</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: % = percent; µg/m\(^3\) = microgram per cubic metre; EDC = environmental design criteria; NO\(_x\) = oxides of nitrogen; PC = process contribution; PEC = predicted environmental concentration; SO\(_2\) = sulphur dioxide.

5.6.6.2.7 Receptors on transportation route

The peak increases in traffic movements are estimated to be:
- During construction, 84-115 vehicle movements associated with the transport of goods (assumed to be HDV) per month, equating to a maximum of approximately 4 HDV vehicle movements per day;
- During operation, 364-450 vehicle movements associated with the transport of goods (assumed to be HDV) per month, equating to a maximum of approximately 15 HDV vehicle movements per day;
- During construction the transport of personnel will be covered by 32-40 trips per day; and
- During operations the transport of personnel will be undertaken by 50 light vehicles on 74-78 trips per day. These assumed peak increases in traffic movements are found to be below the daily movements identified in DMRB screening assessment criteria for both construction and operations phases. They are therefore below the threshold at which potential for significant adverse effects on air quality could affect receptors along the access road (Ilovica, Shtuka, Sekirnik, and Turnovo) or the highway (Novo Selo, Samuilovo, Novo Konjarevo).

5.6.7 Impact Classification

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

5.6.7.1 Magnitude of the Effect

Table 5-73 details the magnitude of effect criteria used for the quantitative assessment of potential impacts on human health and loss of amenity at sensitive receptor locations. Table 5-74 details the magnitude of effect criteria to be used for the quantitative assessment of potential impacts on habitats within the local biophysical study area.
Table 5-73: Magnitude of effect criteria for human health and loss of amenity

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>No expected detectable change in measurable air emission concentrations or measurable deposited dust to ground at sensitive receptors.</td>
</tr>
<tr>
<td>Low</td>
<td>Change in air emission concentrations or deposited dust rates predicted to exceed baseline, but not exceed air quality standards or guidelines at sensitive receptors.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Change in air emission concentrations or deposited dust rates predicted to exceed air quality standards or guidelines (as set out in the EDC) at sensitive receptors. The process contribution to overall concentrations or deposition rates at sensitive receptors is expected to be less than 25% of air quality standards or guidelines (as set out in EDC).</td>
</tr>
<tr>
<td>High</td>
<td>Change in air emission concentrations or deposited dust rates predicted to exceed air quality standards or guidelines (as set out in the EDC) at sensitive receptors. The process contribution to overall concentrations or deposition rates at sensitive receptors is expected to be greater than 25% of air quality standards or guidelines (as set out in EDC).</td>
</tr>
</tbody>
</table>

Table 5-74: Magnitude of effect criteria for habitats

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>No expected detectable change in measurable air emission concentrations within the local biophysical study area.</td>
</tr>
<tr>
<td>Low</td>
<td>Change in air emission concentrations predicted to exceed baseline, but not exceed air quality standards or guidelines within the local biophysical study area.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Change in air emission concentrations predicted to exceed air quality standards or guidelines (as set out in the EDC) within the local biophysical study area. The process contribution to overall concentrations within the local biophysical study area is expected to be less than 25% of air quality standards or guidelines (as set out in EDC).</td>
</tr>
<tr>
<td>High</td>
<td>Change in air emission concentrations predicted to exceed air quality standards or guidelines (as set out in the EDC) within the local biophysical study area. The process contribution to overall concentrations within the local biophysical study area is expected to be greater than 25% of air quality standards or guidelines (as set out in EDC).</td>
</tr>
</tbody>
</table>

Table 5-75 presents the parameters which will be used for the impact assessment for air quality.

Table 5-75: Impact assessment parameters for air quality

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic Extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to Tables 5-17 and 5-18.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Local</strong> Biophysical local study area</td>
<td><strong>Short-term</strong> Effect is reversible at end of construction</td>
<td><strong>Infrequent</strong> Effect occurs intermittently but not continuously over the assessment period</td>
</tr>
<tr>
<td></td>
<td><strong>Regional</strong> Biophysical Regional study area</td>
<td><strong>Medium-term</strong> Effect is reversible at end of operations</td>
<td><strong>Frequent</strong> Effect occurs repeatedly or continuously over the assessment period</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Long-term</strong> Effect is reversible within a defined length of time or beyond closure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Permanent</strong> Effect not reversible</td>
<td></td>
</tr>
</tbody>
</table>
### 5.6.7.2 Determination of Impact

Using the decision matrix presented in Annex 1 and the receptors defined in Section 5.6.3, the impacts have been determined. Table 5-76 presents the classification of each impact for the quantitative assessment of major emission sources. Table 44 in Annex 5E presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact.

The impact assessment for all qualitatively assessed activities is presented in Section 2 of Annex 5E. All qualitatively assessed impacts were classified as negligible or low.

#### Table 5-76: Assessment of impacts for air quality (quantitative ADM)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact target</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>Human health</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of amenity</td>
<td>Low</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>Human health</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of amenity</td>
<td>Low</td>
</tr>
<tr>
<td>Turnovo</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>Human health</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of amenity</td>
<td>Low</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>Human health</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of amenity</td>
<td>Low</td>
</tr>
<tr>
<td>Sushica</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>Human health</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of amenity</td>
<td>Low</td>
</tr>
<tr>
<td>Habitats¹</td>
<td>Operations</td>
<td>Ilovica mine area</td>
<td>NOx</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SO₂</td>
<td>Low</td>
</tr>
</tbody>
</table>

¹ The impact of potential changes to air quality on habitats has been assessed further in the biodiversity impact assessment (Section 5.8).

The air quality contour plot drawings indicate an increase in the concentration of the assessed substances as well as deposition of dust beyond the Bulgarian border. However the emission contribution beyond the Bulgarian border was deemed insufficient to attribute a trans-boundary geographic extent to any assessed substance.

In consideration of the issues raised during the stakeholder engagement, this air quality impact assessment concludes that:

- Details of the baseline air monitoring including monitoring schedule, instrument choice and choice of sub-contractor and laboratory can be found in Section 2.6 of this report and in the air quality baseline (Section 9, Annex 3);
- The impact of blasting, truck movements and processing on the air quality during mining operations has been assessed as part of the ESIA and impacts are considered low;
- The assessment indicates that the Macedonian and EU air quality standards for the protection of human health will not be exceeded at any local villages including Ilovica and Shtuka during mining operation;
- The assessment indicates that the EDC used to assess the risk of potential loss of amenity (impact of air quality on local agriculture) from deposited dust is low;
- The potential impact of dust deposition on cultural heritage sites is assessed in the cultural heritage impact assessment (Section 5.10);
- The potential impact of changes to the air quality on local agriculture is assessed in the geomorphology, terrain and soils impact assessment (Section 5.1);
- The assessment indicates that the increase in traffic flows both on the access road and on the highway to the Bulgarian border will not have an unacceptable impact on air quality;
An air quality impact is defined as a change in air quality due to the project which exceeds the baseline, the Macedonian and international standards; and

Impacts on air quality are negligible at Hamzali.

It is beyond the scope of this air quality impact assessment to comment on the following concerns or comments which were raised during stakeholder engagement:

- In the past, mitigations were not implemented and monitoring results did not trigger additional mitigations. However Euromax are committed to the implementation of the Environmental and Social Management plans (Annex 6); and
- Whether the constitution of Macedonia could be amended to ensure that mining operations will be stopped if problems occur. However the implementation of the Environmental and Social Management plans (Annex 6) will monitor emissions and if exceedances occur there is a clear path of action.

An air quality monitoring programme is presented in Annex 6 as part of the environmental and social management system.

5.7 Greenhouse Gas

This section presents an assessment of the greenhouse impact from a collection of different gases produced by the Ilovica Shtuka Project (the Project). It is typical to report the collective impact as carbon dioxide equivalent (CO\(_2\)e) units to facilitate comparison. The term ‘CO\(_2\)e’ is a measure used to compare the emissions from various GHGs based on their greenhouse warming potential (GWP).

The six key Greenhouse Gases (GHG) produced by human activities and covered by the Kyoto Protocol Agreement are carbon dioxide (CO\(_2\)), methane (CH\(_4\)), nitrous oxide (N\(_2\)O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF\(_6\)).

Carbon Dioxide is the most significant of GHG emissions accounting for 77% of the world’s anthropogenic emissions (IFC, 2007). CO\(_2\) emissions are dominated by fossil fuel combustion, therefore the scope of this assessment is to estimate the annual CO\(_2\)e emissions associated with the Project and provide mitigation recommendations where applicable.

Budgeted emissions of CO\(_2\) in 2016 in the Republic of Macedonia were estimated to be just under 10,000 kt CO2 (UN Framework Convention on Climate Change, 2015).

5.7.1 Source of effects

The assessment covers emissions directly and indirectly generated from the mine site during an operational year. Calculations have been undertaken using the data from the year of maximum production, Year 4 (2022), for conservatism and consistency with the Air Quality Assessment.

Sources of effects are identified below in Section 5.7.2.1 to 5.7.2.5.

5.7.2 Mobile Combustion Emissions

Mobile combustion vehicles will be used at the Site for the mining process. Vehicle fuel usage has been calculated using the assumptions in Table 5-77;

<p>| Table 5-77: Parameters used in the calculation of Mobile Combustion Fuel Usage |
|--------------------------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Operational Hours %</th>
<th>Operational Hours (hrs)</th>
<th>fuel l/hr</th>
<th>fuel usage l/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Shovel</td>
<td>0.77</td>
<td>6781</td>
<td>255</td>
<td>1,729,155</td>
</tr>
<tr>
<td>Secondary Shovel</td>
<td>0.77</td>
<td>6781</td>
<td>172</td>
<td>1,166,332</td>
</tr>
</tbody>
</table>
### 5.7.3 Stationary Combustion Emissions

Although the facility and all processing plant will be powered by purchased electricity, there will be back-up generators installed at the Site. These will be tested biweekly for approximately one hour with an associated diesel fuel usage of 12 m\(^3\) per annum.

### 5.7.4 Blasting Emissions

Blasting will be undertaken at the Site and it is estimated by AMECfw, the design engineers, that 9,000 t of Ammonium Nitrate Fuel oil (ANFO) will be used annually.

### 5.7.5 Purchased Electricity

The facility will be powered by electricity purchased from the Grid. It is estimated by AMECfw that 440,000,000 kWh of electricity will be used annually.

### 5.7.6 Land Clearance

Approximately 290 hectares (ha) of forestry land will be lost for the development of the Site. The TMF will be revegetated to scrubland/grassland at closure.

### 5.7.7 Study Area and receptors

Emissions of Greenhouse Gases have the potential to impact globally, therefore the study area for this assessment is global.

### 5.7.8 Considerations from Stakeholders

No questions or concerns relating to Greenhouse Gas emissions have been identified through stakeholder engagement.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Operational Hours %</th>
<th>Operational Hours (hrs)</th>
<th>fuel l/hr</th>
<th>fuel usage l/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary Shovel</td>
<td>0.77</td>
<td>6745</td>
<td>59.6</td>
<td>402,014</td>
</tr>
<tr>
<td>Primary Loader</td>
<td>0.65</td>
<td>5686</td>
<td>83.5</td>
<td>474,781</td>
</tr>
<tr>
<td>Primary Truck</td>
<td>0.77</td>
<td>6781</td>
<td>103.2</td>
<td>699,799</td>
</tr>
<tr>
<td>Primary Drill</td>
<td>0.77</td>
<td>6781</td>
<td>106</td>
<td>718,786</td>
</tr>
<tr>
<td>Secondary Drill</td>
<td>0.71</td>
<td>6233</td>
<td>60</td>
<td>373,980</td>
</tr>
<tr>
<td>Track Dozer</td>
<td>0.77</td>
<td>6781</td>
<td>78.5</td>
<td>532,309</td>
</tr>
<tr>
<td>Wheel Dozer</td>
<td>0.77</td>
<td>6781</td>
<td>52</td>
<td>352,612</td>
</tr>
<tr>
<td>Grader</td>
<td>0.77</td>
<td>6781</td>
<td>31</td>
<td>210,211</td>
</tr>
<tr>
<td>Water Truck</td>
<td>0.65</td>
<td>5686</td>
<td>53.7</td>
<td>305,338</td>
</tr>
<tr>
<td>Fuel Truck</td>
<td>0.52</td>
<td>4591</td>
<td>9</td>
<td>41,319</td>
</tr>
<tr>
<td>Tire Handler</td>
<td>0.27</td>
<td>2401</td>
<td>5.53</td>
<td>13,278</td>
</tr>
<tr>
<td>Backhoe</td>
<td>0.27</td>
<td>2401</td>
<td>83.5(^1)</td>
<td>200,484</td>
</tr>
<tr>
<td>Light Vehicle</td>
<td>0.52</td>
<td>4591</td>
<td>14</td>
<td>64,274</td>
</tr>
<tr>
<td>Worker Transport Bus</td>
<td>0.52</td>
<td>4591</td>
<td>56</td>
<td>257,096</td>
</tr>
</tbody>
</table>

\(^1\) Fuel usage for Backhoe assumed to be the same as the Primary loader
5.7.9 Key Guideline and Standards

The IFC Performance Standard 3 - Resource Efficiency and Pollution Prevention - is also adopted to quantifying any project related GHGs. The IFC Performance Standard 3: requires projects to estimate their annual GHG emissions from developments that are expected to generate in excess of 25,000 t/yr of CO$_2$e.

Performance Standard 3 also requires that the client considers alternatives and implements technically feasible and cost effective options to reduce project related GHG emissions. These could include alternative project locations, adoption of low carbon energy sources and the reduction of fugitive emissions.

5.7.10 GHG Assessment Method

The GHG assessment was undertaken primarily using the Greenhouse Gas Protocol methodology and tools provided to estimate emissions. The Greenhouse Gas Protocol (GHGP) is a joint initiative of the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) and is the most widely used international accounting tool for government and business leaders to quantify and manage GHG emissions. This assessment methodology is also an internationally recognised tool for calculating Project GHG emissions. The majority of the GHG emissions were calculated using the GHGP spreadsheet tools. Another document which has been used is the National Greenhouse Accounts (NGA) Factors from the Australian Government Department of Climate Change.

The assessment of GHG emissions normally focuses on the following three emission areas:

- Scope 1 covers direct emissions from sources within the boundary of an organisation such as fuel combustion and manufacturing processes. Scope 1 emissions will arise from such activities as the combustion of petrol and diesel fuels for vehicles and plant on site;
- Scope 2 covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation as required; and
- Scope 3 includes all other indirect emissions that are a consequence of an organisation’s activities but are not from sources owned or controlled by the organisation; that is, emissions from off-site waste disposal, emissions associated with the production of fuels, and emissions from the generation of purchased electricity.

The calculation of Scope 1 and 2 emissions is mandatory according to IFC. Scope 1 and 2 emissions have been assessed, using IPPC, GHGP and NGA methodologies, for mobile combustion emissions, stationary combustion emissions, blasting emissions, power consumption and the clearance of existing land for the development of the Site.

Scope 3 emissions (the calculation of which is optional according to IFC), are those which occur outside the project boundary. They have not be included in the assessment at this stage but they will be included in Euromax’s annual reporting once (and if) actual data is available to allow these to be calculated accurately.

5.7.11 Mobile Combustion Emissions

The GHGP Mobile Combustion Tool was used to calculate emissions from the mining vehicles. The input calculations are based on a maximum available vehicle scenario in Year 4 (2022); estimated operational hours and fuel usage (/hr) provided are used to calculate the total annual fuel usage.

5.7.12 Stationary Combustion Emissions

Stationary combustion emission sources on the Site will be the backup generators, used only during emergency operation. These will be tested biweekly for approximately 1 hour. The estimated fuel consumption has been used to calculate the emissions in the GHGP Stationary Combustion Tool.

5.7.13 Blasting Emissions

Emissions from blasting have been calculated using an emission factor of 0.17 from the Australian Government Department of Climate Change, National Greenhouse Accounts (NGA). The annual Ammonium Nitrate Fuel Oil (ANFO) budgeted usage is therefore multiplied by 0.17 to calculate emissions.
5.7.14 Purchased Electricity
Scope 2 emissions from purchased electricity have been calculated using the GHGP Purchased Electricity tool. This uses the annual anticipated consumption data (kWh).

5.7.15 Land Clearance
Emissions from the forestry land clearance, primarily in the Shtuka valley for the TMF, but also across the site where mining infrastructure will be located, have been calculated using the IPCC methodology for Forestry and Grassland (IPCC Guidelines for National Greenhouse Gas Inventories, 2006. Volume 4 and Chapter 6). The calculation assumes that all of the land use clearance and re-vegetation occurs during one year where in reality this will be phased and occur over a number of years. The calculation considers both the above and below ground biomass and assumes that the trees being removed are less than 20 years old.

5.7.16 Results
The GHG assessment considers the most significant emissions relating to the Project. The most significant GHG emissions are assessed to be generated from mobile mine vehicles, stationary combustion, blasting and the purchase of electricity. The GHGP calculation tools are used to predict the Project CO$_2$e emissions and are detailed in Table 2 below. The majority of the annual emissions (93.8%) are Scope 2 emissions from the purchase of electricity. The remaining annual emissions are from mobile combustion (4.3%), stationary combustion (0.01%), blasting (0.4%) and land clearance (1.5%). The emissions from land clearance will not occur every year.

### Table 5-77: Project Annual CO$_2$e Emissions

<table>
<thead>
<tr>
<th>GHG Emission</th>
<th>Mobile Combustion Emissions t/year CO$_2$e</th>
<th>Stationary Combustion Emissions t/year CO$_2$e</th>
<th>Blasting Emissions t/year CO$_2$e</th>
<th>Purchased Electricity Emissions t/year CO$_2$e</th>
<th>Land Clearance t/year CO$_2$e</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO$_2$e</td>
<td>17,063</td>
<td>32</td>
<td>1,530</td>
<td>375,416</td>
<td>6,013</td>
</tr>
<tr>
<td>% of Total</td>
<td>4.3</td>
<td>0.01</td>
<td>0.4</td>
<td>93.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Total Annual CO$_2$e</td>
<td>400,054</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.8 Biodiversity & Ecology
The Ilovica Project aims to achieve “no net loss” (NNL) of natural habitat, a net gain for residual effects to Critical Habitat (CH) and ensure that biodiversity and ecosystem functions are not degraded or lost from the landscape as a result of the Project. Key to this commitment is securing the long-term survival of species that occur in the Project’s area of influence. In essence, these species should have the same chances of long-term survival with or without the Project.

5.8.1 Sources of Effects
The Project has the potential to cause ecological effects during all its phases, including following closure. All of its physical components and activities can have an effect on biodiversity and ecology. The Project description (Section 4) has been reviewed and key activities and sources of effects relevant to ecology and biodiversity are presented below.

Effects on aquatic biodiversity and ecology:
- Diversion of the Shtuka River (construction, operations, closure and post-closure);
- The alteration of hydrology as a result of the Project (e.g. open pit, TMF) (informed by the water quantity assessment) (construction, operations, closure, post-closure); and
- Changes in water quality associated with Project activities (e.g. water seepage from the TMF, seepage collection facility, acid rock drainage, additional sediment load in rivers and streams, vehicular emissions and dust; informed by the water quality assessment) (construction, operations and closure);
Effects on terrestrial biodiversity and ecology:

- Site clearance in preparation for site construction (construction);
- Habitat loss and fragmentation associated with the alignment of linear infrastructure;
- Construction of the tailings management facility (TMF) (construction, operations, closure and post-closure);
- Deposition of tailings within the TMF (operations);
- Introduction of artificial noise as a result of Project activities (e.g. traffic, blasting, crusher; informed by noise and vibration assessment) (operations);
- Introduction of artificial lighting around the site (construction and operations);
- Introduction of barriers to species dispersal, including roads, conveyor, pylons and fencing (construction and operations);
- Changes in land use associated with the Project, including changes in grazing patterns and forestry operations (construction, operations, closure, post-closure);
- Deposition of dust, some of which may be contaminated with heavy metals (informed by the air quality assessment) (construction, operations and closure);
- Release and deposition of NOx, SOx and CO\textsubscript{2} (informed by the air quality assessment, construction, operations and closure); and
- Increased access for people and vehicles (construction, operations and closure).

Potential sources of effects have been discussed with other technical discipline lead authors to ensure a coherent and holistic approach has been applied. As such, the ecology and biodiversity impact assessment has used results from effects analysis from the following Project disciplines:

- Geomorphology, Terrain and Soils (Section 5.1);
- Water Quality and Quantity (Sections 5.2 and 5.3);
- Sediment (Section 5.4);
- Noise and Vibration (Section 5.5);
- Air Quality (Section 5.6); and
- Social (Section 5.12).

5.8.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 4) which provided the DFS engineers with environmental measures which should be incorporated into Project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following presents the environmental measures relevant to biodiversity and ecology which have been incorporated into the Project design.

Erosion Control and Sediment Management

- Energy dissipaters will be installed to prevent the carriage of sediment with fast flowing water;
- Physical erosion control features such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting will be used to control erosion prior to the establishment of vegetative cover; and
As soon as practicable, temporarily disturbed areas will be graded, re-vegetated and reclaimed so that surface water run-off from these areas will be similar to natural or pre-mining conditions.

Dust and Air Quality Management
- Dust suppression through spraying with a water truck and/or fixed sprinklers on roads, stockpiles, crusher, conveyor, material transfer points will be undertaken; and
- Established speed limits will be defined and adhered to. Loads will be sealed and generators for use during the construction phase will be specified for minimal dust and air emissions.

Water Management
- Sewage effluent will be treated in the plant process water system and not discharged to the environment; the treated effluent will conform to the European Union’s Urban Wastewater Directive;
- Water discharges to the environment will be managed to replicate natural variability associated with high and low flows;
- Increased runoff due to vegetation clearance will be stored and attenuated before controlled discharge to watercourses; and
- Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible.

Hazardous Materials Areas
- Fuel and chemical storage and usage areas will be demarcated, sealed and bunded, with storm water directed around these areas;
- Bunded areas, for storage of hazardous materials, are designed to hold 110% of volume of the largest tank in a specific area;
- All fuel or storage tanks will be stored on hard standing to prevent any spills from infiltrating to the underlying soil; and
- Grease and oil traps will be installed at refuelling facilities, workshops and fuel storage depots. Drip trays will be used in the plant and workshops. These will be incorporated into the detailed design of the Workshops and Fuel Storage facilities.

Noise and Lighting Management
- Speed limits will be established for the mine and contractor vehicles to reduce noise and disturbance;
- Directional lighting of site (away from receptors); and
- No lighting on the access road.

Vegetation Clearance and Power line Alignment
- All vegetation adjacent to waterbodies including rivers and streams will be retained unless the waterway is to be removed or diverted; and
- Vegetation clearance will be minimised and areas cleared immediately before work takes place, as far as possible.

5.8.3 Study Area and Receptors
The primary baseline data gathering for biodiversity and ecology was completed within the baseline local study area presented in Section 1.

Following completion of the baseline, the study areas for all disciplines have been collated to produce local and regional study areas for the impact assessment (equivalent to the potential area of influence of the project) for the biophysical environment and the social environment. The local and regional study areas for the
biophysical impact assessments are presented in Section 1 and will be referred to throughout this section as the local and regional study areas.

Biodiversity components affected in accordance with Project implementation are likely to be complex. As such, it is challenging to model the precise changes that are likely to occur for biodiversity across all dimensions. For this reason, valuable biodiversity features have been isolated to evaluate effects of the Project and help focus mitigation needs.

Ecological receptors were chosen for a number of reasons, including legal and policy protection, species-richness, uniqueness or the value placed upon them by local people. The following list summarises the criteria considered in selecting ecological receptors:

- Globally and/or European threatened species as defined by IUCN categories VU (Vulnerable), Endangered (EN) and CR (Critically Endangered);
- Habitats classified as Natural, Modified and Critical, in accordance with EBRD PR6;
- Species and habitats protected at a European level under the Habitats Directive (Directive 92/43/EEC) and Birds Directive (Directive 2009/147/EC) even if these Directives are not yet formally realised within Macedonia;
- Nationally-threatened species that are protected according to national laws and international agreements ratified by Macedonia;
- Restricted-range and endemic species, species that are protected according to National or International laws and agreements (e.g. species listed in the Macedonian Regulation on Wildlife Conservation and Wildlife Development Areas, the Bern, Bonn or CITES Conventions);
- Congregatory and migratory species that might be using sites within the LSA and RSA; and
- Species for which relevant national and international experts have identified the risk of extinction/reduction and suggested the inclusion in conservation mechanisms.

As described in Section 1, receptors were agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust. The following receptors are used within the biodiversity and ecology effects analysis and impact assessment:

- Terrestrial habitats and species, including:
  - Flora and fungi;
  - Micro-, medium and large mammals;
  - Birds;
  - Herpetofauna;
  - Terrestrial Invertebrates; and
  - Critical habitat supporting endangered species.
- Aquatic habitats and species in the Shtuka and Jazga Rivers, including:
  - Fish;
  - Macro-zoo benthos (aquatic invertebrates); and
  - Decapods (e.g. freshwater crayfish).

The selection of these ecological receptors included consideration of how these receptors might respond to Project activities, based upon receptor exposure, receptor sensitivity and receptor vulnerability, which are defined below.
Receptor Exposure
Whether a receptor is likely to be exposed to an effect depends on the temporal and spatial relationship between a Project activity (e.g. a noise emission) and the receptor. It is assumed that the receptor may be exposed if baseline surveys or other information suggest it could be present at the time or location concerned. If there is no mechanism for exposure, the effect is screened out from further consideration.

Receptor Sensitivity
Whether a receptor will show a measurable response to the changes associated with a Project activity depends on its sensitivity. For example, individuals of a species might be exposed to increased levels of noise during construction, but if they are not sensitive to noise, they will not be exposed to a high impact as a result of elevated noise levels. Sensitivity has been considered in relation to the particular Project activity under consideration and the characteristics of the receptor in every case where a receptor may be exposed to an effect.

Receptor Vulnerability
Receptor "vulnerability" refers to the consequences for a receptor that is both exposed and sensitive to an effect. Specialists have considered the extent to which the effects identified might threaten the status or viability of receptors throughout their range or distribution. The proportion of populations of a species or habitat extent affected by the Project has been considered, as well as the extent to which habitats or populations of species are stable, increasing or declining within the RSA.

5.8.4 Considerations from Stakeholder Engagement
The following issues were identified during the stakeholder engagement process (described in Section 1) and are relevant to the impact assessment for biodiversity and ecology:

- Concerns over the potential for bioaccumulation of heavy metals by plants including vegetables (Open House 16 September 2015);
- Concerns over ‘turtle’ (likely tortoise) conservation and possible Project effects to this group (Open House 16 September 2015);
- Concerns over water quality and suspended sediments even when there is no rain (Open House 16 September 2015);
- Concerns regarding what will happen to fauna in the Project area (Open House 16 September 2015);
- Concerns regarding what is considered to be ‘acceptable’ impacts to biodiversity (Open House 16 September 2015);
- Concerns regarding water quality with regard to tailings and effects to air quality (Municipality of Novo Selo, 16:00hrs, 25 March 2015); and
- Will there be a tree planting program? (Municipality of Novo Selo, 16:00hrs, 25 March 2015).

Concerns were also raised by stakeholders over the cause of a fish kill at the Ilovica reservoir in 2013. Members of the community believed that the fish died as a result of drilling activities carried out by Euromax. This issue has not been considered further in the biodiversity impact assessment as the cause was investigated at the time (with water from the reservoir being laboratory tested by the Centre for Public Health) and found to be related to low water levels and low oxygen levels in the reservoir, rather than any effects of mine exploration activities.

5.8.5 Key Guidelines and Standards

National
National laws relating to nature conservation and protection, relevant international conventions and agreements signed by Macedonia and other international policies and standards related to biodiversity were considered as follows:
Law on Environment (Official Gazette of the Republic of Macedonia no. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 44/15); and

Law on Protection of Nature (Official Gazette of the Republic of Macedonia no. 67/04, 14/06, 84/07, 35/10, 47/11, 148/11, 59/12, 13/13, 163/13 and 41/14).

European

- Convention on the Conservation of European Wild life and Natural Habitats (Bern, 1982), ratified 1997; and

International

The following international standards and conventions were referred to in the development of the baseline and impact assessment for biodiversity and ecology:

- IFC’s Performance Standard 6 (IFC, 2012);
- EBRD’s Performance Requirement 6 (EBRD, 2014);
- Convention on Wetlands of International Importance Particularly as Waterfowl Habitat (Ramsar, 1971), ratified 1977;
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979), ratified 1999;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Washington, 1973), ratified 1999; and

5.8.6 Effects Analysis

5.8.6.1 Methods

Effects were assessed for Project activities that are likely to result in a measureable environmental change that could contribute to adverse effects to receptors relative to baseline or guideline values. Changes in condition were defined as changes to the size or function of a population, habitat, or ecosystem from baseline condition. Methods to estimate change in condition included models, calculations, and qualitative analyses based on available information from baseline reports, scientific literature, and expert consultation.

5.8.6.1.1 Habitat receptors

Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment."25 For the purposes of this assessment, habitats are divided into modified, natural, and critical.

It is possible to place ecological importance on recognised habitat features, based upon the criteria defined in Ratcliffe (1977), namely: naturalness, size, rarity and diversity. Application of these criteria follows the principles described by the Nature Conservancy Council (1989) that includes the attributes of "non-recreatability" as a general integrating measure of habitat conservation value.

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Habitat loss due to sensory disturbance and edge effects was estimated by applying a buffer to the Project footprint. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by air emissions, light, noise, vibration, and edge effects.

Direct (within the Project footprint) and other non-footprint direct effects (sensory disturbance and edge effects) were superimposed on the habitat mapping in GIS to evaluate the magnitude and extent of effects on habitats.

Results for the air quality (Section 5.6), noise and vibration (Section 5.5) and geomorphology, terrain and soils (Section 5.1) assessments have been used in the evaluation of terrestrial effects. Results from the water quantity (Section 5.2) and water quality (Section 5.3) assessments have been used in the evaluation of aquatic habitats.

5.8.6.1.2 Species receptors

Indicators used to assess effects to species receptors were:

- Survival and the subsequent ability to reproduce;
- Habitat connectivity;
- Species mobility; and
- Prevalence of habitat quality and quantity changes from baseline.

Potential changes in survival and reproduction were assessed qualitatively by considering potential disturbances (vehicle traffic, light, noise from blasting, vibration) and site clearing activities. These disturbances were considered with relation to known or inferred effects to the survival and reproduction of species for which data on these types of effects are available.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and species mobility.

Species-specific habitat loss was quantified by overlaying species distribution data with the proposed Project footprint. At the species level, the concept of a self-sustaining, ecologically effective population was used as a benchmark when describing the magnitude of effect.

A self-sustaining population is one that will be maintained into the future with a low risk of extirpation (local extinction). Long-term population persistence is the outcome of maintaining viable populations, and maintaining or achieving self-sustaining populations is frequently applied as a conservation target by conservation biologists and resource managers (Fahrig 2001; Nicholson et al. 2006; Ruggiero et al. 1994; With and Crist 1995). By definition, self-sustaining populations are not populations at the brink of extirpation; they are healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Fahrig 2001).

5.8.6.2 Results

This section characterises and predicts the potential effects on ecological features in the absence of mitigation measures (except those already incorporated into Project design as described in Section 5.7.2) during the construction, operation and closure phases of the Project.

For terrestrial habitats and species, results are presented for Land Take, Noise and Air Emissions, including dust deposition and soils. The following provides some of the criteria used to evaluate the effects:

- Noise is considered to affect species presence and distribution when levels exceeded 45dba. This threshold is a general approximation for disturbance of wildlife based upon the threshold for night time disturbance of people defined by the World Bank Group (1999);

- For emissions of SO₂, the World Health Organisation (WHO) natural forest vegetation guideline of 20 µg/m³, averaged over a year, has been used as a limit, above which, vegetation can be affected. Long-term exposure of terrestrial ecosystems to SO₂ emissions is known to affect plant productivity.
directly by inhibiting plant photosynthesis resulting in reduced productivity, vigour and health (Bell and Clough, 1973);

- For emissions of NOx, the vegetation guideline value over which effects are predicted is 30 µg/m³, averaged over a year and this is the guidance value used in this assessment (WHO, 2000). However, NO₂ may have a beneficial effect (i.e., increasing growth) (Hutchinson and Meema, 1987; WHO, 2000) at low concentrations, in the range of 20-90 µg/m³ (Adam et al., 2008). Above 90 µg/m³ NO₂ is expected to have a negative effect on vegetation (Amundson and Maclean, 1982);

- Dry deposition of nitrogen can cause physiological damage (e.g. defoliation and loss of soil biodiversity) to mixed deciduous/coniferous woodlands if the rate of deposition exceeds about 10 kg/ha/yr (Umweltbundesamt 2004). Nutrient enrichment and changes in soil chemistry can cause permanent changes in plant species composition. Transformation of natural vegetation to more modified types may occur if thresholds are exceeded; and

- Dust deposition on vegetation or in water can reduce the quality of natural and modified habitats or degrade it to a point where it is no longer effective. A clear guideline value to protect vegetation from dust is not available. The guideline value for the loss of human amenity is a threshold of 350 mg/m²/day, while baseline deposition ranges from 25 – 88 mg/m²/day.

For aquatic habitat and species, results have been used for indicator locations along the Jazga and Shtuka rivers where the effects of the Project may be felt. Surface water flows, wetted perimeter and water level data has been interrogated to evaluate effects on aquatic and riparian ecology and biodiversity from changes in water quantity. Surface water quality results have been interrogated to evaluate effects on aquatic ecology and biodiversity from changes in water quality.

5.8.6.2.1 Terrestrial habitats and species

Construction

Land Take

Direct ecological effects associated with land take (habitat loss associated with the project footprint) will start to occur during the construction phase and expand during operations.

Table 5-78 shows the construction phase land take by land use or vegetation type within the context of the availability of that habitat type in the LSA and RSA. The table shows that land take within the LSA ranges from 0 to 8% of each land cover type or vegetation community. When considered with reference to the RSA, land take due to project construction is 1.1% or less of the available resource for all land cover types and vegetation communities.

As well as direct loss of habitat from the Project footprint, ecological effects can also be expected from the fragmentation of habitat, the introduction of barriers to dispersal, disturbance associated with increased noise, light and air emissions from project infrastructure. These effects will all begin during the construction phase, though at a lower level than during operations and are therefore mainly evaluated in the operations section below.
Table 5-78: Land Take (Ha) during Construction

<table>
<thead>
<tr>
<th>All values in Ha</th>
<th>TMF&lt;sup&gt;26&lt;/sup&gt;</th>
<th>Open pit area</th>
<th>Haul roads</th>
<th>Plant site</th>
<th>Conveyor Belt</th>
<th>Workshop</th>
<th>ROM pad</th>
<th>Storm water Dam</th>
<th>Offsite access road</th>
<th>On Site access Road</th>
<th>Buildings (geological lab and auxiliary infrastructure buildings)</th>
<th>Total</th>
<th>As a % of available habitat within LSA</th>
<th>As a % of available habitat within RSA&lt;sup&gt;14&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td>0.94</td>
<td>1.54</td>
<td>0.72</td>
<td>20.69</td>
<td>1.67</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>1.24</td>
<td>0</td>
<td>26.80</td>
<td>2%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Settlements and Fields</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.09</td>
<td>1.11</td>
<td>0</td>
<td>9.22</td>
<td>0%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Forest communities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessile oak forest</td>
<td>8.50</td>
<td>0.45</td>
<td>0.37</td>
<td>2.27</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>4.59</td>
<td>0</td>
<td>16.25</td>
<td>1%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Turkey oak forest</td>
<td>17.84</td>
<td>14.19</td>
<td>21.46</td>
<td>0.81</td>
<td>1.63</td>
<td>0</td>
<td>1.69</td>
<td>0</td>
<td>-</td>
<td>4.13</td>
<td>0</td>
<td>61.75</td>
<td>7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Beech forest (subtype 1)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>1.08</td>
<td>0</td>
<td>1.08</td>
<td>0%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Beech forest (subtype 2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Oak and hornbeam forest</td>
<td>2.85</td>
<td>6.17</td>
<td>17.12</td>
<td>0</td>
<td>1.99</td>
<td>14.68</td>
<td>0.54</td>
<td>0.95</td>
<td>4.60</td>
<td>4.60</td>
<td>0.78</td>
<td>54.28</td>
<td>8%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Beech / pine forest</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total (forest communities)</td>
<td>29.19</td>
<td>20.81</td>
<td>38.95</td>
<td>3.08</td>
<td>3.69</td>
<td>14.68</td>
<td>2.23</td>
<td>0.95</td>
<td>4.60</td>
<td>14.40</td>
<td>0.78</td>
<td>133.36</td>
<td>3.31%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total land take per project component</td>
<td>30.13</td>
<td>22.35</td>
<td>39.67</td>
<td>23.77</td>
<td>5.36</td>
<td>14.68</td>
<td>2.23</td>
<td>0.95</td>
<td>8.69</td>
<td>16.75</td>
<td>0.78</td>
<td>165.36</td>
<td>2.72%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

<sup>14</sup> Calculations of extent of vegetation community within RSA is based upon Corine landcover mapping (satellite imagery) owing to the scale of the RSA.

<sup>26</sup> Year two construction footprint, includes bypass channel.
**Noise effects**

The potential disturbance associated with noise during the construction phase differs from the disturbance during the operations phase. Noise levels during construction were modelled using conservative assumptions and compared with baseline levels to determine potential impacts (Section 5.5). Figure 5-16 shows the area within which noise greater than 45 dBA is predicted and may affect wildlife. The total area of potential disturbance outside of the Project footprint is 1208 ha within the LSA.

The noise levels greater than 45 dBA occur within the central concession area, to the north west of the concession area and where construction of roads, the workshop and TMF embankment would occur. Noise from construction is likely to affect species composition within this area. Some animal species may cease to feed or breed on current sites within the proposed Project footprint or could potentially be displaced from affected habitat outside the Project footprint. Whilst a degree of species dispersal is inevitable, it is likely that the species that will be affected are mobile, common and widespread such as the European Wildcat (*Felis silvestris*) and the fox (*Vulpes vulpes*).

![Figure 5-16: Predicted extent of noise measuring 45 dBA or higher (construction phase).](image)

**Air emissions and dust**

Predicted air quality effects are analysed in the operations section, being the phase when they will be greatest.

**Operations**

**Land take**

Land take will increase to its maximum during operations when the TMF and pit are at their full extents.
### Table 5-79: Land Take (Ha) during Operations

<table>
<thead>
<tr>
<th>All values in Ha</th>
<th>TMF (a)</th>
<th>Open pit area</th>
<th>Haul road (b)</th>
<th>Plant site</th>
<th>Conveyor belt</th>
<th>Workshop</th>
<th>Stockpiles</th>
<th>Buildings</th>
<th>Off-Site access road (permanent)</th>
<th>ROM pad (b)</th>
<th>On site access road</th>
<th>SWD (c)</th>
<th>SCF (d)</th>
<th>Sewage treatment plant</th>
<th>Total</th>
<th>As a % of available habitat within LSA</th>
<th>As a % of available habitat within RSA (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td>12.19</td>
<td>11.07</td>
<td>2.03</td>
<td>20.69</td>
<td>1.67</td>
<td>0</td>
<td>0.28</td>
<td>0</td>
<td>0</td>
<td>4.02</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>49.24</td>
<td>4%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Settlements and Fields</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.02</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>4.16</td>
<td>0.1%</td>
<td>&gt;0.1%</td>
</tr>
<tr>
<td><strong>Forest communities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessile oak forest</td>
<td>71.59</td>
<td>11.57</td>
<td>0.3</td>
<td>2.26</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.59</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>90.39</td>
<td>6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Turkey oak forest</td>
<td>150.50</td>
<td>77.05</td>
<td>6.08</td>
<td>0.81</td>
<td>1.63</td>
<td>0</td>
<td>0.81</td>
<td>0</td>
<td>1.44</td>
<td>4.13</td>
<td>0.39</td>
<td>0.39</td>
<td>0</td>
<td>0</td>
<td>242.85</td>
<td>27%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Beech forest (subtype 1)</td>
<td>13.53</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.08</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>14.6</td>
<td>2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Beech forest (subtype 2)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Oak and hornbeam forest</td>
<td>35.97</td>
<td>20.02</td>
<td>19.17</td>
<td>1.99</td>
<td>14.74</td>
<td>2.95</td>
<td>1.42</td>
<td>4.06</td>
<td>0.54</td>
<td>4.60</td>
<td>0.03</td>
<td>0.03</td>
<td>0</td>
<td>0</td>
<td>102.38</td>
<td>15%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Beech / pine forest</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>Total (forest communities)</strong></td>
<td>271.59</td>
<td>108.64</td>
<td>25.55</td>
<td>3.08</td>
<td>3.70</td>
<td>14.74</td>
<td>3.76</td>
<td>1.42</td>
<td>1.98</td>
<td>14.4</td>
<td>0.42</td>
<td>0.42</td>
<td>0.42</td>
<td>0</td>
<td>450.2</td>
<td>7.5%</td>
<td>0.8%</td>
</tr>
<tr>
<td><strong>Total land take per project component</strong></td>
<td>283.78</td>
<td>119.71</td>
<td>27.58</td>
<td>23.77</td>
<td>5.36</td>
<td>14.74</td>
<td>4.03</td>
<td>1.42</td>
<td>4.60</td>
<td>1.98</td>
<td>15.7</td>
<td>0.49</td>
<td>0.49</td>
<td>0.07</td>
<td>503.6</td>
<td>8.2%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

(a) Includes Shtuka diversion channel
(b) ROM pad and haul road take up smaller areas during operations than during construction
(c) Area of SWD is embankment only as will operate dry
(d) Area of SCF includes seepage retained therein
(e) Calculations of extent of vegetation community within RSA is based upon Corine landcover mapping (satellite imagery) owing to the scale of the RSA.
A notable change from the construction phase (year 2) is the increase in the loss of forest communities, reflecting the footprint of the TMF which is almost wholly forested at baseline. At the maximum extent, the Project footprint will result in the loss of 4% of pastures and up to 7.5% of the forest communities within the LSA. Put within the context of the RSA, habitat loss remains less than 1% for pastures, settlements and fields, and for some forest communities (sessile oak forest, beech forest, and beech/pine forest). Oak and hornbeam forest and turkey oak forest are predicted to lose the greatest proportion of available habitat, though at the RSA level this accounts for 2.1% and 3.7% respectively.

Overall, approximately 8.4% of the LSA will be affected by the Project footprint through operations. However, owing to the location of the Project in the mid and lower elevations of the LSA, vegetation types of higher conservation value for both flora and fauna will in general be less affected, as they tend to occur at higher elevations. For example, pasture comprises 18.2% of the LSA, however only 4% of pasture will be affected. Likewise the two forest types found to best represent natural as opposed to modified forest habitat (beech/pine and beech forest sub-type 2) will not be affected at all by the footprint.

Loss of pasture is likely to have impacts for invertebrate groups such as butterflies which are associated with nutrient-poor grasslands. However, predicted small-scale impacts to higher quality habitat at higher elevations shown for vegetation, also apply to butterflies as described below with respect to PBA effects. Effects analyses with respect to high, medium and low butterfly biodiversity zones within the PBA, describe how the vast majority (> 90%) of Project effects are within the moderate biodiversity zone (modified habitat). Only 1.7 ha (0.3%) of the high biodiversity zone (Critical Habitat) are affected. The remaining effects are within the low biodiversity area.

Of the floral SoCC, the bladder campion (Silene vulgaris) may be affected by land take within pastures, as this species is known to occur within meadows and arable ground. However, it is known to occur within a broad range of habitat types including road verges, scrub, lawn and banks, so may in fact benefit from the disturbed ground associated with the project footprint. The three CITES listed orchid species were only found on one transect and could be subject to additional mitigation, for example by putting protection markers or fencing around ecologically sensitive sites which occur just off the footprint (see Section 6.8). Reptiles, mammals and birds may also be affected by the loss of pasture, however the overall impact to fauna will be limited due to the avoidance of higher quality pasture at higher elevations.

Loss of forested habitat has the potential to affect a wide range of plant and animal species. Two fungi SoCC are associated with the roots of forest trees (e.g. oak, hornbeam, beech) and may be impacted by the loss of forest habitat. Foraging habitat for mammals (including bats) and birds will be reduced, but these species are sufficiently mobile to leave the area in advance of clearance and make use of other forested habitat. In contrast the two CITES listed tortoise species, which were also of concern to stakeholders, will not be able to move ahead of clearance. These species will need to be especially targeted for additional mitigation as described in Section 6.7. While the project footprint will directly result in the loss of around 450 hectares of forest, ecological implications are overall limited due to the avoidance of natural forest at higher elevations, plus low percentage forest loss at the regional level. No floral or faunal SoCC are known to rely exclusively upon the forested habitat which is to be lost.

As well as direct habitat loss, Project operations will also introduce barriers to species dispersal through increased human presence and the introduction of infrastructure (e.g. conveyor), power lines and road traffic. Haul roads and access roads cut across the site and traffic volumes on these roads are likely to present a barrier to the movements of some mammals, amphibians and reptiles. High traffic volumes also increase the likelihood of roadkill of those species which do attempt to move across or along roadways. However, mitigation within the Project design including speed management, culverts (where practicable) and an absence of lighting on the access road will limit these effects.

Habitat connectivity will also be constrained during construction and operations. Forest and scrub mosaic facilitates species dispersal within the LSA. Species such as the Forest dormouse (Dryomis nitedula) and Common dormouse (Muscardinus aavelanarius) are primarily arboreal (Batsaikhan, et al., 2008) and as such, severance of forest habitat can isolate populations of these species. Habitat suitability mapping in the baseline report (Annex 3) shows that forested habitat along the high ground of Anovi and Čukar is suitable for forest
Clearance of forest for the open pit may result in individuals on Čukar becoming isolated from the wider population. The Project power line for the operations phase (permanent power supply) will be provided via a new 10.5 km overhead transmission line (OHTL) from the Ilovica-Shtuka substation to the substation (“Sushica OHTL”), and a new 27 km OHTL from the Ilovica-Shtuka substation to the existing Berovo substation (“Berovo OHTL”). This type of infrastructure has the potential to cause direct (collision mortality) and indirect (habitat severance) effects to avian and chiropteran groups.

Species composition may also be affected by the Project, with some species better adapted to respond to disturbance than other species. The introduction of machinery and heavy vehicles from across Europe also has the potential to introduce alien and invasive species, which may be able to rapidly colonise the site given the extent of newly disturbed ground. Additional mitigation will therefore be employed with respect to potential invasive species (see Section 6.7).

The materials used in the construction of haul and access roads have the potential to influence natural habitats and species composition. Surface water run-off from roads may alter the soil or substrate quality, with a potential transition from natural to modified vegetation communities. Erosion control measures in the Project design will lessen such effects, however any change may further benefit alien or invasive species introduced by increased road traffic. Some local species with broad habitat tolerance may also benefit from increased ground disturbance and change in soil conditions. As noted above, floral SoCC Bladder Campion is known to occur in recently disturbed habitats and may increase its local distribution as a result of the Project.

The fencing of the site and likely exclusion of grazing animals will alter vegetation sward structure and composition. The implications of this change can be seen with relation to the Large Blue butterfly. Reliant upon a parasitic relationship with red ants from the Myrmica genus, Large Blue butterflies are most successful within the nests of Myrmica sabuleti, which is in turn reliant upon a short, close-cropped grassland sward. A change in grazing regime has the potential to cause deterioration in the habitat suitability for M. sabuleti and thus decrease the reproductive success of the Large Blue butterfly.

Change in land management within the concession also has implications for areas away from the concession. Some grazing activity which currently occurs within the concession will have to be relocated once Project operations commence, with possible consequences for biodiversity in areas where additional grazing is concentrated.

**Soils**

Change in soil quality and quantity is expected due to the change in land cover/vegetation, increased potential for erosion, increased deposition of air emissions (dust, NOx, SO2) and a decrease in nutrient cycling. Many areas of the site have very limited soil cover at baseline and the natural vegetation communities reflect this. The overall impact to soils will be focussed on areas where vegetation removal causes an increase in erosion potential.

Soils that have been stripped during the construction phase of the Project will need to be stored prior to reinstatement as part of the Project restoration plan. Available soil may be limited by quantity and quality (lack of nutrient content). The storage of soils will cover a considerable length of time at >22 years. This has the potential to result in permanent changes in vegetation on soil receptor sites as well as loss of the soil seed bank from stored soils. Such consequences will be monitored and additional remedial action taken as necessary (Section 6.8).

**Noise**

Noise from blasting, traffic, loading, hauling and ground works will affect many animal species, potentially altering their distribution and behaviour. Noise levels greater than 45 dBA are shown in Figure 5-17. A total area of 1150 ha of potential noise disturbance outside of the Project footprint is predicted during operational activities.

Blasting and drilling during operation will disturb and fragment mobile species such as birds, bats and medium and large mammals. Some species may become accustomed to increases in noise levels depending on their
tolerances. Ground-nesting birds may even benefit from predators (such as foxes) being deterred from the site due to increased noise.

![Figure 5-17: Predicted extent of noise measuring 45 dBA or higher (operations phase).](image)

**Air Emissions**

All Project activities that cause air emissions and dust have the potential to interact with biodiversity features by affecting ecosystem composition, configuration, and function. Sulphur dioxide (SO₂), nitrogen oxides (NOx) and dust are the main compounds likely to affect vegetation and soils. These emissions have been modelled as part of the air quality impact assessment and considered with relation to the thresholds and guidelines presented earlier. For NOx (Figure 5-18), there is a predicted exceedance of the annual 30 µg/m³ threshold within parts of the LSA associated with, and just south of, the concession. No exceedance of the annual 30 µg/m³ threshold is predicted to extend outside the LSA.
Based on the quantitative assessment the predicted deposition does exceed 25% of the EDC for NO\textsubscript{x} but not for SO\textsubscript{2}. An exceedance of the EDC for the protection of habitats is expected for annual NO\textsubscript{x} in an area covering 305 ha within the LSA. No exceedances of annual SO\textsubscript{2} are anticipated anywhere in the modelled domain. EDC for the protection of human health are higher than for habitats and no exceedances of the EDC for human health are predicted.

Grassland species-richness and biodiversity value is generally found within the study area at heights above 800 masl (ref Biodiversity baseline Chapter 10). The exceedances in annual NO\textsubscript{x} occur in habitat areas dominated by sessile oak forest (*Orno-Quercetum petraeae*) at lower altitudes. Much of the oak/hornbeam forest (*Querco-Carpinetum orientalis*) and sessile oak forest is modified by frequent and extensive clear cut felling through licenced and un-licenced operations. This habitat type is ubiquitous and generally fairly tolerant of anthropogenic pressure. Exceedances of annual NO\textsubscript{x} are fairly low with a percentage increase of 8% above the EDC (32.5µg/m\textsuperscript{3}). As such, it is considered unlikely that habitats, or indeed species of conservation concern, will be affected by this exceedance in this relatively discrete area.

The results for SO\textsubscript{2} indicate a relatively constant sulphur dioxide level across the study area, reflecting a low contribution from Project activities (Figure 5-19). The mean annual contribution of between 2 and 5 µg/m\textsuperscript{3} falls well below the WHO natural vegetation impact threshold of 20 µg/m\textsuperscript{3}.
As stated within the geomorphology, terrain and soils impact assessment (Section 5.1), in the worst case scenario (year 12 of operations), the maximum rate of nitrogen deposition is expected to be 7.3 kg/ha/yr, and is limited to the immediate vicinity of the project footprint (Drawing 5-3). This is below the threshold for concern, and therefore is not expected to result in measurable changes to forestry, forested habitat or scrub habitat.

Acidifying emissions are calculated as a function of the predicted NO₂ and SO₂ emissions. Section 5.1 states that in the worst-case scenario year (Year 12 of Operations), there are widespread critical load exceedances for acidifying emissions in the highland zone of the LSA; however, these exceedances do not extend into the lowland zone around and to the west of Ilovica or Shituka. The deposition model reports potential critical load exceedances in the area of Sushica and north of Novo Selo. It is therefore expected that small but detectable changes to soil chemistry will occur between baseline and the end of the operations phase from acidifying emissions. Due to the relatively short duration of the Project, even if the worst case scenario were applied for each year of construction and operations, the models predict that the cumulative exposure of the soils to acidifying emissions will not cause a change in soil chemistry great enough to trigger a change in the distribution of land uses that occur at baseline in the LSA (i.e. cropland agriculture, grazing, or forestry).

During the operation of the Project, the maximum rates of dust deposition occur in the concession area (Figure 5-20). The majority of the LSA will be exposed to much lower rates of dust deposition which are comparable with baseline dust deposition. Specific to forestry habitat, dry deposition of nitrogen can cause physiological damage (e.g. defoliation and loss of soil biodiversity) to mixed deciduous/coniferous woodlands if the rate of deposition exceeds approximately 10 kg/ha/yr (Umweltbundesamt, 2004). In the worst case scenario (year 12 of operations), the maximum rate of nitrogen deposition is expected to be 7.3 kg/ha/yr, and is limited to the immediate vicinity of the Project footprint. This is below the threshold for concern, and therefore is not expected to result in measurable changes to forestry, forested habitat or scrub habitat.
Throughout construction and operations, cumulative dust deposition will increase metal concentrations near the Project footprint, though remaining within the EDC limits (with the exception of increased copper in the highland area of the LSA, which exceeds the EDC but remains within natural range of variation).

Another potential disturbance during operations is the introduction of artificial lighting. Site lighting will be restricted to high traffic areas such as loading points, parking areas and security areas. Although light effects are well documented (Longcore and Rich 2004), there is limited quantitative information available. Lighting could disrupt animals hunting at night, such as golden jackal (Canis aureus) and European wild cat (Felis silvestris). Light pollution affects bat roosts and feeding behaviour and makes bats easier prey for owls. While light effects may be detrimental, it is also important to understand that artificial light can attract species such as moths, possibly resulting in increased predation by bats and other nocturnal insect feeders. With lighting mitigations already included in Project design, detrimental effects to even the most sensitive species are predicted to be a minimal addition over those caused by footprint clearing. Mitigation presented in Section 6.7 describes measures to minimise the effects of site lighting.

**Closure**

The closure and subsequent rehabilitation of the Project area will afford effects to natural and modified habitats and associated flora and fauna. Ground disturbance aligned with the demolition of infrastructure, buildings and road and conveyor removal are considered. Some Project infrastructure may become naturalised over the mine life. For example, species such as bats may have colonised Project buildings. The removal of aggregates used for road building and general infrastructure disturbance is likely to increase sediment loading potential.
Both the mine pit and TMF will require contouring at mine closure. Furthermore, both the mine workshop and process plant will require decommissioning. During the demolition of buildings, ground disturbance, removal of concrete foundations and waste disposal there is potential for contaminated soils to become mobilised and cross-contamination with off-site virgin soils may occur. This has the potential to adversely affect natural habitats, flora and fauna including terrestrial invertebrate SoCC.

As described in Section 6.7, additional mitigations post closure will aim for a positive outcome, working towards ecological restoration.

5.8.6.2.2 Critical Habitat

In addition to the assessment of effects upon terrestrial habitat, it is important to pay particular attention to key SoCC and sites that have triggered critical habitat. The Large Blue butterfly is a key focus for the Project given its classification as endangered at the European level and its role as a designating species for the Ogražden PBA. As such, the following analysis focuses upon impacts to the PBA and the habitat of the Large Blue which are independently classified as CH. The PBA is estimated to cover an area of 4,536 ha. Land take associated with the Project footprint is approximately 500 ha, which equates to approximately 11% of the total area of the PBA.

The PBA is considered to vary in terms of biodiversity quality in accordance with habitat composition, altitude and anthropogenic pressure (Micevski, 2015b, pers. comm.). The designating species of the PBA are the Large blue (Phengaris arion) and the Apollo (Parnassius Apollo), although the Apollo has not been recorded within the PBA during baseline surveys for the Ilovica Project. Large Blue butterflies have been recorded within and outside of the PBA, as illustrated in Figure 2-3. The Large Blue appears to have a restricted range within the PBA, preferring the upland (>800 masl) grasslands which will not be affected by Project infrastructure.

Analysis of habitat quality within the LSA has been undertaken based upon the findings of the baseline surveys. The resulting map, which is broadly based upon the LSA, (Figure 5-21) shows the relative value of the LSA for species within the Lepidoptera (butterfly and moth) order. Species-rich grasslands above 800 masl recorded a higher number of species per transect than those at lower elevations and are thus considered to have greater biodiversity value than other areas. This map enables analysis of land take with relation to high-, medium- and low-value butterfly habitat within the LSA (Table 5-80). Effects analysis with respect to high, medium and low butterfly biodiversity zones within the PBA shows that the vast majority (> 90%) of Project effects are within the moderate biodiversity zone. Only 1.7 ha of the high biodiversity zone (designated as critical habitat) is residually affected. To further contextualise this result it is useful to understand that the Ogražden PBA exists within Bulgaria also. Cumulatively, the Ogražden PBA measures some 49,522 ha. As such, residual effects to CH attributed to the project amount to approximately 0.003% of available habitat at this scale.
Figure 5-21: Project land take and butterfly species richness in accordance with butterfly transects and habitat modelling.

Table 5-80 Project Land Take in High, Medium and Low Value Biodiversity Zones within the LSA

<table>
<thead>
<tr>
<th>Project Component</th>
<th>High Biodiversity (Critical Habitat) (Ha)</th>
<th>Medium Biodiversity (Ha)</th>
<th>Low Biodiversity (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMF</td>
<td>0.4</td>
<td>283.4</td>
<td>0</td>
</tr>
<tr>
<td>Open Pit Area</td>
<td>0</td>
<td>119.7</td>
<td>0</td>
</tr>
<tr>
<td>Haul Road</td>
<td>0</td>
<td>27.3</td>
<td>0</td>
</tr>
<tr>
<td>Upper Plant Site</td>
<td>1</td>
<td>22.8</td>
<td>0</td>
</tr>
<tr>
<td>Off site access road</td>
<td>0</td>
<td>1.1</td>
<td>4.1</td>
</tr>
<tr>
<td>On site access road</td>
<td>0.3</td>
<td>14.2</td>
<td>0.07</td>
</tr>
<tr>
<td>Workshop</td>
<td>0</td>
<td>14.7</td>
<td>0</td>
</tr>
<tr>
<td>Buildings</td>
<td>0</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>ROM Pad</td>
<td>0</td>
<td>1.9</td>
<td>0</td>
</tr>
<tr>
<td>Conveyor Belt</td>
<td>0</td>
<td>5.4</td>
<td>0</td>
</tr>
<tr>
<td>Sewage Treatment Plant</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>
### 5.8.6.2.3 Aquatic habitats and species – Jazga River

#### Construction

Negligible changes to flows are predicted in the Jazga River upstream of the Ilovica Reservoir during construction.

During construction, changes from the baseline water quality are predicted in the Jazga River upstream of the Ilovica Reservoir in pH, alkalinity, cadmium, phosphorus, sulphates and some low amounts of iron precipitation. These changes lead to a moderate magnitude effect and low impact classification in the water quality assessment (Section 5.3). These changes will affect aquatic habitats and species to a degree due to the geographic and temporal reach and the magnitude of the change in accordance with the ecological value present. Therefore the magnitude of effect is considered moderate rather than high in the Jazga upstream of the Ilovica Reservoir.

Negligible changes in inflows to the Ilovica Reservoir are expected during the construction phase. However, Project water supply from the Turija Reservoir to Ilovica Reservoir does not become operational until Year 1 of operations, so during the construction phase Ilovica Reservoir provides water supplies for mine construction, public water supplies to the seven villages plus Ilovica and Shtuka and agricultural water for Ilovica and Shtuka. This will have a high magnitude effect on the water levels in the Ilovica Reservoir (Section 5.2). Nevertheless, the effect on aquatic habitats and species in the reservoir will be low as no species of conservation concern are explicitly linked to an exact water level or the requirement for the level to seasonally fluctuate.

There will be no discernible variation in water quality from baseline water quality predicted in the Ilovica Reservoir due to dilution provided by the River Treska and the reservoir itself the proportional volume of runoff from the project affected areas that may enter the Ilovica Reservoir. Therefore the magnitude of the effect will be negligible.

Directly downstream of Ilovica reservoir, and down to Radovo, modelling predicts that, due to the aforementioned demands on the reservoir water supply during construction, low flows will be non-existent, and baseline Q50 (median) will be reduced by 87%, leading to a high effect. However, there will be a negligible change to water quality, as above, in the reservoir itself and this stretch of the river has limited ecological value due to the existing flow regime (restricted to seepage from and overflows from the Ilovica Reservoir) and there is baseline nutrient loading associated with surrounding agriculture and other human activities. As such, the effect on aquatic habitats and species is considered to be low.
Operations

During operations, it is predicted that baseline low flows in the Jazga River upstream of Ilovica Reservoir will be lost to the pit and median flows will reduce by 17%. This change is attributed to the loss of catchment surface area, the Project’s policy of zero discharge from mine contact areas and loss of water to the pit once the base of the pit reaches a lower elevation than the riverbed (year 5). This loss of flow is predicted over a distance of approximately 0.5 to 0.9 km directly upstream of the inflow into Ilovica reservoir. This will have repercussions for aquatic ecology, with the reduction in wetted perimeter resulting in less riparian vegetation and significantly reduced flows making this stretch of the river less suitable for macroinvertebrates. The effect on this section of the watercourse is high.

During operations the Ilovica reservoir will be used to manage water supply for the Project. It is proposed to operate Ilovica Reservoir so that a freeboard of about 0.5m is maintained below spillway crest elevation by pumping water from Turija Reservoir. The effect on aquatic habitats and species in the reservoir will be negligible as no species of conservation concern are explicitly linked to an exact water level or the requirement for the level to seasonally fluctuate.

During operations, with no mitigation in place, the Project water management in the Ilovica reservoir would lead to a predicted increase to low flows of 66% and a decrease to median flows of 87% downstream of the Ilovica Reservoir. Mitigation described in Section 5.8.6.2 i.e. Euromax will agree with SPWMC a limited number of releases of water of agreed magnitude (flow) and limited duration (a few days) at certain times of the year, during operations, from Ilovica Reservoir, to simulate artificial floods that overflow the spillway, to increase the Q50 flow downstream of the reservoir. This mitigated effect would then be considered low, especially as this stretch of the river has limited ecological value, as described above. In addition, an increase in low flows in this stretch of the river is anticipated to have a positive effect on potential ecological features.
There will be no direct discharges from the Project to the Jazga River during operations, due to the Project's policy of zero discharge from mine contact areas. The aforementioned reduction in flows in the Jazga River upstream of the Ilovica Reservoir will not have an effect on water quality. Therefore there will be a negligible effect on water quality in the Jazga upstream of the Ilovica Reservoir, in the reservoir and downstream of the reservoir.

During operations the effect upstream of the Ilovica reservoir is moderate, elsewhere it is low.

**Closure – Pre Year 110**

Upstream of the Ilovica reservoir and in the reservoir itself, the effects on aquatic habitats and species are the same as for during operations. The effect remains high upstream of the Ilovica reservoir until the pit lake level reaches the Jazga river bed level in year 110, so it is likely that this stretch of river would be unsuitable for fish and some macroinvertebrates prior to year 110 owing to a reduction in Q95 flows.

The water level in the reservoir following closure (in year 27) and up to year 110 will be suppressed from baseline as low inflows from the Jazga upstream will be lost to the pit as well as a cessation of augmentation of the reservoir from Turija pipeline, which will stop at closure. However, the effect on aquatic habitats and species in the reservoir will be negligible as no species of conservation concern are explicitly linked to an exact water level seasonal fluctuation.

Downstream of the Ilovica Reservoir, the flow regime changes again from cessation of operations until post closure at year 110, at which time the reservoir will begin to receive treated pit lake spill to augment flows. Low flow is predicted to reduce by 33% and median flow by 50%, which are considered a moderate effect from a hydrological perspective. However with mitigation described in Section 5.8 would be implemented during operations, and the residual effect would be considered low for aquatic habitats and species, especially as this stretch of the river downstream of the reservoir has limited ecological value.

There will be no direct discharges from the Project to the Jazga River following closure until year 110, due to the Project's policy of zero discharge from mine contact areas. Therefore there will be a negligible effect on water quality in the Jazga upstream of the Ilovica Reservoir, in the reservoir and downstream of the reservoir.

From cessation of operations to year 110, the effect upstream of the Ilovica reservoir is moderate, elsewhere it is low.

**Post-closure – year 110 onwards**

After mine closure, it is expected that a pit lake will form over the course of approximately 90 years (at year 110), after which, the Jazga river upstream of the Ilovica Reservoir will cease losing flow to the pit and the lake will begin to spill. At this time, it will be collected for treatment prior to discharge.

From year 110 there are low or negligible effects on flows in the Jazga. However, without mitigation which will prevent the pit lake to spill directly into the Jazga, the post-closure effect on various water quality parameters (Section 5.3) and the potential for precipitation of iron hydroxides is predicted to result in major negative effects to aquatic life upstream and downstream of the Ilovica Reservoir and in the reservoir itself. SoCC such as the stone crayfish are susceptible to acidification and changes in soluble calcium as described by Favaro et al. (2010). In addition, the reservoir is used as a source of untreated water for irrigation of household crops and agriculture, and predicted water qualities could also have implications for the wider ecology of the area and potential effects to the human food chain.

Mitigation described in Section 6.8 includes a commitment to collect and pipe discharge from the pit lake for (active or passive) treatment where the pH will be neutralised and metal concentrations will be reduced before discharge to the Jazga (under a passive treatment scenario) or to Ilovica Reservoir (for an active treatment plant).

This mitigation, coupled with the cessation of loss of baseflow in the Jazga to the pit, lead to effects on aquatic habitats and species on the Jazga being low to negligible.
5.8.6.2.4 Aquatic habitats and species – Shtuka River

Construction

The location of the TMF in the Shtuka catchment will result in the permanent loss of approximately 5 km of natural lotic\textsuperscript{27} aquatic habitat. The river will be diverted along an engineered, smooth-sided concrete diversion channel which has little ecological value due to the inability of aquatic species to naturalise this channel. The diversion channel will intercept the upper catchment of the Shtuka valley, i.e. upstream of the diversion dam and divert ephemeral drainages and runoff from all areas upgradient of the diversion channel. The diversion channel will discharge into the Storm Water Dam (SWD). The SWD will attenuate high flows up to a 25 year return period storm and allow settlement of sediment-heavy runoff. Normal flows will be allowed to discharge through the porous embankment of the SWD, to maintain ecological flows downstream. However, this feature is considered likely to prohibit the passage of aquatic organisms (e.g. invertebrates and fish), which presents a barrier to natural in-stream movement and migration and thereby means that the stretch of the water course will effectively be lost in terms of ecological recruitment.

Construction of the diversion channel, SWD and the TMF will require extensive drilling, blasting and re-profiling of baseline geomorphology, which will result in an increase in sediment loading in the Shtuka River (prior to diversion). Species such as the Stone Crayfish \textit{(Austropotamobius torrentium)} will be affected by habitat loss and increases in total suspended solids (TSS), while aquatic habitat severance will be detrimental to species recruitment to available habitat. Assuming the commitments to install sediment dams, surface water drainage and surface water storage prior to stripping made in the sediment impact assessment (Section 5.8.6.4) are applied, a negligible effect to aquatic ecology is expected downstream of the sediment management facilities on the Shtuka River.

Although there may be disturbance to runoff and flows in the Shtuka River during the construction of the diversion channel, SWD, SCF and TMF, once the diversion channel is constructed negligible changes in flow patterns are expected downstream of the discharge from the SWD to the natural watercourse (section 5.2).

Operations

The diversion of the Shtuka River will result in the permanent loss of approximately 5 km of natural lotic aquatic habitat due to the TMF construction on this length of the watercourse and the prevention of movement of aquatic species upstream of the SWD. The diversion spillway will be steep enough to prevent any upstream travel of aquatic fauna which presents a barrier to natural in-stream movement and migration.

Once the diversion channel is constructed, all flows in the section of the Shtuka River upstream of the TMF will be diverted past the TMF along the diversion channel. The diverted river flows will return to the SWD via a spillway. The engineered nature of the diversion channel will result in changes in response to high rainfall events and to low flows. However, Section 5.2 shows that flood flows downstream for the TMF will be positively affected due to the additional attenuation provided and Section 6.2 presents mitigation to maintain low flows during operations. As such, negligible changes to the flow regime are expected downstream of the SWD.

A Seepage Control Facility (SCF) will be constructed on the Shtuka River between the TMF and the SWD to capture any seepage from the TMF, the embankment and runoff from both the TMF embankment and waste rock abutment during operations for it to be recycled by pumping back to the TMF or the plant site. The SCF will be sized to ensure during extreme rainfall events sufficient dilution will be provided before the SCF is overtopped.

High impacts on water quality in the Shtuka River will be mitigated by the SCF and the installation of a (95% efficient) grout or gel curtain to intercept seepage and encourage it to surface for recycling (Section 6.8.6.3); in addition to the encapsulation of the acid generating material. The predicted unmitigated water quality during operations (Section 5.3) does not differ enough from the baseline water quality to warrant concern that this

\textsuperscript{27} Lotic aquatic habitat = aquatic habitat which is reliant on a dynamic environment or flowing fresh water
mitigation, along with dilution from the diversion channel, would not be able to fully mitigate effects on aquatic habitats and species downstream of the SWD.

**Closure**

The TMF will remain in the Shtuka valley following closure. Therefore regardless of whether the diversion channel falls into disrepair and potential brownfield naturalisation, there is a permanent loss of approximately 5 km of natural lotic aquatic habitat in the valley. In addition, the presence of the SWD and TMF is considered likely to prevent the passage of aquatic organisms (e.g. invertebrates, fish), upstream, although following closure it is possible the SWD will be de-commissioned. Runoff/sediment ponds, including the SWD, will be decommissioned during the closure phase, once monitoring identifies that discharge water quality is acceptable for discharge to the environment.

Following closure, without mitigation, low flows would be affected, however with mitigation proposed in Section 6.2 in place, effects on aquatic habitats and species downstream on the TMF due to change in flow regime, will be low.

The SCF and the grout or gel curtain will be maintained in perpetuity or until water quality monitoring allows their decommissioning. The SCF will continue to collect seepage from the TMF and runoff from the TMF embankment plus the waste rock abutment. Seepage and runoff collected in the SCF will then be piped to a treatment facility (described in Section 6.8). This mitigation also includes the provision for funds to allow this process to continue in perpetuity.

The SCF and mitigation previously described should be able to mitigate high impacts on water quality in the Shtuka River downstream of the TMF. However the predicted unmitigated water quality following closure (Section 5.3) differs significantly from the baseline water quality. Quantitative analysis has not yet been completed to confirm residual water quality parameters which have the potential to reduce the suitability of this habitat to support aquatic invertebrates and fish, but these are likely to include low pH and elevated metal levels. Therefore, as part of the detailed design of the SCF and grout curtain, the design criteria will need to ensure that residual water quality will not affect aquatic habitats and species. On this basis, a conservative approach is taken and the effect on aquatic receptors is considered moderate downstream of the TMF.

**Aquatic Critical Habitat**

The presence of stone crayfish within the LSA and RSA triggered critical habitat screening for this species. This species appears to be relatively abundant throughout the CHAA (RSA). It was concluded that stone crayfish did not trigger critical habitat under criterion 1 owing to the fact that the CHAA does not support >10% of the European range for this species (Füreder, 2010). Nonetheless, this species along with many other species depend on the natural aquatic habitat afforded within the LSA. As such, and in accordance with good practice all areas of natural habitat will be afforded protection in accordance with the mitigation hierarchy to achieve no net loss of biodiversity (refer section 6.8).

**5.8.7 Impact Classification**

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

**5.8.7.1 Magnitude of the Effect**

To classify magnitude using an ordinal scale (i.e., negligible, low, moderate, or high) in a manner meaningful for biodiversity features, the effect size must be placed in the context of the feature. That is, classifying magnitude in a meaningful way depends on the historical and ecological context of the feature, which includes effects of previous and existing developments and population trajectories of the feature in the appropriate scale (RSA), and will be feature specific. Hence, this assessment focuses on SoCC and their habitat.

Most ecological threshold values in the accepted literature indicate that a habitat loss of 40% or more would be required before irreversible decline occurs (Rompre et al. 2010, Swift and Hannon 2010). Lande's (1997) demographic model predicted that species with low demographic potential cannot persist if suitable habitat is
reduced by more than 20%. For impact assessment purposes more of a buffer is required owing to uncertainties. A lower “screening value” of 10 to 20% is applied in this assessment and analysis is focused on the LSA wherein the Project can exercise more conservation influence.

Where possible, magnitude was quantified as a specific value such as number of hectares of habitat lost. However the magnitude criteria have been defined based on qualitative descriptions of the potential for an effect to contribute to a substantial change in the structural integrity (e.g., self-sustaining population) or ecological function (Table 5-81). Magnitude is then combined with duration and geographic extent using the reasoned narrative presented in the analysis section to define an overall RSA-level effect. Table 5-81 presents the criteria used for the impact assessment.

Table 5-81: Impact Assessment Criteria for Ecology

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic Extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>Local: Biophysical local study area</td>
<td>Short-term: Effect is reversible at end of construction</td>
<td>Infrequent: Effect occurs intermittently but not continuously over the assessment period</td>
</tr>
<tr>
<td>Low</td>
<td>Regional: Biophysical regional study area</td>
<td>Medium-term: Effect is reversible at end of operations</td>
<td>Frequent: Effect occurs repeatedly or continuously over the assessment period</td>
</tr>
<tr>
<td>Moderate</td>
<td>Beyond regional – Greater than regional study area, including transboundary</td>
<td>Long-term: Effect is reversible within a defined length of time or beyond closure</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Measurable large habitat and/or other effects to SoCC, but no exceedance of resilience limits of regional population</td>
<td>Permanent: Effect not reversible</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Importance/Sensitivity of Receptor</th>
<th>Example of sensitivity of ecological receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Species: IUCN status of critically endangered (CR) or endangered (EN) and/or critical habitat threshold (Tier 1 or 2 met). Habitats: Extensive naturalness, size, rarity and diversity (Ratcliffe, 1977). Additionally, principles described by the Nature Conservancy Council (1989) that includes the attributes of “non-recreatability”.</td>
</tr>
<tr>
<td>High</td>
<td>Sensitive area or receptor with little resilience to imposed stresses OR IUCN status of vulnerable (V), near threatened (NT), or data deficient (DD) protected nationally and listed on Habitats or Birds Directive.</td>
</tr>
</tbody>
</table>

Consideration of Receptor Sensitivity

Determination of the consequence of impacts to ecology is based upon the impact classifications from the impact assessment process, specifically the RSA level effect, combined with the sensitivity of ecological receptors (Table 5-82).
5.8.7.2 Determination of Impact

Using the decision matrices presented in Section 1 and the receptors defined in Section 5.7.3, the impacts and consequences have been determined, incorporating only those mitigations presented in Section 5.7.2 and the mitigation applied by technical disciplines providing results that feed into this impact assessment (e.g. water, soil, air quality and noise).

Table 5-83 presents the classification of each impact where overall consequence is predicted to be moderate or higher. Table 1 in Annex 5F presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for all impacts.

The ecological implications of an assessed effect are gauged at the RSA population level which is a more ecologically relevant scale. As noted above, RSA level effect is determined by combining magnitude, geographic extent and duration of the effect and may be:

- Negligible: No detectable effect to a valued feature;
- Low: Detectable effect, but within known or inferred ability for a feature to absorb without loss to structural integrity (e.g., self-sustaining population) or ecological function at the RSA scale;
- Moderate: Effect near limits or slightly beyond known or inferred ability for a feature to absorb without loss to structural integrity (e.g., self-sustaining population) or ecological function at the RSA scale; or
- High: Effect well beyond known or inferred ability for a feature to absorb without loss to structural integrity (e.g., self-sustaining population) or ecological function at the RSA scale.

Finally the RSA level effect is combined with sensitivity using the matrix given in Section 1 to derive overall consequence. For biodiversity, the four consequence levels may be defined as follows:

- Negligible: no measurable adverse impacts to valued features from the Project;
- Minor: impact level acceptable to viability of valued features; mitigation is adequate and achievable but monitoring may be necessary;
- Moderate: impact level requires follow up action, including the possibility of offsetting to achieve NNL; monitoring necessary to evaluate continued viability or integrity of valued features and provide opportunities for adaptive management; and
- Major: impact level requires higher-level mitigation (i.e., offsetting) to achieve NNL; implies proximity to, and risk of exceedance of, biodiversity standards; monitoring necessary to evaluate continued viability of valued features and provide opportunities for adaptive management.

Terrestrial Habitat and Species

The geographical extent of direct footprint impacts (e.g. land take) will be local because effects are restricted to the LSA. Impact duration without reclamation will affect the habitat and associated species over the medium-term. Impact duration including reclamation will be long-term (i.e., 50 years after closure) because reclaimed habitat will not be available immediately after mine closure. Of most concern are impacts to critical habitat, natural habitat and flora and fauna SoCC. However, as noted in the effects analysis, the more natural forest communities and most species rich grassland occur at higher elevations and are impacted less than the average loss across all habitats.
During the construction phase, 2% of pastures within the LSA are lost, which is estimated to represent 0.4% of the available pasture habitat within the RSA. The loss of pasture rises to 4% in the LSA during operations and closure which represents 0.7% at the RSA scale. This loss is not expected to be increased due to air emissions from the Project, therefore loss of pasture is classified as being an impact of minor consequence. For pasture, only a negligible increase in disturbance is predicted with relation to air emissions from the Project. Effects associated with NO\textsubscript{x}, SO\textsubscript{2} and dust will not increase physical footprint effects on pasture or forest.

Terrestrial settlements and fields (although modified habitat) are used by various listed SoCC, including flora, butterflies and bats and so are also considered to be high sensitivity. However, at a maximum loss of 1% of the available habitat within the LSA, impact consequence is negligible.

The complete avoidance of impacts to beech (sub-type 2) and beech/pine forest, which only occur at higher elevations, reduces the overall impact to the natural forest communities. However, some SoCC will be associated with modified forest habitats, including fauna such as bats and fungi which are associated with oak and hornbeam forest which is impacted at 15% in the LSA during operations and early closure. Maximum disturbance of any forest type is 27% for the turkey oak community in the LSA, but that is still under 4% of the available habitat at the RSA level. Some forest clearance will be permanent due to the construction of the pit and the TMF.

The magnitude of forest impacts is negligible or low for natural habitat but moderate for modified forest and, in some cases, permanent. Taking a conservative approach (without additional mitigation), overall forest impacts are considered to be moderate magnitude and of moderate consequence, except major consequence for permanent impacts on the TMF. Additional mitigations will be required to lessen impacts to forest habitats.

Considering the distribution of flora SoCC overall, impacts are predicted to be moderate magnitude and moderate consequence. Additional mitigations will be required to further minimise impacts and work towards NNL.

For non-butterfly fauna SoCC overall, impacts are also predicted to be moderate magnitude and moderate consequence. Additional mitigations will be required for bats and herpetofauna to further minimise impacts and work towards NNL.

Aquatic Habitat and Species

Even with mitigation commitments made in Sections 6.2 and 6.3 implemented, negative impacts to aquatic habitat will remain.

Impacts concern the loss of 5 km of lotic aquatic habitat within the Shtuka valley, the residual impact of water quality post closure downstream from the TMF and the reduction in flows over 0.5 to 0.9 km of the Jazga River.

The impact of reduced flows in the stretch of the Jazga River upstream of the Ilovica reservoir, which is of high sensitivity, throughout operations from year 5 to year 110 results in a moderate consequence.

The main impact to the Ilovica Reservoir comes from water management of the reservoir for Project supplies and specifically the water demand during construction, during which time the Ilovica Reservoir will not receive abstraction water from the Turija reservoir supply. However due to mitigation proposed from year 1 (i.e. short impact duration), the low sensitivity of the habitat in the reservoir to fluctuations and the low ecological value of the Jazga downstream and within the reservoir, this results in a minor consequence.

In the Shtuka River, the main impact to aquatic habitat is from the loss of 5 km of natural aquatic habitat when the Shtuka is diverted into the diversion channel around the TMF. As a permanent impact, until the channel falls into disrepair in closure, this results in a major consequence upstream which requires additional mitigation. Efforts to minimise adverse effects through additional mitigation should focus on impacts to SoCC. Consideration of additional mitigation is required to meet the commitment for NNL of natural habitat.

In addition, the potential impact on water quality post closure, downstream of the TMF, requires further investigation and is therefore classified as a moderate consequence.
Critical Habitat

Impacts to critical habitat will be discrete yet negative. The geographical extent of impacts will be local because effects are restricted to the LSA. The focus of critical habitat recognition has been generating an understanding of the biodiversity features of the PBA and associated designating species such as the Large Blue butterfly. The quality of habitat varies across the PBA and the Project footprint avoids much of the best quality habitat (Micevski, 2015a, pers. comm.). Land take through the operational phase will increase and encroach toward species-rich pasture identified as CH. The Impact duration without reclamation of the Project footprint will affect the critical habitat and associated species over the medium-term (operation and closure). Impact duration including reclamation will be long-term (i.e. 50 years after closure) because reclaimed habitat will not be available immediately after mine closure.

Although the high biodiversity PBA butterfly zone (critical habitat) is essentially avoided, the predicted impacts on 13.3% of the moderate biodiversity zone within the LSA and broader PBA during construction and operations is a moderate magnitude impact. Given that the high biodiversity zone is outside of the project footprint and the Large Blue butterfly was also observed outside the PBA, it is possible that impacts would be classed as low if a fuller understanding of species regional distribution and habitat use was obtained. This species is likely to be under recorded at the RSA scale. More information in this regard may come out of the separate local EIA and ESIA addendum for the Berovo – Ilovica OHL. Re-assessment of overall impacts will be addressed in the addendum.

Furthermore, efforts to reintroduce the Large Blue have been successful within the UK28 and few other species are now as well understood as this enigmatic example. However, given the very high sensitivity of the PBA, which is classified as critical habitat, a moderate level impact still results in a major consequence without additional mitigation. Such additional mitigation will also lessen effects on other fauna of conservation interest, including additional invertebrate species. Consideration of additional mitigation is required to meet the commitment for NNL of natural habitat and net gain for critical habitat.

Table 5-83: Impacts for Ecology where overall consequence is moderate or higher

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Source of impact</th>
<th>Impact consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial habitats – forest communities (excluding the TMF)</td>
<td>Construction, operations</td>
<td>Site clearance and project footprint.</td>
<td>Moderate.</td>
</tr>
<tr>
<td>Terrestrial habitats – forest communities (TMF)</td>
<td>Construction, operations, closure</td>
<td>Site clearance and project footprint.</td>
<td>Major.</td>
</tr>
<tr>
<td>Flora SoCC</td>
<td>Construction, operations, closure</td>
<td>Site clearance and project footprint.</td>
<td>Moderate.</td>
</tr>
<tr>
<td>Terrestrial Fauna SoCC (non-butterfly)</td>
<td>Construction, operations, closure</td>
<td>Site clearance and project footprint, noise from traffic, blasting, and crusher, fauna becoming trapped in trenches and ditches attributed to construction activities.</td>
<td>Moderate.</td>
</tr>
<tr>
<td>Aquatic habitat and species – Upstream of Ilovica Reservoir</td>
<td>Operations, closure</td>
<td>Reduction of baseflow in Jazga leading to loss of aquatic habitat.</td>
<td>Moderate.</td>
</tr>
<tr>
<td>Aquatic habitat and species – Shtuka River upstream of SWD</td>
<td>Construction, operations, closure, post-closure</td>
<td>Permanent diversion of the Shtuka River into the diversion channel.</td>
<td>Major.</td>
</tr>
</tbody>
</table>

28 http://www.ceh.ac.uk/large-blue-butterfly accessed 30.12.15
5.9 Ecosystem Services

5.9.1 Source of Effects

Project activities will change the physical landscape and socio-economic context, which will result in direct and indirect impacts to priority ecosystem services.

The key sources of impacts will include:

- Changes in land cover and the physical presence of the Project in the landscape (e.g. reduction of an ecosystem’s capacity to supply grazing for livestock due to reduction in extent from vegetation clearance);
- Changes to hydrological regimes;
- Changes to availability of ecosystem services due to increased influx of people;
- Changes to alien invasive species in areas where vegetation has been cleared;
- Changes to the supply of provisioning ecosystem services (e.g., mine infrastructure areas may be fenced off which could restrict access to grazing lands for cattle); and
- Presence of associated infrastructure including the proposed overhead powerline.

Potential sources of effects have been discussed with other technical discipline lead authors to ensure a coherent and holistic approach has been applied.

5.9.2 Incorporated Environmental Measures

The following presents the environmental measures relevant to Ecosystem Services which have been incorporated into the project design:

**Erosion Control and Sediment Management**

- Energy dissipaters will be installed to prevent the carriage of sediment with fast flowing water;
- Physical erosion control features such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting will be used to control erosion prior to the establishment of vegetative cover; and
- As soon as practicable, temporarily disturbed areas will be graded, re-vegetated and reclaimed so that surface water run-off from these areas will be similar to natural or pre-mining conditions.

**Dust and Air Quality Management**

- Dust suppression through spraying with a water truck and/or fixed sprinklers on roads, stockpiles, crusher, conveyor, material transfer points will be undertaken; and
- Established speed limits will be defined and adhered to. Loads will be sealed and generators for use during the construction phase will be specified for minimal dust and air emissions.

**Water Management**

- Sewage effluent will be treated in the plant process water system and not discharged to the environment; the treated effluent will conform to the European's Union's Urban Wastewater Directive;
Water discharges to the environment will be managed to replicate natural variability associated with high and low flows;

Shtuka channel to be designed, where possible, at closure to facilitate naturalisation e.g. colonisation of aquatic and marginal vegetation (as discussed in Section 5.8.2);

Increased runoff due to vegetation clearance will be stored and attenuated before controlled discharge to watercourses; and

Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible.

**Hazardous Materials Areas**

- Fuel and chemical storage and usage areas will be demarcated, sealed and bunded, with storm water directed around these areas;
- Bunded areas, for storage of hazardous materials, are designed to hold 110% of volume of the largest tank in a specific area;
- All fuel or storage tanks will be stored on hard standing to prevent any spills from infiltrating to the underlying soil; and
- Grease and oil traps will be installed at refuelling facilities, workshops and fuel storage depots. Drip trays will be used in the plant and workshops. These will be incorporated into the detailed design of the Workshops and Fuel Storage facilities.

**Vegetation Clearance and Overhead Powerline Alignment**

- All vegetation adjacent to waterbodies including rivers and streams will be retained unless the waterway is to be removed or diverted; and
- Vegetation clearance will be minimised and areas cleared immediately before work takes place, as far as possible.

**5.9.3 Study Area and Receptors**

The approach taken to ecosystem services review and Impact assessment was based on guidance and tools developed by the World Resources Institute (Landsberg et al, 2011).

Consultation results described within the socio-economic baseline and impact assessments have been integrated within this assessment to ensure that identification of baseline priority ecosystem services transcends geographical boundaries such as the LSA. It should be noted that residents of the village of Sushica are outside of the LSA, but within the regional study area; however they may travel to within the LSA to secure the personal and commercial benefits of priority ecosystem services available.

Therefore the study area for ecosystem services is the same as the biophysical study area presented in section 2.8, plus the residents of Sushica and the key receptors for ecosystem services are the following:

- Residents in Ilovica;
- Residents of Shtuka;
- Residents of Strumica; and
- Residents of Sushica.

Table 5-1 lists the LSA communities and their population. Other communities were considered in the screening process, but were ruled out as no Project-associated effects were predicted.

**Table 5-84: Communities in the local study area and populations**
### Community Municipality Population (2002)

<table>
<thead>
<tr>
<th>Community</th>
<th>Municipality</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>Bosilovo</td>
<td>1,907</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Bosilovo</td>
<td>781</td>
</tr>
<tr>
<td>Strumica</td>
<td>Strumica</td>
<td>45,087</td>
</tr>
<tr>
<td>Sushica</td>
<td>Novo Selo</td>
<td>1,811</td>
</tr>
</tbody>
</table>

#### 5.9.4 Considerations from Stakeholder Engagement

The following issues were identified during the stakeholder engagement process and are relevant to the impact assessment for ecosystem services:

- Concerns over the potential for bioaccumulation of heavy metals by plants including vegetables (Open House 16 September 2015);
- Concerns over water quality and suspended sediments even when there is no rain (Open House 16 September 2015);
- Concerns regarding what will happen to fauna in the Project area (Open House 16 September 2015);
- Concerns regarding water quality with regard to tailings and effects to air quality (Municipality of Novo Selo, 16:00hrs, 25 March 2015);
- Will there be a tree planting program? (Municipality of Novo Selo, 16:00hrs, 25 March 2015);
- Concern that the Project may contaminate groundwater and produce;
- Concern that the tailings dam will influence water used for agriculture and livestock;
- Concern that livestock grazing may be disturbed by mining facilities and loss of access to concession;
- Concern that the Project will cause vibrations and changes in air quality affecting beekeeping;
- Concern that the mine may inhibit access to hunting and affect wildlife populations;
- Concern that fuel wood removed during construction should go to residents of Ilovica and Shtuka;
- Concern that tree removal will affect the air quality in the area adversely;
- Concern that there will be changes in drinking water quality due to mining activity;
- Concern that the Project will change the availability of drinking water, particularly in the Ilovica Reservoir; and
- Concern about the Project’s effect on water quality in communities.

#### 5.9.5 Key Guidelines and Standards

The following National and International guidance and laws pertaining to the identification and maintenance of ecosystem services include:

**National**

National laws relating to nature conservation and protection, relevant international conventions and agreements signed by Macedonia and other international policies and standards related to biodiversity and ecosystems were considered as follows:

- Law on Environment (Official Gazette of the Republic of Macedonia no. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 44/15); and
Law on Protection of Nature (Official Gazette of the Republic of Macedonia no. 67/04, 14/06, 84/07, 35/10, 47/11, 148/11, 59/12, 13/13, 163/13 and 41/14).

European


- European Union (EU) states in its biodiversity strategy to 2020 its intention to “ensure no net loss of biodiversity and ecosystem services” through assessment and mitigation of impacts of EU funded projects, plans, and programs (EU, 2011);


International

Since 1 January 2012, the International Financial Corporation (IFC) has required its clients to address ecosystem services in their assessment and management of environmental and social risks and impacts. References to ecosystem services requirements are found in Performance Standards (PS) 1, 4, 5, 6, 7 and 8 (IFC 2012). PS 6 requires clients to “maintain the benefits from ecosystem services” when designing and implementing projects, as well as to “implement mitigation measures that aim to maintain the value and functionality of priority services”.

These commitments are also echoed in the EBRD Performance Requirements. The overall goal is to mitigate project impacts on “priority” ecosystem services so that the benefits people derive from these services are maintained when the Project is developed, operated and then closed. Similarly, for services used and depended on by a Project, the goal is to ensure that there will be a sustainable supply throughout the Project’s planned operational life.

Additionally, Euromax has put in place the following policies, all of which have been considered in the ecosystem services effects analysis:

- Community Policy (August 2013);

- Community Investment Framework (September 2014);

- Stakeholder Engagement Plan (September 2015), including the following procedures:
  - Community Investment (Section 10 of the SEP; Annex 2);
  - Employment and Procurement (Section 11 of the SEP; Annex 2); and
  - Grievance Mechanism (Attachment A, SEP; Annex 2).

- Environmental Policy (August 2013):
  - Land Acquisition and Resettlement Framework (LARF), Ilovica-Shtuka Project.

5.9.6 Effects Analysis

5.9.6.1 Methods

Ecosystem services are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. In the strictest sense, without beneficiaries, there are no ecosystem services. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. For the purposes of this assessment, the definitions of ecosystem services were based on those developed by the

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Millennium Ecosystem Assessment (MA, 2005). These definitions were chosen to keep consistency with the IFC’s Performance Standards, and because they are widely recognised.

Table 5-85: Ecosystems services categories (MA, 2005)

<table>
<thead>
<tr>
<th>Broad categories</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting services</td>
<td>Natural processes essential to resilience, and functioning of ecosystems. e.g., primary production.</td>
</tr>
<tr>
<td>Regulating services</td>
<td>Control of the natural environment, e.g., maintenance of key ecological processes, protected areas, habitat of special value, groundwater recharge, catchments.</td>
</tr>
<tr>
<td>Provisioning services</td>
<td>Supporting human needs, e.g., traditional hunting grounds, medicinal plants and minerals, water sources, fishing grounds, fire wood.</td>
</tr>
<tr>
<td>Cultural services</td>
<td>Aesthetic, spiritual, recreational, and other cultural values, e.g., sacred sites, recreation, sense of place.</td>
</tr>
</tbody>
</table>

Without the beneficiaries (that is, the local community (Type I) and the Project (Type II)), there are no ecosystem services. In terms of a project’s location, an understanding of the ecosystem processes occurring in the area is important, as it enables an understanding of how those processes affect the supply and demand of the ecosystem services arising from such processes, and the value the ecosystem services eventually offer to beneficiaries (i.e. ecosystem service supply). A conceptual ecosystem services flow path illustrating these supply linkages, using the photosynthesis process and the functions, services and benefits that flow from it as an example, is shown in Figure 23.

Figure 23: The flow of ecosystem services to beneficiaries – Primary production is the supporting role of elements, soils and climate to facilitate ecosystem function, in this case photosynthesis.

The assessment of the impacts of the project on priority ecosystem services involved the following steps (expanded upon in Section 5.9.5.1.1):

- Identifying priority ecosystem services within the local study area (LSA), as defined in the Ecosystem Services baseline report (Annex 3, Chapter 11);
- Establishing the baseline for the priority ecosystem services assuming current levels of use;
- Predicting project impacts on priority ecosystem services (their supply, use or benefits as appropriate), using current levels as the baseline; and
- Mitigating project impacts on priority ecosystem services to ensure that benefits are maintained.

As well as assessing the impacts of the Project on ecosystem services used or depended on by others, the assessment also considered the dependence of the Project on ecosystem services. The aim in this case is to ensure that operational performance can be maintained throughout the lifetime of the Project. The review therefore involved the following steps (expanded upon in Section 5.9.5.1.1):
Identifying priority ecosystem services (services which the Project is strongly dependent on, with limited alternatives);

Predicting potential changes in the supply of priority ecosystem services and associated benefits over the lifetime of the Project;

Assessing loss in operational performance as related to changes in priority ecosystem services; and

Identifying measures needed to manage project dependencies on priority ecosystem services so that operational performance can be sustained.

The information used to carry out the assessment was obtained from a variety of baseline and impact assessment social and ecological surveys and assessments, including:

- Ecosystem services report of the Regional Study Area (RSA)/LSA Ilovica (Biomaster, 2015);
- Ethnobotanical (people and plant relationships) observations (Biomaster, 2014 and 2016/2016a);
- Habitat and land use mapping/Surveys of biodiversity and ecosystems (Annex 3, Chapter 10);
- Socio-economic studies - Interviews, focus groups, and stakeholder meetings as part of the socio-economic baseline study and Impact Assessment (Annex 3, Chapter 14 and section 5.12 Impact Assessment);
- Soils survey and mapping (Annex 3, Chapter 3 and section 5.1 Impact Assessment); and
- Integrated water studies - quality and quantity (Annex 3, Chapters 5 and 6 baseline and sections 5.2 and 5.3 Impact Assessment).

5.9.6.1.1 Assessing the Projects Effects on Ecosystem Services

The impact assessment process was aligned with the World Resources Institute (WRI) approach (Landsberg et al., 2013), consisting of a combination of the WRI approach to assessment of Project impact on priority ecosystem services and thereby assessment of impact on beneficiaries (Figure 24); and the prescribed impact assessment method being used for the ESIA.

5.9.6.1.2 Assessing the Projects Dependence on Ecosystem Services

Type II priority ecosystem services are "those services on which the project is directly dependent for its operations" (IFC, 2012). A project can compromise its own future viability or performance if it undermines the services on which it depends or if these services are at risk of being undermined by others within the proposed lifetime of the Project. Changes in an ecosystem service are more likely to lead to a loss in benefit to the project if large changes in the service are expected, or if the service is already close to a sustainability threshold. Economic development and demographic change in an area, for example, might be expected over
the life of a project, possibly resulting in increased deforestation with associated loss in protection from erosion that could be costly to the project (Landsberg et al., 2011).

The availability and level of supply of ecosystem services needed by the Project was therefore reviewed. The following flowchart illustrates the process for identifying priority services with respect to the dependence of the Project on ecosystem services.

Figure 5-25: Decision Tree for identifying Priority Ecosystem Services which the Project depends on[30].

The decision tree shown in Figure 25 reflects the following criteria which were used to identify priority ecosystem services:

- The service contributes directly to the project’s operations;
- It could change over the life of the project in ways that could lead to operational risks; and
- The project has no viable alternatives to this service to achieve planned operational performance.

For each of the priority ecosystem services, future supply and benefits to the project were predicted based on expected ecosystem change driven by factors external to the project and the project itself.

The impact assessment identifies the intensity of a particular impact from the Project and then compares that intensity with the sensitivity of the receiving environment to derive an overall severity for the impact. In the context of ecosystem services, this is a ‘social’ receiving environment that includes communities and their social functions, or their ‘cultural norms’. This method relies on a detailed description of both the impact and the ecosystem service valued component that is the receptor valued for its contribution to human wellbeing. The intensity of an impact depends on its characteristics, which includes factors such as its magnitude, duration, area of extent, and nature in terms of whether positive, negative, direct, indirect or cumulative.

5.9.6.2 Magnitude of the effect

Table 5-86 presents the categorisation of effects which will inform the effects analysis, results for which are presented in Section 5.9.6.3, and impact classification, the results for which are presented in Section 5.9.7.

Table 5-86: Magnitude assessment rating scale

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Rating scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>No predicted change from baseline.</td>
</tr>
<tr>
<td>Low</td>
<td>Where the impact affects the environment in such a way that natural, and/or cultural and social functions and processes are slightly affected and valued, important, sensitive or vulnerable systems or communities are also slightly affected. Measurable but small changes prevail on the natural, and/or cultural/social functions/process as a result of project implementation.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Where the affected environment is measurably altered but natural, and/or cultural and social functions and processes continue albeit in a modified way, and valued, important, sensitive or vulnerable systems or communities are moderately affected.</td>
</tr>
<tr>
<td>High</td>
<td>Where natural and/or cultural or social functions and processes are measurably altered to the extent that they will temporarily or permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. The changes to the natural and/or cultural/social-economic processes and functions are drastic and commonly irreversible and unacceptable.</td>
</tr>
</tbody>
</table>

5.9.6.3 Results

The following sections present predicted impacts on priority ecosystem services and therefore, human well-being. The impact assessment is not separated into construction/operation/decommissioning phases, as the ecosystem services are generally tied to land cover types and associated loss to the Project footprint (especially provisioning and regulating ecosystem services), or the presence of the Project in the landscape (cultural ecosystem services), which will be in effect for the lifetime of the Project. However, where potential impacts on ecosystem services are considered specific to a particular Project phase (for example, regulation of air quality is more likely to be affected during the operational phase of the Project), this is stated.

Direct effects to ecosystem services associated with SO₂, NOx, dry deposition of nitrogen and dust have all been considered. With the exception of NOx all effects are within the accepted environmental parameters to indicate negligible effects. The exceedances in annual NOx occur in habitat areas dominated by sessile oak forest (Orno-Quercetum petrae) at lower altitudes. Much of the oak/hornbeam forest (Querco-Carpinetum orientalis) and sessile oak forest is modified by frequent and extensive clear cut felling through licenced and un-licenced operations. This habitat type is ubiquitous and generally fairly tolerant of anthropogenic pressure. Exceedances of annual NOx are fairly low with a percentage increase of 8% above the EDC. As such, it is considered unlikely that ecosystem services will be affected by this exceedance in this relatively discrete area.

Land take during Project operation will increase to its maximum during operations when the TMF and pit are at their full extents. Table 5-87 presents the total loss of land cover and vegetation types predicted for the operations and closure phases (prior to any revegetation taking effect).
### Table 5-87: Land take – Operation and Closure Phases Maximum Extent

<table>
<thead>
<tr>
<th>All values in Ha</th>
<th>TMF (a)</th>
<th>Open pit area</th>
<th>Haul road</th>
<th>Plant site</th>
<th>Conveyor belt</th>
<th>Workshop</th>
<th>Stockpiles</th>
<th>Buildings</th>
<th>Off-Site reservoirs (permanent)</th>
<th>ROM pad</th>
<th>On site access road</th>
<th>SWD</th>
<th>SCF</th>
<th>Sewage treatment plant</th>
<th>Total</th>
<th>As a % of available habitat within LSA</th>
<th>As a % of available habitat within RSA (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td>12.19</td>
<td>11.07</td>
<td>2.03</td>
<td>20.69</td>
<td>1.67</td>
<td>0</td>
<td>0.28</td>
<td>0</td>
<td>0</td>
<td>1.24</td>
<td>0.07</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>49.24</td>
<td>4%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Settlements and Fields</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.02</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0.07</td>
<td>4.16</td>
<td>0.1%</td>
<td>&gt;0.1%</td>
</tr>
<tr>
<td>Forest communities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessile oak forest</td>
<td>71.59</td>
<td>11.57</td>
<td>0.3</td>
<td>2.26</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.59</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>90.39</td>
<td>6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Turkey oak forest</td>
<td>150.50</td>
<td>77.05</td>
<td>6.08</td>
<td>0.81</td>
<td>1.63</td>
<td>0</td>
<td>0.81</td>
<td>0</td>
<td>0</td>
<td>1.44</td>
<td>4.13</td>
<td>0.39</td>
<td>0.39</td>
<td>0</td>
<td>242.85</td>
<td>27%</td>
<td>3.7%</td>
</tr>
<tr>
<td>Beech forest (subtype 1)</td>
<td>13.53</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.08</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>14.6</td>
<td>2%</td>
<td>0.30%</td>
</tr>
<tr>
<td>Beech forest (subtype 2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Oak and hornbeam forest</td>
<td>35.97</td>
<td>20.02</td>
<td>19.17</td>
<td>0</td>
<td>1.99</td>
<td>14.74</td>
<td>2.95</td>
<td>1.42</td>
<td>4.06</td>
<td>0.54</td>
<td>4.60</td>
<td>0.03</td>
<td>0.03</td>
<td>0</td>
<td>102.38</td>
<td>15%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Beech / pine forest</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.07</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total (forest communities)</td>
<td>271.59</td>
<td>108.64</td>
<td>25.55</td>
<td>3.08</td>
<td>3.70</td>
<td>14.74</td>
<td>3.76</td>
<td>1.42</td>
<td>0</td>
<td>1.98</td>
<td>14.4</td>
<td>0.42</td>
<td>0.42</td>
<td>0</td>
<td>450.2</td>
<td>7.5%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Total land take per project component</td>
<td>283.78</td>
<td>119.71</td>
<td>27.58</td>
<td>23.77</td>
<td>5.36</td>
<td>14.74</td>
<td>4.03</td>
<td>1.42</td>
<td>4.60</td>
<td>1.98</td>
<td>15.7</td>
<td>0.49</td>
<td>0.49</td>
<td>0.07</td>
<td>508.2</td>
<td>8.2%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

- (f) Includes Shtuka bypass channel
- (g) Calculations of extent of vegetation community within RSA is based upon Corine landcover mapping (satellite imagery) owing to the scale of the RSA.
5.9.6.3.1 Provisioning Ecosystem Services

The potential impacts on provisioning within the Project Area of Influence will extend throughout the life of the Project, due to the presence of the Project and associated loss of land cover to its footprint. Livestock husbandry, apiculture (bee keeping), fruit, vegetable, arable and wild food consumption have all been identified as integral to the relevant provisioning ecosystem services. Despite plans to re-vegetate much of the Project footprint and in the absence of mitigation, long term or permanent residual impacts are expected on much of the affected pasture and forestry land (Section 6.9).

Livestock including Grazing Provision

This service is produced from grasslands affected by the Project. The supply, use and benefits associated with this ecosystem service are all expected to change as a result of the Project. Many of the local herding families have adopted the ‘hefting’ method of grazing. Hefting is a traditional method of managing flocks of sheep and cattle on large areas of common land and communal grazing. Initially, sheep and cattle have to be kept in an unfenced area of land by constant shepherding. Over time this has become learned behaviour, passed from ewe to lamb or cow to calf over succeeding generations. Lambs and calves graze with their mothers instilling a lifelong knowledge of where optimal grazing and shelter can be found throughout the year. This type of husbandry requires little or no input from a shepherd/herder on a day to day basis as livestock will graze, shelter and reproduce with little intervention. Hefted cattle are difficult to relocate as this learned behaviour does not replicate well to new grazing areas.

Approximately 49 ha (4% of the available resource within the LSA) of pasture will be directly affected by the Project. Grazing habitat and grassland condition may also decline to an extent due to secondary impacts such as pollution by fugitive dust and hydrological change. Restricted access arrangements and barriers created by the presence of infrastructure may mean that some access to traditional production areas is lost. This ecosystem service was identified as a priority service for local herding beneficiaries in the villages of Ilovica and Shtuka.

At the RSA level less than 1% of available grazing habitat will be residually affected by the Project. A reduction at this scale is not considered to be a high intensity effect and is of minor environmental consequence. Nevertheless, on a worst-case basis, a moderate magnitude Project effect on this ecosystem service is expected where access restrictions and footprint loss impact directly upon the beneficiaries of this ES, specifically those families who graze their livestock on affected land.

Frui
t, Vegetable and Arable Production

Arable land and gardens comprise the majority of agricultural land, accounting for 85% (6,528 ha) of land in the Municipality of Bosilovo and 62% (5,318) in the Municipality of Novo Selo (Annex 3, Chapter 10). Within the LSA, arable production is limited to the lower altitude land around the Jazga and Shtuka flood plain amounting to approximately 700 ha. With greater altitude further up these catchments soils become poorer and grazing of sheep and cattle becomes more prevalent. Approximately 1.2 ha (1% of the available resource within the LSA) of arable habitat will be directly affected by the Project.

Apiculture (beekeeping) for honey production is practised within the LSA and a number of bee hives are situated on the slopes to the east of Shtuka. The Project would result in direct and potentially indirect effects being afforded to this element of provisioning priority ecosystem service. Project land take would result in the reduction of available habitat and the hives themselves. Equally, effects from blasting on apiculture are not understood but likely to be adverse.

At the RSA level; less than 1% of available arable habitat will be residually affected by the Project. A reduction of this nature at the RSA scale is considered to be of low environmental consequence. Nevertheless, on a worst-case basis, a moderate magnitude Project effect on this ecosystem service may be felt where land take and access restrictions may impact directly upon the beneficiaries of this ES within the RSA.
Wild Foods

Wild foods such as fungi and snails are collected throughout the LSA as described by Biomaster (2015). Reductions in land cover types that support the supply of this ecosystem service due to Project impact will negatively affect the supply. A total of 450 ha of forestry habitat will be affected. This figure represents 7.5% of the available resource within the LSA. Whilst it is challenging to understand the exact quantity of reduction in available produce it is clear that effects to supply will be afforded.

Wild foods are not considered to be fundamental to the physical existence of beneficiaries at the local scale although it is recognised that commercial fungi collection is prevalent within the RSA (Biomaster, 2014). A reduction of approximately 0.8% of forest habitat at the RSA scale is considered of low environmental consequence. On a worst-case basis, moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES; specifically those individuals within the RSA that may need to travel further to gather wild foods and/or where access to usual resources may be restricted.

Biomass fuel and timber

Wood for fuel and construction is classified as a priority ecosystem service. Throughout the LSA licenced and un-licenced forestry operations have created large swathes of open habitat as described within the biodiversity baseline chapter (Annex 3, Chapter 10). Beneficiaries of this service are locally widespread with wood fuel consumption peaking during the winter months. Reductions in land cover types (woodland and scrub mosaic) that supply this ecosystem service will negatively affect the supply of this ecosystem service and therefore upon the well-being of ES beneficiaries. Whilst this ecosystem service is identified as a provisioning service, the harvesting of timber also adversely affects regulating ecosystem services, such as erosion control.

Whilst it is understood that local beneficiaries have an element of reliance on the provision of timber for fuel and construction there is a reasonable abundance of this ecosystem service at the RSA scale. A reduction of approximately 0.8% of forest habitat at the RSA scale is considered to be of low environmental consequence. Nevertheless, on a worst case basis, a moderate magnitude Project effect on this ES is expected for beneficiaries of this ecosystem service; specifically those individuals within the RSA that may need to travel further to gather fuel and/or where access to their usual resources may be restricted, for example people that presently gather wood within the LSA.

Freshwater

Freshwater falls under both Type I and Type II priority ecosystem services. The Project may impact the supply of this ecosystem service and the Project is also dependent on both the quantity and the quality of supply of this ecosystem service.

Freshwater as a Type I Priority ES

Public water supplies are obtained from the Jazga and Shtuka Rivers and from groundwater sources. The proposed mine site is located in the upper Jazga and Shtuka catchments. Ilovica and Shtuka villages with their water supply systems, including the Ilovica Reservoir, are situated downstream of the proposed site. Further downstream, the Jazga and Shtuka catchments discharge surface water and groundwater into the Strumica valley where they contribute to the flow in the Turija and Strumica Rivers and groundwater is abstracted for agricultural irrigation. The Jazga River is used for public water supply system to Ilovica village for domestic purposes (other than drinking) and for irrigation of plots and gardens. The water currently abstracted at the (Jazga) intake has been adequate, in recent years, to meet the quantity of (non-potable) needs of the residents of Ilovica.

The Ilovica Reservoir supplies agriculture and public water supply for Bosilovo, Sekirnik, Turnovo, Radovo, Borievo, Ednokukevo and Robovo via the water treatment plant, plus intermittent supplies to Shtuka and Ilovica. Peak agricultural and domestic demand occurs in the summer months (between July and September).

Two intakes on the Shtuka River are used for public water supply system to Shtuka village. Water is used for domestic purposes (including drinking) and irrigation of plots and gardens. The water abstracted at the intakes
has not been adequate to meet the needs of the residents of Shtuka and is augmented by treated water supply from the Ilovica water treatment works during summer months.

The magnitude of potential effects could extend throughout the LSA. Water management of water levels in the Ilovica Reservoir and abstraction from the Turija reservoir is required throughout construction and operations to ensure that effects on ES beneficiaries are minimized. Potential impacts on water quality would most likely occur following closure of the Project. In post closure, water quality will be affected in the Shtuka River by seepage from the TMF embankment and TMF (Section 5.3), and in the Jazga by the spilling of the pit lake and the lack of active water management and availability of non-contact water to maintain water quality and flows downstream in both watercourses. As such the duration of effects to type 1 beneficiaries are considered in perpetuity.

Unmitigated water quality and quantity results in an assessment of a high magnitude effect being afforded.

**Freshwater as a Type II Priority ES**

A site water balance predicts that the mine process plant would have a negative water balance and would require somewhere between 746 m$^3$/hr and 917 m$^3$/hr of fresh water. Two major sources of water will supply the mine:

- Water reclaim from the TMF, SCF and pit; and
- External sources of fresh water.

The external source of fresh water supply is the Turija reservoir via a pipeline to be constructed from Turija dam to Ilovica reservoir. The Project water supply may be affected if water supply from Turija to irrigation downstream of the project is maintained at baseline levels.

The magnitude of potential Project effects on this ecosystem service is considered high. The amount of water demanded by the Project in terms of the available water resource is also high.

**Natural medicines perfumes and pharmaceuticals**

It is understood that as many as 60 species of medicinal herb are available within the LSA (Biomaster, 2014). In addition to provision of priority ecosystem services species such as Bigroot cranesbill (*Geranium macrorrhizum*) provide pharmaceutical and cultural importance to local communities. As previously described Oak moss lichen also plays an important role in the provisioning ecosystem services marketplace. Oak moss is commercially harvested within the region (including the LSA) and exported to the Grasse region of France where its fragrant compounds are extracted (Micevski, 2015, pers. comm., 10 September 2015). Land take effects will affect the availability of these species. The extent to which other unaffected habitats can continue to provide these goods dictates the spatial reliance to beneficiaries.

The commercial and personal value of natural medicines and pharmaceuticals within the region is understood. These ES are provisioned by pasture and forestry habitat. The cumulative reduction in available habitat amounts to 1.5% at the RSA scale; a reduction considered to be of low environmental consequence. A moderate magnitude Project effect on this ecosystem service is however expected for the beneficiaries of this ES on a worst case basis, where project land take may effect both individual and/or communal access and supply within the RSA, especially to beneficiaries within close proximity to the Project footprint.

**5.9.6.2 Regulating**

The effects of placing Project infrastructure within, and intercepting, streams and drainage features will both reduce the surface area of these land cover types, reducing their ability to regulate water flows, and alter their hydrological properties and ecological integrity, which may affect their capacity to regulate water flows.

The LSA is comprised of two catchments. These hydrological systems will regulate water run-off, influence ground water recharge and maintain the water storage potential of the landscape. The natural landscape is also likely to regulate flooding during snow melt or intensive rainfall events.
Erosion Control
Currently, vegetative cover plays an important part in soil retention on steep slopes. Removal of vegetative cover could result in increased scour and soil erosion throughout the year. Localised landslides could become more likely as well as sedimentation of surface water bodies and water courses.

The magnitude of these impacts depends on the effectiveness of slope stabilisation and vegetation restoration measures currently being developed and are intended to be implemented progressively throughout Project construction and operation where practicable.

Proposed measures should minimise impacts but there is nevertheless likely to be a residual risk of soil erosion over quite large areas used to graze livestock in restored habitats. Erosion regulation provided by topsoil and vegetative cover within the LSA is considered to be a type 2 priority service in terms of project dependence because of the potential costs of managing soil erosion impacts and landslips, potentially over a long period of time. Slope soils from which vegetation will be stripped are at risk from sheet and rill erosion, resulting in undercutting or exposure of the soil profile on vulnerable steep slopes. The project-induced changes in vegetation and landform put it at higher risk of soil erosion over extensive areas, which can be costly to manage in order to repair the project’s own infrastructure, avoid reputational risks or damage to other land users which requires compensation.

Given a level of acceptance that a slope stabilisation and re-vegetation strategy will be implemented and successful it is considered that a moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ecosystem service (including the Project) within the RSA.

Regulation of Water Timing and Flows
The Jazga and Shtuka river systems provide drinking and irrigation water to local villages. Current vegetative cover is likely to filter suspended sediments and slow the water cycle. The potential Project impacts on the hydrological system (creation of Shtuka bypass channel/modification of surface and ground water regimes) are considered to have a considerable effect on the ability of this ecosystem service to function. However, during the construction phase, a Storm Water Dam (SWD) will be constructed on the Shtuka River downstream of the TMF. The SWD will attenuate extreme flows and allow settlement of sediment-heavy runoff from the stripped embankment site and from the partially stripped TMF basin. Normal flows will be allowed to discharge through the porous dam of the SWD, to maintain ecological flows downstream, and high flows will be attenuated to ensure that flood risk is not increased downstream.

During operation of the Project the SWD will store sediment-heavy runoff from the TMF embankment and infrastructure within its catchment. Stored water meeting the project total suspended solids (TSS) discharge standard will be released to the Shtuka River. The SWD is provided to mitigate a potential TSS impact of the TMF in the Shtuka River.

At project closure a spillway will be constructed in the TMF that will be designed to safely pass the Probable Maximum Flood, to ensure that flood risk in the downstream villages is not increased from the baseline scenario following closure.

These measures are designed to facilitate Project performance and also prevent flooding. The Project design takes into account such potential impacts, and will put in place appropriate storm water and flood management engineered measures to manage unacceptable impacts.

Given the design mitigation that is committed and illustrated above it is considered that a moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA.

5.9.6.3.3 Cultural Ethical and Spiritual Values
Sacred sites and intangible cultural heritage, evident within the LSA, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. Changes in natural ecosystems arising from Project
land take, and changes in the appearance of the landscape due to the visual presence of the Project are likely to affect the ability of local communities to benefit from this ES.

Ethical and spiritual intangible value from ecosystem services within the LSA is derived from the agricultural setting which supports small scale self-sustenance lifestyle and a traditional way of life. In addition, sites such as Benli Tash (a natural rock formation) and Shtuchki Vodopad (a waterfall on the Shtuka River) offer spiritual and cultural value to those that visit (both cultural heritage sites are shown on Figure 5-28).

As described by Biomaster (2016) Bigroot cranesbill (*Geranium macrorrhizum*) has pharmaceutical and cultural importance to local communities. It is understood that villagers from Ilovica and Shtuka pick this plant around Easter when it is in bloom and its prevalent at the Shtuchki Vodopad site. The plant represents fertility and it is understood that children are bathed with the plant and an egg on the Easter weekend. The plant symbolises good health and the egg symbolises fertility (Biomaster, 2016).

![Bigroot cranesbill (Geranium macrorrhizum) Biomaster (2016).](image)

Studies undertaken and documented by Biomaster (2016) indicate that this species is relatively widespread, occurring in damp rich soils throughout the LSA. Furthermore, although it is understood that this species readily artificially translocates and is generally robust and ubiquitous the Shtuchki Vodopad site is specifically visited for the occurrence of the plant. The Benli Tash site is situated out of the Projects area of influence and no residual effects are predicted. However, the Shtuchki Vodopad waterfall will be permanently affected by the Project.

A high magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA with the Shtuchki Vodopad site lost a result of Project development.

**5.9.6.3.4 Supporting**

Supporting ecosystem services include the supply of habitat for species, support of primary production such as agriculture, and water cycling. The support of primary production such as arable crops, forestry and fruit is a priority ecosystem service. The LSA and broader RSA provide supporting ESs that are defined by natural habitats that facilitate species reproduction and dispersal. Habitat that is considered available for primary
production as an ES will be affected by Project proposals. A total of 8.4% of the LSA and 0.9% of available habitat within the RSA will be affected by the Project.

On a worst case basis, a moderate magnitude Project effect on this ecosystem service is expected where beneficiaries of the ES, within the LSA, experience negative effects.

5.9.7 Impact Classification

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1. The following subsections present any deviation or ecosystem services specific elements of the assessment criteria.

Table 1 in Annex 5H presents the route to the classification of all the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact and the consequence once the receptor sensitivity has been considered.

5.9.7.1 Direction

Direction describes the trend of the effect compared with baseline conditions. There are three options for direction:

- Adverse – effect is worsening or is undesirable.
- Neutral – effect is not changing compared with baseline conditions and trends.
- Positive – effect is improving or is desirable.

5.9.7.2 Sensitivity of the Receptor

Sensitivity for each ecosystem service supplied and/or demanded ranged from low to high according to increasing level of threat (Table 5-88).

Table 5-88: Sensitivity assessment rating scale

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Rating scales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Ecosystem service is readily substitutable or replaceable, there is a high likelihood beneficiaries can adapt to loss in the ecosystem service benefit and maintain overall well-being.</td>
</tr>
<tr>
<td>Medium</td>
<td>Ecosystem service is possibly substitutable or replaceable, there is a moderate or partial likelihood beneficiaries can adapt to loss in the ecosystem service benefit and maintain overall well-being.</td>
</tr>
<tr>
<td>High</td>
<td>Ecosystem service is not substitutable and/or irreplaceable, there is a low or limited likelihood beneficiaries can adapt to loss in the ecosystem service benefit and maintain overall well-being.</td>
</tr>
</tbody>
</table>

5.9.7.3 Impact classification

The ecological implications of an assessed effect to an ecosystem service are gauged at the RSA level which is a more ecologically/socially relevant scale. As noted above, RSA level effect is determined by combining magnitude, geographic extent and duration of the effect and may be:

- Negligible: no detectable effect on beneficiaries as a result of changes to a valued feature/ecosystem service and no change from ES baseline scenario;
- Low: detectable effect, but within known or inferred ability of beneficiaries to absorb without loss to social functions and well-being at the RSA scale. Small changes prevail on the cultural/social functions/process as a result of project implementation;
Moderate: effect near limits of beneficiaries to absorb without loss to social functions and well-being at the RSA scale. Cultural/social functions/processes continue, albeit in a modified way as a result of project implementation; or

High: effect well beyond ability of beneficiaries to absorb without loss to social functions and well-being at the RSA scale. Changes to cultural/social functions/process are drastic and commonly irreversible.

Finally the RSA level effect is combined with sensitivity using the matrix given in Annex 1 to derive overall consequence. For ecosystem services, the four consequence levels may be defined as follows:

- Negligible: no measurable adverse impacts to priority ecosystem services from the Project;
- Minor: impact level acceptable to functioning of priority ecosystem services; mitigation is adequate and achievable but monitoring may be necessary;
- Moderate: impact level requires follow up action; monitoring necessary to evaluate continued functioning of ecosystem service and well-being of impacted communities; and
- Major: impact level requires additional mitigation; implies proximity to and risk of exceedance of good international industry standards; monitoring necessary to evaluate continued viability of ecosystem service and well-being of impacted people.

5.9.8 Determination of Impact and Consequence

The following provides a summary of the impact evaluation and consequence evaluation for each of the ecosystem services categories described in Section 5.8.6.3.1.

The impact severity ratings presented in Table 6 are based on the anticipated major or moderate impacts on ecosystem services only, before specific mitigation measures have been applied. Where specialist studies do not address mitigation of impacts on ecosystem services, or where residual impacts on ecosystem services remain following application of specialist recommendations, additional mitigation measures to address such impacts are also provided in Section 6 mitigation measures.

Livestock including Grazing Provision

A moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of alternative grazing is substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.

Fruit, Vegetable and Arable Production

A moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of alternative arable habitat is substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.

Wild Foods

A moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of wild foods is readily substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.

Biomass fuel and timber

A moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of timber for fuel and construction is readily substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.
**Freshwater as a Type I Priority ES**

In the event that water quality and quantity is impacted negatively, for example, by eutrophication or an accidental industrial leakage, the magnitude of impacts could be moderate to high. As such, a conservative approach has resulted in an assessment of a high magnitude effect being afforded.

The sensitivity of the ecosystem service is high, as freshwater supply in the necessary quantities and to the required quality standards is not easily substitutable. The impact classification at the RSA level is considered to be high with a major impact consequence in the absence of mitigation (see Table 6).

**Freshwater as a Type II Priority ES**

The magnitude of potential Project effects on this ecosystem service is considered high. The amount of water demanded by the Project in terms of the available water resource is relatively high. The sensitivity of the ES is high, as the ES is not viably substitutable for the Project as demonstrated in Annex 3, Chapter 5 (Water Quantity). The impact classification at the RSA level is considered to be high with a major impact consequence in the absence of mitigation (see Table 5-89).

**Natural medicines perfumes and pharmaceuticals**

A moderate-magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of natural medicines and pharmaceuticals is readily substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.

**Erosion Control**

Given a level of acceptance that a slope stabilisation and re-vegetation strategy will be implemented and successful it is considered that a moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES (including the Project) within the RSA. The sensitivity of this ES is ranked as medium – the supply of stability provided by soils is substitutable or replaceable via soft and hard engineering. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence (see Table 5-89).

**Regulation of Water Timing and Flows**

Given the design mitigation that is committed and illustrated above it is considered that a moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The effects to this ES will be permanent at the local scale owing to the diversion of the Shtuka. The sensitivity of this ES is ranked as medium – the supply of engineered water regulation systems make this ES readily substitutable or replaceable. The Project impact at the RSA level will be high with a moderate impact consequence (see 5-89).

**Ethical and Spiritual Values**

A high-magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA as sites such as the Shtuchki Vodopad will be residually affected. The sensitivity of this ES is ranked as medium – the supply of species such as the Bigroot cranesbill is substitutable or replaceable though residual effects to other features will be afforded. In the absence of mitigation Project impact at the RSA level will be high with a moderate impact consequence (see Table 5-89).

**Supporting**

A moderate magnitude Project effect on this ecosystem service is expected for beneficiaries of this ES within the RSA. The sensitivity of this ES is ranked as medium – the supply of supporting habitat is abundant, substitutable or replaceable. In the absence of mitigation Project impact at the RSA level will be moderate with a minor impact consequence.
Table 5-89: Assessment of Impacts for Priority Ecosystem Services

<table>
<thead>
<tr>
<th>Receptor (Priority Ecosystem Service)</th>
<th>Source of impact</th>
<th>Impact consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Type 1</td>
<td>Impacts on quantity and quality of water supply where Project infrastructure intercepts available aquatic resources (ground and surface water features).</td>
<td>Major</td>
</tr>
</tbody>
</table>
| Freshwater Type 2                    | Quantity of fresh water supply to the Project may be affected by change in supply from Turija Reservoir; and  
|                                      | Security of supply affected due to other developments/projects or irrigation also abstracting water from the Turija reservoir; Water quality deterioration may necessitate treatment of water being used in Project activities, increasing Project operation costs and affecting operational performance. | Major              |
| Erosion Control type 1 and 2        | Site clearance and project footprint (vegetation loss);  
|                                      | Change in soil quality and quantity; and  
|                                      | Increased exposure to natural weathering and dust mobilisation and deposition.                                                                                                                                  | Moderate           |
| Regulation of Water and Slowing of the water cycle (Including Filtering water and slowing of the water cycle) | Site clearance and project footprint (Placing Project infrastructure within and intercepting streams, springs and natural drainage lines will both reduce the surface area of these land cover types, reducing their ability to regulate water flows;  
|                                      | Change in soil quality and quantity; and  
|                                      | Increase in surface water drainage facilities within the LSA.                                                                                                                                                   | Moderate           |
| Ethical and Spiritual Value          | Site clearance and Project footprint permanently affecting sites, specifically the Shtuchki Vodopad waterfall.                                                                                                    | Moderate           |

5.10 Cultural Heritage

5.10.1 Sources of Effects

The elements of the project which have been identified as potential primary sources of effects for cultural heritage include:

- Ground disturbance in preparation for, and during, construction and mine operation. Ground disturbance can result from any activity which ‘breaks ground’, but can also be caused by sub-surface compaction (construction and operations);
Noise and vibration effects from construction and operation activities. The noise and vibration impact assessment (Section 5.5) has been used to inform the cultural heritage impact assessment (construction and operations);

The effects of deposited dust and particulate matter generated by the Project during construction and operation activities. This includes vehicular transport of excavated material. The air quality impact assessment (Section 5.6) has been used to inform the cultural heritage impact assessment (construction and operations); and

Visual effects observed from locations of cultural significance during construction and operation activities. The landscape and visual assessment (Section 5.11) has been used to inform the cultural heritage impact assessment (construction and operations).

The installation of overhead powerlines is anticipated to result in the same sources of effects on cultural heritage receptors as other elements of the project, however the current project description does not include details of the construction of the powerline. Likely effects (not assessed here, but to be included in an addendum to the ESIA) may include:

- Direct ground disturbance during construction of both the anchor points and the access routes created to reach them;
- Noise effects during construction as a result of vehicles and construction activity; and
- Visual effects during construction and operation.

5.10.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 4 and Annex 1C) which provided the Project engineers with environmental measures to be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment.

Incorporated environmental measures to manage air quality, noise and visual effects have already been considered in the relevant chapters, the results of which are used in this chapter. No environmental measures pertaining specifically to cultural heritage have been incorporated into the engineering design.

5.10.3 Study Area and Receptors

The primary baseline data gathering for cultural heritage was completed within the baseline local study area presented in Section 1.

Following completion of the baseline, the baseline study areas for all disciplines have been collated to produce impact assessment areas for the social impact assessments, which are also presented in Section 1 and will be referred to throughout this chapter as the local and regional study areas.

The dataset of potential cultural heritage receptors, which was collated during the baseline study, was mapped using geographical information systems (GIS) and compared with the footprint of the proposed design (as outlined in the project description, Section 4). Using the mapped results and the identified potential sources of effects, the following criteria were formulated to identify receptors which would be assessed in the effects analysis. All other potential receptors presented in the baseline were scoped out of the impact assessment, due to lack of pathway from source to receptor, or distance from the source. The following criteria were used to select receptors for effects analysis:

- All cultural heritage receptors within the project footprint with a medium, high or very high sensitivity;
- All cultural heritage receptors within 1 kilometre of the proposed open pit area with a medium, high or very high sensitivity (to account for ground-borne vibrations during blasting);
All tangible and intangible ‘living’ cultural heritage receptors associated with the settlements of Ilovica and Shtuka with a medium, high or very high sensitivity; and/or

All cultural heritage receptors within 50 metres of the transportation route from the mine to the Bulgarian border with a medium, high or very high sensitivity.

Table 5-90 presents the cultural heritage receptors which are considered in the effects analysis. Receptors have been agreed across all technical disciplines to ensure the evaluation of combined impacts and indirect impacts can be robust.

Table 5-90: Cultural heritage receptors

<table>
<thead>
<tr>
<th>Location</th>
<th>Cultural heritage receptors (and unique Golder ID)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>‘Living’ Cultural Heritage Receptors</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Within the Project footprint | - Preslop spring memorial stone (SP-01)  
- Shtuchki Vodopad (NF-01) |
| Associated with Ilovica | - Ilovica Muslim cemetery (CE-01)  
- Ilovica Christian cemetery (CE-02)  
- St. Demetrius Church (CH-01)  
- Ilovica Mosque (MO-01)  
- Popova Livada (RE-01)  
- Krst (RE-02)  
- Benli Tash (RE-03) |
| Associated with Shtuka | - Shtuka Christian cemetery (CE-03)  
- Shtuka Muslim cemetery (CE-04)  
- Sts. Cyril and Methodius Church (CH-02)  
- Monastery of St. George (CH-03)  
- Shrine at the Monastery of St. George (RE-04) |
| Within 50 metres of the transportation route from the mine to the Bulgarian border | - Sekirnik Christian cemetery (CE-06)  
- St. Nicholas the Wonderworker Church (CH-06)  
- Sekirnik Park (CM-01)  
- Memorial to Baba Vangja (RE-05)  
- St. Clement Church (CH-10) |
| **Intangible cultural heritage receptors** | |
| Within LSA | - Religious beliefs and practices  
- Traditional music and dance  
- Traditional agricultural way of life |
| **Archaeological receptors** | |
| Within the Project footprint | - Adit/tunnel site (AR-03)  
- Domus Gaber (AR-05)  
- Anovi (AR-06)  
- Preslop (AR-07)  
- Krvavichevo (including Golemata Niva) (AR-08)  
- Gradishte (AR-10)  
- Old mill (AR-11) |
| Within 1 kilometre of the proposed open pit area | - Crkvishte (AR-04) |

5.10.4 Considerations from Stakeholder Engagement

The stakeholder engagement process (described in Section 1) identified one issue relevant to the impact assessment for cultural heritage.
A concern was raised regarding the potential risk of flooding at the archaeological site of Crkvishte (AR-04, (Stakeholder Engagement Round 3).

5.10.5 Key Guidelines and Standards
The key standards and guidelines that relate to cultural heritage used in the impact assessment are:
- Macedonian Law on Protection of Cultural Heritage (2005);
- EBRD Performance Requirement 8: Cultural Heritage (2014);
- IFC Performance Standard 8: Cultural Heritage (2012); and
- IFC Guidance Note 8: Cultural Heritage (2012).

5.10.6 Effects Analysis
5.10.6.1 Methods
Following the selection of receptors, cultural heritage receptors were incorporated into the effects analyses for noise and vibration, air quality and landscape and visual to assess indirect impacts to cultural heritage. The effects analysis and impact assessment methodologies for these disciplines are provided in the relevant chapters: noise and vibration (Section 5.5), air quality (Section 5.6) and landscape and visual (Section 5.11).

The residual (post mitigation) impacts presented in the noise, air quality and visual impact analysis were used as the source of effects in the cultural heritage effects analysis (refer to Supporting Annexes: 5D, 5E, 5I). In consultation with the technical specialists for each of these disciplines (as well as socio-economics; Section 5.12), spatial analysis was completed to identify whether noise, visual or air quality residual impacts were considered a material concern at any of the identified cultural heritage receptors. Any material concern identified was evaluated along with any direct effect of ground disturbance to complete a holistic qualitative analysis of the effects of the Project on each of the cultural heritage receptors. Those receptors for which an effect is predicted (i.e. higher than negligible) will be carried forward to the impact assessment process.

A high level analysis of the potential effects on cultural heritage resulting from the construction of the overhead powerline, which will be assessed in greater detail in a future Addendum to this ESIA is also provided here.

5.10.6.2 Results
The results of the effects analysis are presented by receptor and organised by receptor type. The summary provided for each receptor only includes those sources of effect which are predicted to actually affect the receptor. An indication of the magnitude of effect is presented in the following sections, which corresponds with the definition in the magnitude criteria (Section 5.10.6). Table 5-91 presents a summary of the effects analysis results. The narrative in the following section provides a justification for these magnitudes.

In the case of air quality, it is predicted that the environmental design criteria (EDC) for all measured pollutants will not be exceeded at any cultural heritage receptor (as described in Section 5.6). As such, the air quality effects of deposited dust and particulate matter at cultural heritage receptors will be low or negligible in magnitude. Consequently, air quality is expected to have a negligible magnitude effect on cultural heritage at the majority of receptors. Consideration is still given, however, to the effect of air quality on the environmental setting of a cultural heritage receptor; whilst there may be no loss of amenity, setting may still be affected.

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Noise and vibration magnitude of effect</th>
<th>Air quality magnitude of effect</th>
<th>Visual magnitude of effect</th>
<th>Cultural heritage magnitude of effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Living’ cultural heritage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptor</td>
<td>Noise and vibration magnitude of effect</td>
<td>Air quality magnitude of effect</td>
<td>Visual magnitude of effect</td>
<td>Cultural heritage magnitude of effect</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Preslop Spring Memorial Stone (SP-01)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Shtuchki Vodopad (NF-01)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Ilovica Muslim Cemetery (CE-01)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Ilovica Christian Cemetery (CE-02)</td>
<td>-</td>
<td>-</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>St Demetrius Church (CH-01)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
<td>Negligible</td>
</tr>
<tr>
<td>Ilovica Mosque (MQ-01)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
<td>Negligible</td>
</tr>
<tr>
<td>Popova Livada (RE-01)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Krst (RE-02)</td>
<td>-</td>
<td>-</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Benli Tash (RE-03)</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Shtuka Christian Cemetery (CE-03)</td>
<td>-</td>
<td>-</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Shtuka Muslim Cemetery (CE-04)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Sts. Cyril and Methodius Church (CH-02)</td>
<td>-</td>
<td>-</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Monastery of St. George (CH-03)</td>
<td>Moderate - high (noise) &amp; Low - moderate (vibration)</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Shrine at the Monastery of St. George (RE-04)</td>
<td>Moderate - high (noise) &amp; Low - moderate (vibration)</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sekirnik Christian Cemetery (CE-06)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td>St. Nicholas the Wonderworker Church (CH-06)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td>Sekirnik Park (CM-01)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td>Memorial to Baba Vangja (RE-05)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td>St. Clement Church (CH-10)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Intangible cultural heritage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious Beliefs and Practices</td>
<td>Low – moderate (noise)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
</tr>
<tr>
<td>Traditional Music and Dance</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td>Traditional Agricultural Lifestyle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Archaeology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adit/tunnel site (AR-03)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Domus Gaber (AR-05)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Anovi (AR-06)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Preslop (AR-07)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Krvavichevo/Golemata Niva (AR-08)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Gradishte (AR-10)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Old Mill (AR-11)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Crkvishite (AR-04)</td>
<td>High (vibration)</td>
<td>-</td>
<td>-</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
5.10.6.2.1 ‘Living’ Cultural Heritage

Preslop Spring Memorial Stone (SP-01)

Ground disturbance effects

- Construction – Preslop spring memorial stone (SP-01) is situated within the Project footprint, inside the extent of the proposed tailings management facility (TMF). It will be removed during construction and it is expected that this receptor would be lost as a result.

Magnitude of Effect on Cultural Heritage

As it is expected that this receptor will be lost during construction, it is considered that there will be a high magnitude effect.

Shtuchki Vodopad (NF-01)

Ground disturbance effects

- Construction – Shtuchki Vodopad (NF-01) is situated within the footprint of the proposed TMF and it is expected this receptor would be lost during construction.

Magnitude of Effect on Cultural Heritage

As it is expected that this receptor will be lost during construction, it is considered that there will be a high magnitude effect.

Ilovica Muslim Cemetery (CE-01)

Visual effects

- Construction and Operations – It is anticipated that a moderate magnitude visual effect will be experienced at Ilovica Muslim cemetery (CE-01).

Magnitude of Effect on Cultural Heritage

Although the setting of this receptor will be affected visually, this is not expected to necessitate any modifications in the receptor’s use and so a low magnitude effect is predicted.

Ilovica Christian Cemetery (CE-02)

Visual effects

- Construction and Operations – The visual setting of CE-02 is likely to be adversely affected throughout the life of the mine, where it is predicted that there will be a high magnitude visual effect. A moderate magnitude visual effect is predicted in general for Ilovica; however, this receptor is at the periphery of the village, adjacent to CE-03 and CH-02 on the border with Shtuka, where the visual effects of the Project will be greater in magnitude. Although the proposed open pit area and plant site will be screened by Çukar peak, the proposed TMF would dominate easterly views along the Shtuka valley, whilst the mine workshop area, haul road and access road would be prominent in the immediate foreground.

Magnitude of Effect on Cultural Heritage

A low magnitude effect is anticipated during construction and operations when the receptor’s setting is impacted by visual effects; although the setting will be altered it is not expected that this will result in any modification of receptor use.

St. Demetrius Church (CH-01)

Visual effects

- Construction and Operations – The bare-earth Zone of Theoretical Visibility (ZTV) indicates that a moderate magnitude visual effect is expected at this receptor throughout the life of the mine. The ZTV,
however, does not take into account surrounding buildings which, from observations made in the field, are considered to screen views towards the site.

**Magnitude of Effect on Cultural Heritage**

Based on the effects analysis and observations from the field it is considered that there will be no change from the baseline conditions at this receptor as a result of direct or indirect sources of effect. As such, a negligible magnitude effect on cultural heritage is expected and so this receptor is not considered further in the impact assessment.

**Ilovica Mosque (MQ-01)**

**Visual effects**

- Construction and Operations – The bare-earth Zone of Theoretical Visibility (ZTV) indicates that a moderate magnitude visual effect is expected at this receptor throughout the life of the mine. The ZTV, however, does not take into account surrounding buildings which, from observations made in the field, are considered to screen views towards the site.

**Magnitude of Effect on Cultural Heritage**

No change from the baseline conditions is predicted at this receptor as a result of direct or indirect sources of effect (based on the effects analysis and observations from the field); a negligible magnitude effect on cultural heritage is expected and so this receptor is not considered further in the impact assessment.

**Popova Livada (RE-01)**

**Visual effects**

- Construction and Operations – A moderate magnitude visual effect is expected at this receptor throughout the life of the mine.

**Magnitude of Effect on Cultural Heritage**

Although the setting of this receptor will be affected visually, a low magnitude effect is predicted as no modifications in the receptor’s use will be necessary. Use of this receptor is limited, with its cultural value derived from the rock carvings located there, rather than the wider setting.

**Krst (RE-02)**

**Visual effects**

- Construction and Operations – A high magnitude visual effect is expected at this receptor throughout the life of the mine. Although a moderate magnitude visual effect is predicted in general for Ilovica, this receptor is located outside the village, to the west. It is not screened by the urban development within the town and, as such, the visual effects are predicted to be higher.

**Magnitude of Effect on Cultural Heritage**

A low magnitude effect is anticipated at this receptor because use of the site, which is limited to a relatively small part of the community, will not be modified as a result of the Project. The perceived ‘cross’ shape of the rock formation is the significant cultural element of the receptor, not the wider setting.

**Benli Tash (RE-03)**

**Visual effects**

- Construction and Operations – The visual assessment indicated that none of the elements of the mine would be visible from Benli Tash (RE-03). This was confirmed during the cultural heritage baseline study, as a small vegetated mound to the east of the receptor screens the view towards the mine site. A negligible visual effect is anticipated.
Magnitude of Effect on Cultural Heritage

It is predicted that this receptor will not be affected, either directly or indirectly, by the Project, and so a negligible magnitude effect is anticipated and the receptor is not considered further in the impact assessment.

Shtuka Christian Cemetery (CE-03)

Visual effects

- Construction and Operations – The visual setting of CE-03, which is located along the northern periphery of Shtuka, is likely to be adversely affected throughout the life of the mine, where it is predicted that there will be a high magnitude visual effect. Although the proposed open pit area and plant site will be screened by Čukar peak, the proposed TMF would dominate easterly views along the Shtuka valley, whilst the proposed mine workshop area, haul road and access road on the southern face of Čukar would be prominent in the immediate foreground.

Magnitude of Effect on Cultural Heritage

A low magnitude effect is anticipated during construction and operations when the receptor's setting is impacted by visual effects; although the setting will be altered it is not expected that this will result in any modification of receptor use.

Shtuka Muslim Cemetery (CE-04)

Visual effects

- Construction and Operations – A moderate magnitude visual effect has been predicted for Shtuka Muslim Cemetery (CE-04), although views towards the mine site will be infrequent due to the density of buildings, existing trees and the topography of the land to the east and north of the settlement. Located to the south of the settlement, views from CE-04 towards the mine site will likely be screened but there is potential for views to the north east of the proposed TMF which will, ultimately, extend above the existing skyline. The rising land to the north east of the receptor will screen much of the view towards the proposed TMF. The moderate magnitude visual effect experienced here, as opposed to the high magnitude effect experienced at CE-03, is as a result of their relative locations within Shtuka.

Magnitude of Effect on Cultural Heritage

A low magnitude effect is expected at CE-04. While the setting will be altered as a result of the Project, it is not expected that this will modify use of the receptor. The cemetery is no longer active and has fallen into disuse, to the extent that urban development has expanded up to the periphery of the receptor, and has even begun to encroach upon it. The receptor is also currently being affected directly as a result of domestic waste being dumped in the area. Consequently, use of the site is already inhibited and so it is considered that use of the receptor will not be materially changed as a result of the visual effects predicted.

Sts. Cyril and Methodius Church (CH-02)

Visual effects

- Construction and Operations – The visual setting of CH-02 is likely to be adversely affected throughout the life of the mine, where it is predicted that there will be a high magnitude visual effect. Although the proposed open pit area and plant site will be screened by Čukar peak, the proposed TMF would dominate easterly views along the Shtuka valley, whilst the mine workshop area, haul road and access road on the southern face of Čukar would be prominent in the immediate foreground.

Magnitude of Effect on Cultural Heritage

A low magnitude effect is anticipated during construction and operations when the receptor's setting is impacted by visual effects; although the setting will be altered it is not expected that this will result in any modification of receptor use.
Monastery of St. George (CH-03)

Noise and vibration effects

- Construction – During construction a moderate magnitude noise effect is predicted at the Monastery of St. George (CH-03) throughout the day and a high magnitude noise effect is predicted in the evening.

- Operations – A high magnitude noise effect is predicted throughout the day, evening and night at CH-03 during operations, as a result of vehicle traffic and operational activities within the open pit area and along the haul and access roads.

- Construction and Operations – There is also potential that CH-03 will be affected by ground-borne vibrations caused by blasting activities in the proposed open pit area during operations and along both the haul and access roads during construction. The greatest effect is likely to result from blasting along the access road, which is predicted to have a moderate magnitude vibration effect at CH-03. Blasting in the proposed open pit area and along the haul road is predicted to have a low magnitude effect on CH-03. This is based on the vibration effects analysis model results (see Section 5.5) using guidelines established by the United States Bureau of Mines (US Bureau of Mines, 1980).

Air quality effects

- Operations – Although it is not predicted that the EDC for dust deposition or particulate emissions will be exceeded at CH-03, the model indicates that this receptor will receive some of the highest levels of air pollution of all cultural heritage receptors. This is due to its proximity to the proposed open pit area. In the worst case, dust deposition is predicted to reach 338.7 mg/m²/day at CH-03, resulting in a low magnitude air quality effect. The EDC criterion for loss of amenity due to dust deposition is 350 mg/m²/day.

Visual effects

- Construction and Operations – It is considered that the Project would adversely affect the visual setting of CH-03, with the tranquil, wooded valley setting of the receptor being altered or even lost. The proposed TMF would dominate the view along the Shtuka valley, whilst the proposed mine workshop area and haul road would also be prominent. A high magnitude visual effect is predicted.

Magnitude of Effect on Cultural Heritage

Use of this receptor is limited to a single religious holiday, the Nativity of Theotokos (21 September). During the construction period, in the absence of mitigation, there is a moderate – high magnitude noise effect predicted. It is likely celebrations will have to be modified. Consequently, during construction there will be a moderate magnitude effect at this receptor.

During operations there is predicted to be adverse effects to the visual setting of the receptor and dust deposition will also have an effect on its setting. A high magnitude noise effect is also predicted. Use of the receptor comprises outdoor activities, including a meal. In the absence of mitigation, during operations, there will be a moderate magnitude effect.

Shrine at the Monastery of St. George (RE-04)

Noise and vibration effects

- Construction – During site construction a moderate magnitude noise effect is predicted at the shrine at the Monastery of St. George (RE-04) throughout the day and a high magnitude noise effect is predicted in the evening.
Operations – A high magnitude noise effect is predicted throughout the day, evening and night at RE-04 during operations, as a result of vehicle traffic and operational activities within the open pit area and along the haul and access roads.

Construction and Operations – There is potential that RE-04 will be affected by ground-borne vibrations caused by blasting activities in the proposed open pit area during operations and along both the haul and access roads during construction. The greatest effect is likely to result from blasting along the access road, which is predicted to have a moderate magnitude vibration effect at RE-04. Blasting in the proposed open pit area and along the haul road is predicted to have a low magnitude effect on RE-04. This is based on the vibration effects analysis model results (see Section 5.5) using guidelines established by the United States Bureau of Mines (US Bureau of Mines, 1980).

Air quality effects

Operations – Although it is not predicted that the EDC for dust deposition or particulate emissions will be exceeded at RE-04, the model indicates that this receptor will receive some of the highest levels of air pollution of all cultural heritage receptors. This is due to its proximity to the proposed open pit area. In the worst case, dust deposition is predicted to reach 338.7 mg/m²/day at RE-04, resulting in a low magnitude air quality effect. The EDC criterion for loss of amenity due to dust deposition is 350 mg/m²/day.

Visual effects

Construction and Operations – It is considered that the project would adversely affect the visual setting of RE-04, with the tranquil, wooded valley setting of the receptor being altered or even lost. The proposed TMF would dominate the view along the Shtuka valley, whilst the proposed mine workshop area and haul road would also be prominent. A high magnitude visual effect is predicted.

Magnitude of Effect on Cultural Heritage

The number of people using the shrine at RE-04, or the regularity with which it is used, is not known, although it is likely its use will be modified or temporarily suspended during construction when a moderate - high magnitude noise effect is predicted. Consequently, a moderate magnitude effect is expected at this receptor during construction.

During operations, predicted noise levels are assessed to be high at this location, and the setting of the shrine is likely to be adversely affected by the visual and air quality effects. The exposed nature of RE-04, and the introspection inherent to its use, means that setting is integral to the cultural value of this receptor. Use is likely to be modified as a result of effects on setting and a moderate magnitude effect is anticipated during operations.

Sekirnik Christian Cemetery (CE-06)

Magnitude of Effect on Cultural Heritage

A negligible magnitude effect on cultural heritage is predicted at CE-06 as no effects, either direct or indirect, are anticipated as a result of the proposed development. This receptor is not considered further in the impact assessment.

St. Nicholas the Wonderworker Church (CH-06)

Magnitude of Effect on Cultural Heritage

A negligible magnitude effect on cultural heritage is predicted at CH-06 as no effects, either direct or indirect, are anticipated as a result of the proposed development. This receptor is not considered further in the impact assessment.
Sekirnik Park (CM-01)
Magnitude of Effect on Cultural Heritage
A negligible magnitude effect on cultural heritage is predicted at CM-01 as no effects, either direct or indirect, are anticipated as a result of the proposed development. This receptor is not considered further in the impact assessment.

Memorial to Baba Vangja (RE-05)
Magnitude of Effect on Cultural Heritage
A negligible magnitude effect on cultural heritage is predicted at RE-05 as no effects, either direct or indirect, are anticipated as a result of the proposed development. This receptor is not considered further in the impact assessment.

St. Clement Church (CH-10)
Magnitude of Effect on Cultural Heritage
A negligible magnitude effect on cultural heritage is predicted at CH-10 as no effects, either direct or indirect, are anticipated as a result of the proposed development. This receptor is not considered further in the impact assessment.

5.10.6.2.2 Intangible Cultural Heritage
Religious Beliefs and Practices
Noise and vibration effects
- Construction – There are predicted noise effects during construction for one receptor which may resultantly affect or modify the way in which people practice their religious beliefs. This is the moderate - high magnitude effect at the Monastery of St. George (CH-03).

Blasting activities at the proposed open pit area during operations could potentially affect or modify the way in which people practice their religious beliefs.

Magnitude of Effect on Cultural Heritage
The practice of religious beliefs will remain largely unaltered as a result of the Project across much of the study area. Noise effects during construction will, however, likely disturb religious practices in Shtuka, for example celebrations during the Nativity of Theotokos festival. It is likely that this disturbance would result in temporary changes to religious practices. Consequently, a moderate magnitude effect on religious beliefs and practices is expected. The blasting regime also has the potential to affect regular religious services (weekly/bi-weekly) and major holidays, resulting in a moderate magnitude effect on cultural heritage.

Traditional Music and Dance
Magnitude of Effect on Cultural Heritage
The practice of traditional music and dance is likely to continue unaltered as a result of the Project and so a negligible magnitude effect is predicted for this receptor.

Traditional Agricultural Lifestyle
Magnitude of Effect on Cultural Heritage
The socio-economic impacts of the Project, specifically those pertaining to agriculture, are outlined in detail in Section 5.12. The current system of small-scale agricultural production (including the use of garden agriculture), the type of crops produced and the methods used are not expected to change as a result of the Project. The Project will generate employment opportunities in the area, but it is not expected that the number of individuals who abandon farming to work at the Project will result in significant changes to farming practices
in the area. Although the access road will directly affect a number of small scale agricultural plots, practices should not be affected and as such, a negligible effect upon the traditional agricultural way of life is predicted.

5.10.6.2.3 Archaeology

Adit/Tunnel Site (AR-03)

Ground disturbance effects

- Construction – The adit/tunnel site lies within the footprint of the proposed mine workshop area and is expected to be disturbed or lost during construction.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost during construction, it is considered to be a high magnitude effect.

Domus Gaber (AR-05)

Ground disturbance effects

- Construction – Domus Gaber (AR-05) is located within the footprint of proposed TMF and so it is expected this receptor will be lost during construction.

Operations – As tailings are deposited within the TMF during operations, it is expected that any archaeological remains not removed during construction would be significantly disturbed through vehicle movements and compaction of sub-surface sediments.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost during construction, it is considered to be a high magnitude effect.

Anovi (AR-06)

Ground disturbance effects

- Construction - Anovi (AR-06) is situated within the proposed open pit area and it is expected this receptor will be lost during pre-stripping in the construction phase of the mine (e.g. removal of vegetation).

- Operations – It is expected that any archaeological remains which survive the construction phase will be lost during mine operations as ore is extracted.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost, it is considered to be a high magnitude effect.

Preslop (AR-07)

Ground disturbance effects

- Construction – Preslop (AR-07) is enclosed between the footprints of the proposed upper plant site and the TMF (approximately 50 m distant from each) and is likely to be significantly disturbed or removed during construction. It is expected that this receptor will be lost as a result.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost, it is considered to be a high magnitude effect.

Krvavichevo including Golemata Niva (AR-08)

Ground disturbance effects

- Construction – Krvavichevo (AR-08a) (including the area of Golemata Niva (AR-08b)) is situated within the footprint of the proposed upper plant site and is likely to be significantly disturbed or removed during construction. It is expected that this receptor will be lost as a result.
Magnitude of Effect on Cultural Heritage

As this receptor will be lost during construction, it is considered to be a high magnitude effect.

**Gradishte (AR-10)**

*Ground disturbance effects*

- Construction – Gradishte (AR-10) is situated within the footprint of the proposed TMF and it is expected that this receptor will be lost during construction.
- Operations – As tailings are deposited within the TMF during operations, it is expected that any archaeological remains not removed during construction would be significantly disturbed through vehicle movements and compaction of sub-surface sediments.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost during construction, it is considered to be a high magnitude effect.

**Old Mill (AR-11)**

*Ground disturbance effects*

- Construction – The old mill (AR-11) is situated within the footprint of the proposed TMF and it is expected that this receptor will be lost during construction.
- Operations – As tailings are deposited within the TMF during operations, it is expected that any archaeological remains not removed during construction would be disturbed through vehicle movements and compaction of sub-surface sediments.

Magnitude of Effect on Cultural Heritage

As this receptor will be lost during construction, it is considered to be a high magnitude effect.

**Crkvishte (AR-04)**

*Noise and vibration effects*

- Construction and Operations – The proximity of Crkvishte (AR-04) to the proposed open pit area means that there is potential that the receptor may be affected by ground-borne vibrations caused by blasting activities. A high magnitude vibration effect is predicted at the receptor as a result of blasting in the open pit area during operations, and a moderate magnitude effect predicted as a result of blasting along the haul road during construction. Blasting along the access road is predicted to have a negligible impact upon AR-04. This is based on the vibration effects analysis model results (see Section 5.5) using guidelines established by the United States Bureau of Mines (US Bureau of Mines, 1980).

Magnitude of Effect on Cultural Heritage

As there is potential for the receptor to be affected by ground-borne vibrations which may result in damage to the receptor, a moderate magnitude effect is expected at AR-04.

**5.10.7 Impact Classification**

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

**5.10.7.1 Magnitude of the Effect**

Table 5-92 presents the parameters which will be used for the impact assessment for cultural heritage.
### Table 5-92: Impact assessment parameters for cultural heritage

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Geographic extent</th>
<th>Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negligible</strong></td>
<td>Local: Biophysical local study area</td>
<td>Short-term: Effect is reversible at end of construction</td>
<td>Infrequent: Effect occurs intermittently but not continuously over the assessment period</td>
</tr>
<tr>
<td></td>
<td>Regional: Biophysical Regional study area</td>
<td>Medium-term: Effect is reversible at end of operations</td>
<td><strong>Frequent</strong>: Effect occurs repeatedly or continuously over the assessment period</td>
</tr>
<tr>
<td></td>
<td>Beyond regional – transboundary</td>
<td>Long-term: Effect is reversible within a defined length of time or beyond closure</td>
<td>Permanent: Effect not reversible</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated effect on tangible or intangible cultural heritage receptors is slight – considered to be of 'nuisance' value.(^{(a)})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated effect on tangible or intangible cultural heritage receptors is moderate. It is considered that the receptor will be changed resulting in modifications to cultural functions and processes.(^{(b)})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated effect on tangible or intangible cultural heritage receptors is severe. It is considered that the receptor will be wholly changed so that cultural functions and processes are significantly limited or lost entirely.(^{(c)})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(\text{Expanded definition of low magnitude:}\)
- 'Living' cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are slightly changed, but no modification of receptor use is required.
- Intangible cultural heritage receptors are slightly changed, but traditional beliefs, practices or behaviours are not modified.
- Archaeological receptors or their settings are slightly altered, but their integrity is maintained or archaeological receptors are altered but no information is lost (through archaeological excavation and recording).

\(\text{Expanded definition of moderate magnitude:}\)
- 'Living' cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are changed, and modification of receptor use is required.
- Intangible cultural heritage receptors are changed, and traditional beliefs, practices or behaviours are modified.
- Archaeological receptors or their settings are altered and key elements are changed such that the resource value is modified and/or information is lost.

\(\text{Expanded definition of high magnitude:}\)
- 'Living' cultural heritage receptors, or component parts thereof, are altered, removed or damaged such that their value and/or functionality/setting/accessibility are entirely changed or lost. Receptor use is prevented, or significantly limited.
- Intangible cultural heritage receptors are entirely changed, and traditional beliefs, practices or behaviours cannot continue and are lost, or are severely inhibited.
- Archaeological receptors or their settings are altered and key elements are changed such that the resource value is entirely altered or lost.

### 5.10.7.2 Consideration of Receptor Sensitivity

Determination of the consequence of impacts to cultural heritage is based upon the impact classifications from the impact assessment process, combined with the sensitivity of the cultural heritage receptors (Table 5-93).
Table 5-93: Sensitivity of cultural heritage receptors

<table>
<thead>
<tr>
<th>Importance/sensitivity of receptor</th>
<th>Example of sensitivity of cultural heritage receptors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very high</strong></td>
<td>Cultural sites of international or national importance with significant cultural or touristic value. Sites which cannot be moved because they are natural features and are critical(^{32}) and/or rare at the national or international level. Intangible cultural heritage with the greatest social(^{33}) and/or historic(^{34}) and/or scientific(^{35}) and/or environmental(^{36}) value. Intangible cultural heritage which is recognised and designated at a national or international level. Intangible cultural heritage endemic to a certain place or group of people (and therefore ‘rare’), and which is widely representative of that specific toponym or group. Intangible cultural heritage which is non-replicable. Archaeological and historic sites of national or international importance, with the highest potential for further, significant discoveries to be made. Archaeological and historic sites with rare and/or previously unstudied or understudied features with a high potential for crucial further research. Archaeological and historic sites which are afforded protection and where no intrusion is permitted.</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>Cultural sites of national or regional importance with significant cultural value. Non-replicable cultural sites or cultural sites which are potentially replicable and which could be moved in highly exceptional circumstances (in consultation with the affected communities). Intangible cultural heritage with significant social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage which is endemic to a certain place or group of people (and therefore ‘rare’), and which is representative of a significant proportion of that specific toponym or group. Non-replicable intangible cultural heritage or that which are difficult to replicate. Archaeological and historic sites of regional or national importance, with high potential for further discoveries to be made. Archaeological and historic sites with understudied features and/or high potential for further research.</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>Cultural sites of local importance with significant cultural value. Cultural sites which are replicable and which can be moved in certain extenuating circumstances (in consultation with the effected communities). Intangible cultural heritage with social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage which is common and widely representative of the population as a whole, and therefore potentially replicable, through community engagement. Archaeological and historic sites of local importance, with some potential for further discoveries to be made. Archaeological and historic sites with features which have been comprehensively studied and/or are poorly preserved, with limited potential for further research.</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>Cultural sites of limited local importance and cultural value. Cultural sites which are defunct and/or have little or no historic value. Cultural sites which are replicable and which can be moved, or destroyed (in consultation with the affected communities). Intangible cultural heritage with limited social and/or historic and/or scientific and/or environmental value. Intangible cultural heritage which is common and widespread, but only representative of a limited proportion of the population. Intangible cultural heritage which has the greatest potential to be replicated, through community engagement. Archaeological and historic sites of limited local importance, with low or no potential for further discoveries to be made. Archaeological and historic sites with features which have been comprehensively studied and/or are poorly preserved/destroyed, with no potential for further research.</td>
</tr>
</tbody>
</table>

\(^{32}\) Critical cultural heritage consists of one or both of the following types of cultural heritage: (i) the internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designations (IFC, 2012a).

\(^{33}\) Value to society in the present.

\(^{34}\) Value to our understanding of the human past.

\(^{35}\) Value to our understanding of people and their environment.

\(^{36}\) Value to our understanding of the environment.
5.10.7.3 Determination of Impact

Using the decision matrices presented in Annex 1 and the receptors predicted to be affected by the project (i.e. those identified during the effects analysis as experiencing anything greater than a negligible effect), the impacts have been determined. Table 5-94 presents the consequence of each impact. Table 1 in Annex 5I presents the route to the classification of the impacts, presenting the magnitude, geographic extent, duration and frequency for each impact, as well as the sensitivity of each receptor. All receptors included in the impact assessment are shown in Drawing 5-28.

Table 5-94: Assessment of impacts for cultural heritage

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preslop Spring Memorial Stone (SP-01)</td>
<td>Construction</td>
<td>Ground disturbance - construction of TMF</td>
<td>Moderate</td>
</tr>
<tr>
<td>Shtuchki Vodopad (NF-01)</td>
<td>Construction</td>
<td>Ground disturbance - construction of TMF</td>
<td>Moderate</td>
</tr>
<tr>
<td>Religious beliefs and practices37</td>
<td>Construction</td>
<td>Noise – construction</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Construction and Operations</td>
<td>Noise – blasting</td>
<td>Major</td>
</tr>
<tr>
<td>Adit/Tunnel Site (AR-03)</td>
<td>Construction</td>
<td>Ground disturbance – construction of mine workshop area</td>
<td>Moderate</td>
</tr>
<tr>
<td>Crkvishte (AR-04)</td>
<td>Construction and Operations</td>
<td>Ground vibrations - blasting</td>
<td>Moderate</td>
</tr>
<tr>
<td>Domus Gaber (AR-05)</td>
<td>Construction and Operations</td>
<td>Ground disturbance – construction of TMF</td>
<td>Moderate</td>
</tr>
<tr>
<td>Anovi (AR-06)</td>
<td>Construction and Operations</td>
<td>Ground disturbance – construction and ore extraction in open pit area (creation of mine pit)</td>
<td>Major</td>
</tr>
<tr>
<td>Preslop (AR-07)</td>
<td>Construction</td>
<td>Ground disturbance - construction of upper plant site and TMF</td>
<td>Major</td>
</tr>
<tr>
<td>Krvavichevo and Golemata Niva (AR-08)</td>
<td>Construction</td>
<td>Ground disturbance - construction of upper plant site</td>
<td>Major</td>
</tr>
<tr>
<td>Gradishte (AR-10)</td>
<td>Construction and Operations</td>
<td>Ground disturbance - construction of TMF</td>
<td>Major</td>
</tr>
<tr>
<td>Old Mill (AR-11)</td>
<td>Construction and Operations</td>
<td>Ground disturbance - construction of TMF</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

5.11 Landscape and Visual

This section presents the findings of the landscape and visual effects analysis. There are two main parts to the assessment:

- Landscape effects: which relate to the permanent effects on the fabric, character and scenic quality of the landscape resulting from physical and perceptual changes (i.e. to landform, vegetation cover, or tranquillity of the landscape), whether or not the changes can be seen by the local population.

- Visual effects: which relate to changes in existing views and the effects of those changes on the current population (e.g. residents, workers or visitors) within the study area.

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37 This includes impacts upon religious practices including those held at CH-03, specifically the Nativity of Theotokos festival.
The aim of the assessment is to identify any significant changes to landscape characteristics or views and to develop appropriate mitigation measures to reduce adverse effects.

Whilst landscape and visual effects and mitigation measures are presented in this section, the full impact analysis process is covered under the quality of life evaluation in the socio-economic impact assessment (Section 5.12) and the cultural heritage impact assessment (Section 5.10), as the visual impact is one observed by human receptors and forms only part of the evaluation in the aforementioned chapters.

5.11.1 Sources of Effects

Elements of the Project identified as potential sources of change to the landscape and visual baseline include:

- Vegetation clearance which exposes areas of bare earth (construction);
- Construction and operational use of plant sites and infrastructure, including the access roads, haul roads, powerline, offices, workshops, crushing/process plant, conveyor belt, and stockpiles. In particular, the mine workshop area, haul roads and powerline on the southern face of Čukar (construction and operations);
- Permanent changes to landform through open pit mining and construction of the TMF. In particular, the ‘engineered’ horizontal benches and rises of the open pit and the TMF dam (construction, operations, closure, post-closure); and
- Site activity, including movement of people by vehicle or mobile plant; dust plumes and lighting associated with the process plant, mine workshop area and mobile plant (construction and operations).

5.11.2 Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 4) which provided the Project engineers with environmental measures which should be incorporated into Project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. The following list presents the environmental measures relevant to landscape and visual issues which have been incorporated into Project design:

- The minimisation of natural vegetation clearance and use of natural or planted vegetation to provide a screening effect for operations will be included within the construction contractor’s scope of works and will be monitored during the construction period as part of construction management activity;
- The use of earth colours, avoiding any bright or reflective colours, will be incorporated into the detailed design of the process plant and mine workshop buildings and discussed with the appointed architect for the detailed design of the Project;
- Dust suppression will occur during drilling, on haul roads, at major material transfer points such as loading or unloading of stockpiles and during all grading activities as required. Typical vehicle/plant speed will be controlled at 25 km/hr;
- Progressive reclamation: ripping of compacted areas and re-vegetation as soon as disturbed areas are no longer in use. Re-vegetation with native vegetation will be a requirement in the construction and operational phases as well as the Mine Closure Plan (Annex 6) and will be included in scopes of work for contractors during construction and operations; and
- The access road to the mine will not be illuminated.

5.11.3 Study Area and Receptors

5.11.3.1 Landscape Study Area

The study area for the landscape character assessment includes those areas physically affected by the mine footprint or the associated infrastructure (e.g. the proposed access road and the route of the overhead powerline), along with those areas adjacent to it (up to a distance of 2 km).
5.11.3.2 Visual Study Area

ZTV mapping was updated for the effects analysis to take account of changes to Project design and to inform the revised study area for the visual assessment (Drawings 5-30 to 5-37). The study area is presented in Section 1.

Given the size of the visual study area, it was considered impractical to undertake a visual assessment from all the receptors within the study area, especially as the visual effect is likely to be very similar at adjacent settlements. To avoid repetition and to limit the size of the assessment, the number of receptors to be assessed has been reduced to 14 representative viewpoints. The selected viewpoints are typical of views from settlements (or groups of settlements), roads and visitor destinations used for public gatherings at a range of distances and orientations from the mine.

The viewpoints used to assess potential visual impacts are listed in Table 5-95 and shown on Drawing 5-37.

Table 5-95 Viewpoints included in the visual effects analysis

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Type of Receptor</th>
<th>Viewpoint</th>
<th>Represents views from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilovica</td>
<td>Settlement</td>
<td>VP1</td>
<td>Ilovica</td>
</tr>
<tr>
<td>Road between Ilovica/Shtuka and</td>
<td>Road</td>
<td>VP2</td>
<td>Views approaching Ilovica and Shtuka from the south</td>
</tr>
<tr>
<td>Turnovo</td>
<td>Settlement</td>
<td>VP3</td>
<td>Church and the northern edge of Shtuka</td>
</tr>
<tr>
<td>Turnovo</td>
<td>Settlement</td>
<td>VP6</td>
<td>Northern end of the village</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Settlement</td>
<td>VP8</td>
<td>Sekirnik*</td>
</tr>
<tr>
<td>Borisovo</td>
<td>Settlement</td>
<td>VP17</td>
<td>Borisovo, Mokrijevo, Koleshino and Mokrino.</td>
</tr>
<tr>
<td>Radovo</td>
<td>Settlement</td>
<td>VP20</td>
<td>Northern edge of the village</td>
</tr>
<tr>
<td>Drovos</td>
<td>Settlement</td>
<td>VP23</td>
<td>Drovos and Chanaklija</td>
</tr>
<tr>
<td>Petralinci</td>
<td>Settlement</td>
<td>VP24</td>
<td>Petralinci, Saraj, Gecherlija, and Staro Baldovci</td>
</tr>
<tr>
<td>Carevi kuli Fortress</td>
<td>Visitor site</td>
<td>VP26</td>
<td>Carevi kuli Fortress and the hills behind Strumica.</td>
</tr>
<tr>
<td>Monastery of St George (Chapel in</td>
<td>Cultural Heritage</td>
<td>VP29</td>
<td>Chapel in Shtuka Valley (used for religious festival once a year) *</td>
</tr>
<tr>
<td>Shtuka valley)</td>
<td>Visitor site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumba Peak</td>
<td>Visitor site</td>
<td>VP32</td>
<td>Strategic summit and the Belasica mountains.</td>
</tr>
<tr>
<td>Smolare Falls</td>
<td>Visitor site</td>
<td>VP33</td>
<td>Smolare Falls area (not necessarily the precise location of the waterfall).</td>
</tr>
<tr>
<td>Koleshino Falls</td>
<td>Visitor site</td>
<td>VP34</td>
<td>Koleshino Falls area (not necessarily the precise location of the waterfall).</td>
</tr>
</tbody>
</table>

5.11.4 Considerations from Stakeholder Engagement

The stakeholder engagement process (described in Section 1) identified three specific issues relevant to landscape and visual impacts.

- The first issue related to whether the TMF be visible from Shtuka village. The effects are assessed within this study and impacts are addressed in Sections 5.10 and 5.12.
- A concern was raised regarding whether the mine will be visible from Novo Selo. Euromax confirmed that the mine will not be visible from Novo Selo due to the topography of the surrounding areas.
The final concern raised was whether there will be an embankment at the TMF. These effects are assessed within this study and impacts are addressed in Sections 5.10 and 5.12.

5.11.5 Key Guidelines and Standards

There are no Macedonian or EU standards or legislation relating specifically to the assessment of landscape and visual effects, neither are there any international guidelines or World Bank standards which relate specifically to the subject.

The International Finance Corporation (IFC) Performance Standard 3: Resource Efficiency and Pollution Prevention (2012) highlights the need to reduce pollution from new development. The term is deemed to include “potential visual impacts, including the effects of lighting”.

In the absence of international guidance, the proposed methodology employed for this assessment is based primarily on current UK guidance, namely:


Reference has also been made to:


5.11.6 Effects Analysis

5.11.6.1 Landscape Methodology

The following activities were used to evaluate the effects on the landscape:

- Overlaying the mine footprint on the landscape character area (LCA) plan and aerial photographs to estimate the physical extent of the changes to the landscape attributes (landform, vegetation, water, built form, cultural, tranquillity, scarcity; and condition) within LCA 1, LCA 3 and LCA 4 (Drawing 5-30);

- Preparing a computer-generated model of the main mine components to assess the permanent changes to landform and land cover; and

- Comparing the main mine components with field observations/judgements made during the baseline study.

Changes to the landscape attributes within each LCA were assessed and categorised individually using the criteria in Table 5-96 to determine the magnitude of effect on landscape impacts.

| Table 5-96: Criteria for determining the magnitude of effects on landscape |
|---------------------------------|-----------------|-----------------|-----------------|
| **High**                        | **Moderate**    | **Low**         | **Negligible**  |
| Major loss or alteration to     | Notable loss or | Minor loss or   | Very minor loss |
| the landscape character.        | alteration to   | alteration to   | or alteration   |
| Typically changes to five or    | the landscape   | the landscape   | to the landscape|
| more landscape attributes.      | character.      | character.      | character.      |
|                                 | Typically major changes to three or four key landscape attributes. | Typically major changes to one or two key landscape attributes. | Typically no major changes to key landscape attributes. |

5.11.6.2 Visual Methodology

The visual effects on the local population (viewers) were considered in relation to the predicted appearance of the mine and the associated infrastructure from those receptors listed in Table 5-95 and assessing the degree of change compared to the existing baseline views. Visual effects were assessed using the following methods:
Updating the ZTV mapping and analysis to predict the visual envelope for the main mine components (i.e. TMF, open pit, powerline, plant site area, mine workshop area and primary crusher/conveyor belt drawings 5-31 to 5-36);

Generating simplistic computer-generated visualisations to illustrate the size, scale of the mine development from locations which represent typical views from settlements, roads, and cultural sites. The visualisations represent the end of the operations period, prior to the closure phase (considered to be the worst case scenario in terms of physical changes to the landscape); and

Comparing the main mine components with field observations/judgements made during the baseline study.

The effects on viewers were assessed in relation to change to the composition and quality of the view, the prominence of the development and the distance between the viewer and the development.

**The composition and quality of the view**

A view comprises a number of attributes which collectively contribute to the composition and scenic quality of the view. The assessment considers changes to these attributes (which include scale, colour, texture, form and pattern) to determine the overall effects on the view composition.

**Prominence of the development**

The overall prominence of the mine components are measured in terms of the extent or proportion of the viewer’s field of vision occupied by the proposed development (Figure 5-27). There is usually a strong correlation between prominence and distance.

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**DOMINANT** - The development occupies more than 50% of the horizontal field of view.

**PROMINENT** - The development occupies more than 25% of the horizontal field of view.

**DISCERNABLE** (visible but not obvious) - The development occupies less than 10% of the horizontal field of view.

*Figure 5-27: Criteria for Assessing the Prominence of the Development*
Distance between the viewer and the development

There is usually a correlation between viewer distance and magnitude of change (i.e. the greater the distance, the less the visual impact), though occasionally distant viewers may be more adversely affected than closer viewers whose views are screened by intervening landform and/or vegetation.

Magnitude of visual change

The overall effects on view composition, prominence and distance are calculated using the criteria in Table 5-97. The magnitude of change is based on a qualitative assessment undertaken by a professional assessor and does not necessarily reflect the individual opinions or perception of the viewers within the communities who may be disposed or predisposed to the mine project, altering their tolerance to visual change.

Table 5-97: Criteria for determining the magnitude of visual effect

<table>
<thead>
<tr>
<th>Attribute</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change to the composition and quality of the view</td>
<td>Major change to all attributes</td>
<td>Moderate change to all attributes or Major change to some attributes</td>
<td>Low change to all attributes or Moderate change to some attributes</td>
<td>Negligible change to attributes</td>
</tr>
<tr>
<td>Prominence of the development</td>
<td>The development is dominant</td>
<td>The development is prominent</td>
<td>The development is discernible</td>
<td>The development is not visible or barely discernible</td>
</tr>
<tr>
<td>Distance between the viewer and the development</td>
<td>Distance between the viewer and the development is Less than 2 km</td>
<td>Distance between the viewer and the development is 2 to 5 km</td>
<td>Distance between the viewer and the development is 5 to 10 km</td>
<td>Distance between the viewer and the development is greater than 10 km</td>
</tr>
</tbody>
</table>

5.11.6.3 Results

5.11.6.3.1 Summary of effects on landscape

In terms of the direct physical effects, the Project footprint (including the access road and the powerline) extends into LCA 1, LCA 3 and LCA 4 (Drawing 5-30). The effects on these LCAs are summarised below.

LCA 1 - Flat Agricultural Land

The primary source of the effect on the landscape is the construction of the permanent off-site access road and overhead powerline across open agricultural land, having an urbanising effect on a rural area.

The off site access road and new powerline would, for the main part, be located within LCA 1 ‘flat agricultural land’ which is considered to be of low sensitivity and already contains a number of roads and overhead powerlines which detract from the rural character of the open farmland in the valley bottom. The predicted effects on LCA 1 are low.

LCA 3 - Mountain Forest

The following comprise the primary source of effects on the landscape:

- TMF: Permanent modification of the landform, introducing man-made forms into the natural topography.
- Mine Pit: Permanent modification of the landform, introducing man-made forms into the natural topography. Horizontal benches on pit face contrast with angle and gradients of natural topography.
- Process plant, mine workshop area, stockpiles, conveyor belt, haul/access roads, lighting and overhead powerline: ‘Industrialising’ effect on the character of the mountain forest landscape.

The mine development would result in modification of the natural landform (and to a lesser extent the natural vegetation), resulting in a permanent change to the natural character of the ‘mountain forest’ landscape (irrespective of whether or not these components are visible). These features would leave a permanent
remainder of mineral working on the mountainside above the Strumica Valley for future generations. Therefore, the effects are predicted to be **high**.

**LCA 4 - Undulating Pasture/Scrub**

The following comprise the primary source of effects on the landscape:

- Plant site area: modification of landform, man-made structures and site activity will change the character of the attractive, tranquil landscape.

- Permanent off site access roads and new powerline to the east of Shtuka, along with the mine workshop area on the edge of the LCA introducing man-made structures and activity to a relatively tranquil area.

There would be minor incursions into the ‘undulating pasture/scrub’ landscape which is of medium sensitivity, although this LCA is commonplace in the region and could be more readily reinstated than the mountain forest landscape.

The predicted effects on LCA 4 are **low**, due mainly to the temporary nature of the development in these areas (i.e. the plant site, workshop area and infrastructure could be removed at mine closure without permanent modification of the landscape).

5.11.6.3.2 **Summary of visual effects**

The visual assessment considers the effects of the main mine components from representative viewpoints, without mitigation measures. Drawings presenting photographs of existing views and a computer-simulated visualisation of the same view including the Project infrastructure are provided in Annex 5J.

Not all of the visualisations have been used in the effects analysis, as they were scoped out when identifying key receptors (Section 5.11.3.2). Nevertheless, visualisations for Borievo, Monospitovo, Bansko, Ednokukjevo, Bosilovo and Vasilevo are included in Annex 5J for information only.

The results of the effects analysis are described below.

**Ilovica**

Viewpoint 1 in Annex 5J shows typical views from the village and a simulated view of the project. Primary sources of visual effects are as follows:

- Mine workshop area and haul roads on the southern face of Čukar.

- TMF: changing profile of the existing mountain skyline.

- Site activity: movement of mobile plant, dust and lighting.

Views towards the mine will be possible from the edge of the village and from open spaces within the village, including the Jazga River corridor. The open pit will be partially screened by Čukar, although the TMF will be prominent on the skyline to the right of Čukar and will obstruct views up the Shtuka valley. The haul roads up the southern slopes of the hillsid will be prominent (vegetation clearance, exposed earth and vehicles on the 20 m wide haul roads will all contrast with the retained vegetation). Partial views of the mine workshop area and the powerline will be possible from properties on the edge of the village.

Overall the visual effect of the development will be **moderate**.

**Road between Ilovica/Shtuka and Turnovo**

Viewpoint 2 in Annex 5J shows typical views from the road approaching Ilovica and Shtuka and a simulated view of the project. Primary sources of visual effects are as follows:

- TMF: Changing profile of the existing mountain skyline.

- Mine workshop area and haul roads on the southern face of Čukar.
Site activity: movement mobile plant, dust and lighting.

Travelling northwards on the road from Turnovo towards Ilovica and Shtuka, the TMF will be a dominant feature on the hillside. Towards the latter part of the operational period, the TMF will break the existing skyline, creating a new ‘man-made’ profile to the mountain tops. The haul roads will be prominent on the southern face of Čukar and the workshop area and powerline supports will be partially visible to the south and west of the concession area, although they would be seen against a backdrop of higher ground, which would reduce their prominence. The view will be experienced by a large number of people travelling to the villages and working on the surrounding agricultural land.

Overall, the visual effect of the development will be high through operations with a change to moderate at post-closure when buildings and infrastructure are rehabilitated, traffic reduces and vegetation develops on the face of the TMF embankment.

Shtuka

Viewpoint 3 in Annex 5J shows typical views from the northern edge of Shtuka and a simulated view of the project. Primary sources of visual effects are as follows:

- Mine workshop area, haul roads on the southern face of Čukar.
- TMF: Changing profile of the existing mountain skyline.
- The new powerline in the middle distance as it crosses the Shtuka Valley.
- Site activity: Movement of mobile plant, dust and lighting.

Due to natural topography and the density of buildings and trees within Shtuka, views towards the mine will be infrequent. Rising land to the north and east of Shtuka village will mostly screen the open pit and the process plant. Due to their proximity, the haul roads will be prominent on the southern face of Čukar, especially from Saints Cyril and Methodius Church. The TMF to the east will be dominant, extending above the existing skyline and substantially changing the character and composition of the easterly views along the Shtuka Valley, especially from the church and the northern and eastern edge of the village. The mine workshop area, on the edge of the Shtuka valley will be prominent, although it will be removed at the end of operations. The new powerline will be a notable feature as it crosses the valley in the middle distance.

Overall, despite the proximity to the mine, the magnitude of visual effects experienced by residents in the main part of the village will be low, although the visual effects experienced at the church and some houses to the north and east of the village will be high through operations with a change to moderate at post-closure when buildings and infrastructure are removed, traffic reduces and vegetation develops on the stepped TMF benches.

Turnovo

Viewpoint 6 in Annex 5J shows typical views from the northern edge of Turnovo and a simulated view of the project. Primary sources of visual effects are as follows:

- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the TMF benches (post-closure).
- Mine workshop area, and haul roads on the southern face of Čukar.
- The ROM Pad and the Primary crusher.

Views towards the mine are mainly restricted to residents on the northern edge of Turnovo. Views towards the mine from within the village are partially screened by intervening buildings. Where open views to the north are possible, the TMF will be prominent, although it will not break the skyline and will be more than 5 km from Turnovo. The open pit will be barely discernible and the process plant will be screened by Čukar, although the ROM pad and conveyor will be notable components of the view. The mine workshop area will be partially
screened by intervening high ground. The powerline will be apparent to the south and west of the concession area, although its visibility will be reduced against the backdrop of vegetation on the rising ground behind. The visual effects experienced from some houses to the north of the village will be **moderate** through operations with a change to **low** at post-closure when buildings and infrastructure are rehabilitated, traffic reduces and vegetation develops on the face of the TMF embankment.

**Sekirnik**

Viewpoint 8 in Annex 5J shows typical views from the northern edge of Sekirnik and a simulated view of the project. Viewpoint 31 shows a simulated view of the Project from Sekirnik Park. Primary sources of visual effects are as follows:

- Haul roads on the southern face of Čukar.
- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment (post-closure).
- Overhead powerline across agricultural land north of Sekirnik.

Views towards the mine are mainly restricted to residents on the northern edge of Sekirnik. Views towards the mine from within the village, including Sekirnik Park (cultural heritage site), are mostly screened by intervening buildings. The open pit, workshop area and plant site area and ROM pad will not be visible.

Where open views are possible, the TMF will be prominent, although it will not break the skyline and will be more than 5 km from Sekirnik. The overhead powerline will be obvious where it crosses the flat agricultural farmland north of Sekirnik and ascends the hillside west of Čukar, although its impact will be lessened by the existing transmission/distribution lines to the north of the village.

The visual effects experienced from some houses to the north and east of the village will be **moderate** through operations with a change to **low** at post-closure when buildings and infrastructure are rehabilitated, traffic reduces and vegetation develops on the face of the TMF embankment.

The impact on the setting of Sekirnik Park (cultural heritage site) is considered in the cultural heritage assessment (Section 5.10).

**Borisovo**

Viewpoint 17 in Annex 5J shows typical views from Borisovo, (which is representative of views from Mokrievo, Koleshino and Mokrino) and a simulated view of the Project. Primary sources of visual effects are as follows:

- TMF: Permanent modification of the landform.

Due to the higher elevation of land around Borisovo, a number of residents within the village are afforded views across the valley towards the mine. From this location, the open pit, ROM pad and conveyor will be hidden from view behind Čukar and it is unlikely the powerline, haul roads or mobile plant will be immediately apparent, due to the distance. The TMF and the process plant will be apparent. All the mine components will be viewed against a backdrop of higher ground which will assist with its visual integration. From this location, the appearance of the skyline will remain unchanged.

The visual effects experienced from the village will be **low**.

**Radovo**

Viewpoint 20 in Annex 5J shows typical views from Radovo and a simulated view of the project. Primary sources of visual effects are as follows:

- Mine workshop area and haul roads prominent on the southern face of Čukar.
- ROM pad and the process plant area.
TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.

Mine pit: Horizontal benches will be prominent.

Overhead powerline across agricultural land south and west of the concession area.

Views towards the mine are mainly restricted to residents on the northern edge of Radovo. Views from within the central part of the village are mostly screened by intervening buildings. Where views are possible, the TMF and the open pit will be prominent, although from this location all the mine components will be viewed against the backdrop of higher ground and will be more than 5 km away, thus reducing the amount of change compared to existing views. The process plant, ROM pad and conveyor will be partially visible. The overall composition of the view will not be significantly different from the existing situation. The main impacts are likely to arise during operations from the contrast between the colour and texture of the TMF and open pit in relation to the surrounding vegetation.

The visual effects experienced from some houses to the north of the village will be moderate throughout operations with a change to low at post-closure when buildings and infrastructure are rehabilitated, traffic reduces and vegetation develops on the face of the TMF embankment and on the face of the pit.

Drvosh

Viewpoint 23 in Annex 5J shows typical views from the southern approach to Drvosh (not the village itself) and a simulated view of the project. Primary sources of visual effects are as follows:

- Open pit: Permanent modification of the skyline and prominent horizontal benches.
- Process plant site, conveyor and lighting on the skyline.
- TMF: Visible from the southern approach, although it will not be visible from the village itself.
- Haul roads on the face of Čukar.

Views towards the mine are mainly restricted to residents on the eastern edges of Drvosh and are partially obscured by an intervening ridge of higher ground to the east, which creates the illusion that the mine is more distant than it actually is. From within the village the TMF and the workshop area will not be visible, although the mine pit with the horizontal ‘man-made’ benches/lifts will be prominent. There will be a notable change in the landform and the skyline (i.e. the northern shoulder of Čukar will be lower, exposing views of mountains on the far horizon).

Overall despite its proximity to the mine, the development will not be overbearing and will not adversely affect the setting of the village. The visual effects experienced from the Drvosh and Chanaklija will be low.

Petralinci

Viewpoint 24 in Annex 5J shows typical views from Petralinci (which is representative of views from Saraj, Gecherlija and Staro Baldovci), and a simulated view of the project. Primary sources of visual effects are as follows:

- Open pit: Permanent modification of the landform and prominent horizontal benches.
- Process plant site and conveyor.
- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.
- Workshop area and haul roads on the southern face of Čukar.
- New powerline on the mountainside west of the mine.
Views towards the mine are mainly restricted to residents on the northern and eastern edges of Petralinci. Views from within the centre of the village are mostly screened by intervening buildings. The open pit, especially the horizontal benches/lifts, will be prominent and are likely to draw the viewer’s eye towards the extraction. There will be a notable change in the landform (i.e. the northern shoulder of Ćukar will be lower, exposing views of mountains on the far horizon), although it is more than 5 km away. The process plant, mine workshop area and conveyer will be visible, although assuming they are painted with a recessive colour they are likely to merge with the higher ground behind. The TMF will be visible, although it will be seen between higher mountains in front of, and beyond the TMF. Visual assimilation will improve as the proposed vegetation becomes established.

The visual effects experienced from Petralinci, Saraj, Gecherlija and Staro Baldovci will be low through operations and closure.

**Carevi kuli Fortress**

Viewpoint 26 in Annex 5J shows typical views from the Carevi kuli Fortress and the hills behind Strumica and a simulated view of the project. The photograph and corresponding visualisation are ‘zoomed in’ and therefore the mine appears to occupy a greater proportion of the view than it will in reality.

Primary sources of visual effects are as follows:
- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.
- Open Pit: Permanent modification of the landform. The horizontal benches will contrast with the natural topography.

Viewed from Carevi kuli fortress and the hills south of Strumica, all the main components of the mine will be visible, although they will be viewed against a backdrop of higher ground. The composition of the view will not change and at a distance of approximately 18 km the mine will appear as a comparatively minor component within the easterly views from the fortress. The horizontal benching in the open pit and the contrast colour of the ‘bare earth’ areas may contrast with the greens of the surrounding vegetation. Overall, the development is unlikely to affect the setting of the historical site or the views from the adjacent hills.

The visual effects experienced from Carevi kuli Fortress and the hills behind Strumica will be negligible.

**Monastery of St George (Chapel in Shtuka Valley)**

Viewpoint 29 in Annex 5J shows a simulated view of the project from the location of the Monastery of St George. Primary sources of visual effects are as follows:
- Mine workshop area, on the northern side of the Shtuka Valley, during the operations, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.
- TMF: Dominating feature, obstructing views along the Shtuka Valley.
- Site activity: movement of mobile plant, dust and lighting.

The Monastery of St. George (religious site) lies to the northwest of Shtuka in the Shtuka Valley. The monastery is a small un-consecrated chapel which is rarely used, but does act as the venue for religious festivities once a year. During the operational period the tranquil character of the valley and the setting of the monastery will be adversely affected. The TMF will be a dominant feature, although some screening will be afforded by trees around the monastery. The angular ‘man-made’ face of the TMF will contrast with the natural topography of the steeply incised valley in which it is located. Due to their proximity the mine workshop area and the haul roads up the southern face of Ćukar will also be prominent, although the open pit, RoM pad, conveyer and process plant area will be screened by the intervening landform. The site access road will follow the valley side to the south of the monastery. Post operations when the mine workshop is removed the valley will become more tranquil.
The visual effect during operations will be High. The impact on the monastery is evaluated in the cultural heritage impact assessment (Section 5.10) in the context of its frequency of use (i.e. views will only be experienced once a year).

**Tumba Peak and Smolare Falls**

Viewpoints 32 and 33 in Annex 5J show visualisations of the potential views from Tumba Peak and Smolare Falls respectively (estimated locations and they do not take into account any screening afforded by trees, especially surrounding Smolare Falls). Primary sources of visual effects are as follows:

- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.

The TMF may be visible from both locations, although due to the distance (over 13 km and over 17 km respectively) and the backdrop of higher ground, the changes to the views will be minimal. The setting of this important viewpoint will not be affected.

The visual effects will be negligible.

**Koleshino Falls**

Viewpoint 34 in Annex 5J shows a visualisation of the worst-case scenario views from the Koleshino Falls area (does not take into account the extensive screening afforded by trees surrounding Koleshino Falls). Primary sources of visual effects are as follows:

- TMF: Permanent modification of the landform, although visual assimilation will occur as vegetation develops on the face of the TMF embankment.

From Koleshino Falls (a popular visitor destination), the TMF and process plant site, will be partially visible, although at a distance of over 10 km these components will appear as very small features on the mountainside. Changes to the composition of view will be minor and viewed against the backdrop of the higher ground. The mine will not affect the setting of the popular visitor destination.

The visual effects experienced from Koleshino Falls will be negligible.

**Impact Classification**

The assessment of visual impacts is undertaken in the cultural heritage and socio-economic impact analyses (Sections 5.10 and 5.12, respectively).

**Socioeconomics**

The Project has the potential to have both positive and detrimental socio-economic effects that are experienced at differing degrees by surrounding communities. These effects may extend to the broader region, including municipalities adjacent to the Project, and the nation as a whole. This section summarises relevant socio-economic baseline information against which potential Project effects are measured, classifies these potential effects in terms of magnitude and consequence, proposes mitigation to limit detrimental effects and describes benefit enhancement measures to generate positive effects to local communities. The residual effect is assigned a significance ranking after mitigation is applied and assumed effective.

**Sources of Effects**

The Project description (Section 4) provides a detailed breakdown of Project components and activities. The elements of the Project which have been identified as potential sources of change to the baseline state of the socio-economic environment include:

- Capital expenditures, including goods, services and contractors (Construction);
Operational expenditures, including goods, services and contractors (Operations, Closure);

Payment of taxes and revenues (Construction, Operations);

Demand for workforce (Construction, Operations, Closure);

Worker training and education (Construction, Operations, Closure);

Payment of employment wages (Construction, Operations, Closure);

Community investment (Construction, Operations, Closure);

Land acquisition and occupation (Construction, Operations, Closure);

Proposed overhead powerline (OHL) Ilovica-Berovo (Construction, Operation, Closure);

Pit excavation and infrastructure (Construction, Operations);

Crushing and blasting (Construction, Operations);

Demand for water and electricity (Construction, Operations, Closure);

Waste generation (Construction, Operations, Closure);

Housing of workers off-site (Construction, Operations, Closure);

Transportation of workers, consumables and equipment (Construction, Operations, Closure); and

Transportation of copper concentrate (Operations).

Most of these Project components or activities are expected to affect the socio-economic environment directly. Some also have the potential to indirectly influence socio-economic features through their effect on the physical and biological environments. The results of the following assessments are considered in the socio-economic assessment to determine implications for changes to social and economic features, or land uses:

- Geomorphology, terrain and soils (Section 5.1);
- Water quantity and quality (Sections 5.2 and 5.3);
- Noise and vibration (Section 5.5);
- Air quality (Section 5.6);
- Biodiversity and ecology (Section 5.8); and
- Landscape and visual (Section 5.11).

5.12.2 Socioeconomic Elements of the Project and Incorporated Environmental Measures

Golder produced an engineering design considerations document (described further in Section 4) which provided the DFS engineers with environmental measures which should be incorporated into project design to avoid environmental impacts, thereby minimising the additional mitigation required as a result of the impact assessment. Where applicable, these are discussed in the text of the report below.

Most socio-economic effects are not pre-empted by Project engineering design considerations. Rather, they are related to the size of the Project in terms of capital expenditures, workforce requirements by Project phase, and the developer's operational policies. Some effects on communities are related to environmental effects of the Project that may be screened out through Project engineering design criteria.

Socio-economic elements of the Project that inform potential socio-economic effects have been assumed to include:
Construction schedule: 2017 to 2018;
First full year of operation: 2019;
Operational mine life: 20 years;
Construction labour demand: 1,200 Full Time Equivalents (FTEs);
Shift schedule for direct employees: Three eight hour shifts per day, seven days per week;
Average annual operational labour demand: 487 FTEs;
Capital expenditure: €425 to €450 million;
Average annual operational expenditure: €95 to €100 million;
Average annual production: 10 mtpa;
Average annual output: €150 million;
Construction accommodation: approximately 150 expatriates and 430 out-of-area Macedonians staying in hotels or rental housing;
Electricity access: installation of a high voltage electrical line corridor (OHL Ilovica-Berovo);
Waste management: Off-site landfills and transfer stations; on-site waste sorting and storage, sewage treatment plant;
Off-site access road: Both the temporary construction and permanent operations off-site access roads will be designed to accommodate mining traffic (refer to Section 4); and
Transportation of copper concentrate: Ten trucks making daily round trips to Bulgaria.

Euromax has put in place the following policies, all of which have been considered in the socio-economic effects analysis:

- Recruitment and Selection Policy & Procedure (draft, Aug 2015);
- Health and Safety Policy, (August 2013);
- Community Policy (August 2013);
- Community Investment Framework (September 2014);
- Procurement Policy (February 2017);
- Human Resources Policy (draft, January 2016);
- Code Of Business Conduct and Ethics (June 2014);
- Disclosure, Confidentiality & Insider Trading Policy (June 2014);
- Anti-Corruption and Bribery Policy (November 2014);
- Project Stakeholder Engagement Plan (2016), including the following procedures:
  - Stakeholder Identification;

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38 A full time equivalent (FTE) is the hours worked by a full-time employee, and is calculated based on Macedonian labour conventions, which suggest an eight hour work day, with five days of work per week. This amounts to a FTE of 2,080 hours per annum.

39 There is an SEP presented in Annex 2 relating to this ESIA. There is a separate SEP for Project execution, referred to here.
Engagement Plan for each stakeholder group;
Information disclosure and communication methods;
Grievance Redress Mechanism;
Monitoring and Reporting; and
Responsibility for SEP Implementation.

Environmental Policy (August 2013).

The manner in which the socio-economic elements of the Project are incorporated into the effects analysis is described in greater detail in each respective assessment section.

Environmental measures incorporated in the socio-economic effects analysis are described in relevant biological and physical assessment sections (e.g., soil, water quality and quantity, air, noise, and landscape and visual). The socio-economic impact assessment uses the residual impacts from the disciplines listed in Section 5.12.1. Therefore, the socio-economic impact assessment includes all of the mitigation measures which are identified in the biological and physical impact assessments in determining effects on communities.

5.12.3 Study Area and Socio-economic Features

5.12.3.1 Study areas

The analysis of social and economic effects does not lend itself to establishing discrete study areas within which effects will be felt and outside of which effects are not anticipated. Rather, socio-economic impact assessment includes the communities that have the potential to experience socio-economic effects. Most socio-economic effects are expected to be felt by communities close to the Project, namely those in the municipalities of Bosilovo and, to an extent, Novo Selo. Collectively, these communities form the socio-economic local study area (LSA).

Table 5-84 lists the LSA communities and their population. Other communities were considered in the screening process, but were ruled out as no Project-associated effects were predicted.

<table>
<thead>
<tr>
<th>Table 5-98: Communities in the local study area and populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td><strong>Primary Affected</strong></td>
</tr>
<tr>
<td>Ilovica</td>
</tr>
<tr>
<td>Shtuka</td>
</tr>
<tr>
<td>Strumica</td>
</tr>
<tr>
<td><strong>Secondary Affected</strong></td>
</tr>
<tr>
<td>Borievo</td>
</tr>
<tr>
<td>Bosilovo</td>
</tr>
<tr>
<td>Drvosh</td>
</tr>
<tr>
<td>Ednokukjevo</td>
</tr>
<tr>
<td>Hamzali</td>
</tr>
<tr>
<td>Petralinci</td>
</tr>
<tr>
<td>Radovo</td>
</tr>
<tr>
<td>Robovo</td>
</tr>
<tr>
<td>Sekirnik</td>
</tr>
<tr>
<td>Staro Baldovci</td>
</tr>
<tr>
<td>Turnovo</td>
</tr>
<tr>
<td>Novo Konjarevo</td>
</tr>
<tr>
<td>Novo Selo</td>
</tr>
<tr>
<td>Samuilovo</td>
</tr>
</tbody>
</table>
Although the communities of Gecherlija and Saraj are in the Municipality of Bosilovo, they have not been included in the LSA as the Project interactions screening did not identify potential interaction with the Project. Of the communities in the Municipality of Novo Selo, only those expected to experience Project effects have been included in the LSA.

The LSA does not include the communities affected by the two 110kV overhead line (OHL) power connections: one will connect to an existing sub-station in Sushica, approximately 7 km south of the mine site; the second will run from Ilovica to Berovo, 30 km north of the mine site. The route passes through private land parcels that consist of orchards, abandoned meadows and pastures as well as state owned natural forest. While recognition of this associated infrastructure is included in this ESIA, complete impact analysis for the OHL will be completed in an addendum to this ESIA.

While socio-economic effects will be felt greatest locally, some effects may extend beyond the primary and secondary affected communities into neighbouring municipalities (e.g. Vasilevo), or the nation. This is particularly true of positive economic and employment effects. The regional study area (RSA) for the socio-economic impact assessment is, therefore, the Republic of Macedonia. Where effects are expected to occur in specific centres within the Republic (e.g. Skopje, Shtip), this is noted.

5.12.3.2 Socio-economic features

As described in Section 1, receptors have been agreed across technical disciplines to ensure the evaluation of combined impacts and indirect impacts is robust. Given the breadth of features in the socio-economic environment, the approach taken will be to discuss effects by feature, noting which user groups, communities or jurisdictions will experience the respective socio-economic effect and to what degree. Similarly, the impact of many socio-economic effects are assessed at the local or regional scale (e.g. demographic and population changes, economic effects, sourced employment and procurement).

Socio-economic “receptors” include the LSA communities (Table 5-84), other communities outside the LSA experiencing select socio-economic effects (i.e. Skopje, Shtip), specific land user groups, and, where appropriate, jurisdictions (e.g. the Republic of Macedonia, the municipalities of Bosilovo and Novo Selo). Socio-economic features of the environment include:

- Economy;
- Employment, education and incomes;
- Population demography;
- Community health, safety and security;
- Quality of life;
- Infrastructure; and
- Land use.

5.12.4 Considerations from Stakeholder Engagement

The following issues were identified during the stakeholder engagement process (described in Section 1) and are relevant to the impact assessment for socio-economics:

Comments Related to the Economy

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sushica</td>
<td>Novo Selo</td>
<td>1,811</td>
</tr>
</tbody>
</table>
Concern that there will be a detrimental effect on the sale of agricultural products as a result of potential buyers’ perception that produce has been contaminated by the mine;

Desire to have the mine procure goods and services locally where possible, with emphasis on agricultural produce and food products;

Local employment should be maximised, and should be spread out throughout the community;

Job postings should be accessible to local people and be posted in a timely manner;

Concern that local employment will not be high quality, instead focused on manual labour;

There should be an employment policy that targets women with families;

Desire to have training and scholarships to help maximise employment; and

Desire to have community contributions that improve culture, arts and education.

Comments Related to Human Health and Quality of Life

Concern that blasting, truck movement and dust deposition will affect human health;

Concern about greenhouse gas emissions from trucks idling at the Bulgarian border;

Concern that tree removal will affect the air quality in the area adversely;

Concern that there will be changes in drinking water quality due to mining activity;

Concern that the Project will change the availability of drinking water, particularly in the Ilovica Reservoir;

Concern about the Project’s effect on water quality in communities;

Concern over increased risk of cancer due to exposure to chemicals or dust;

Concern that vibrations as a result of blasting may be felt in communities;

Concern that blasting, mining activities, and Project traffic will create noise disturbance; and

Request for support to reconstruct the health clinic in Ilovica.

Comments Related to Physical Infrastructure

Statement that local irrigation water is currently taken from the Turija Canal and the Ilovica Reservoir and concern that supply could be affected by the Project;

Statement that a new water supply and sewage system needs to be constructed;

Concern that the Project will affect water supply, sewage and electricity;

Concern that the Project will influence the water supply network, increasing costs for people;

Concern that vibrations from Project traffic and blasting may structurally damage nearby houses;

Questions have been raised about where workers will be housed;

Concern that existing roads are too narrow for mine traffic; and

Concern that the Project will worsen traffic congestion at the Novo Konjarevo Bridge.

Comments Related to Land Use

Concern that the Project may contaminate groundwater and produce;
Concern that the tailings dam will influence water used for agriculture and livestock;
Concern that livestock grazing may be disturbed by mining facilities and loss of access to concession;
Concern that the Project will cause vibrations and changes in air quality affecting beekeeping;
Concern that the mine may inhibit access to hunting and affect wildlife populations; and
Concern that fuel wood removed during construction should go to residents of Ilovica and Shtuka.

The comments noted above have been addressed through the socio-economic impact assessment and the mitigation and benefit enhancement measures presented in Section 6.12. Additional mitigation relating to stakeholder concerns related to environmental effects are considered in the respective impact assessments.

5.12.5 Key Guidelines and Standards

This ESIA has been prepared with a view to capture key areas of interest to the people of Macedonia, as identified through stakeholder engagement, and through focus group interviews conducted as part of the socio-economic baseline data collection program.

Guidelines considered in this assessment include:

- International Finance Corporation (IFC) - Performance Standards on Environmental and Social Sustainability (IFC, 2012):
  - Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
  - Performance Standard 2: Labour and Working Conditions;
  - Performance Standard 4: Community Health, Safety and Security; and
  - Performance Standard 5: Land Acquisition and Involuntary Resettlement.

- International Finance Corporation - Investing in People: Sustaining Communities through Improved Business Practice (IFC, 2000).

- European Bank for Reconstruction and Development (EBRD) – Environmental and Social Policy (EBRD, 2014):
  - Performance Requirement 1: Assessment and Management of Environmental and Social Risks and Impacts and Issues;
  - Performance Requirement 2: Labour and Working Conditions;
  - Performance Requirement 4: Health and Safety;
  - Performance Requirement 5: Land Acquisition, Involuntary Resettlement and Economic Displacement; and
  - Performance Requirement 10: Information Disclosure and Stakeholder Engagement.

- Equator Principles (2013):
  - Principle 2: Environmental and Social Assessment;
  - Principle 3: Applicable Environmental and Social Standards;
  - Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
  - Principle 5: Stakeholder Engagement; and
Principle 6: Grievance Mechanism.


Additional guidelines and standards related to inputs into socio-economic topics such as human health, quality of life, and land and resource use are identified in the respective discipline sections, namely geomorphology, terrain and soils (Section 5.1), water quantity (Section 5.2), water quality (Section 5.3), noise and vibration (Section 5.5), air quality (Section 5.6) and landscape and visual (Section 5.11).

5.12.6 Effects Analysis

5.12.6.1 Methods

The process of socio-economic impact assessment employs both qualitative and quantitative approaches when assessing Project effects. Quantitative analysis involves modelling the Project's effect on the economy and population of the Republic of Macedonia as a whole. The model is based on the 2010 Republic of Macedonia input-output tables available from the State Statistical Office (RoMSSO 2010), and is updated with information from the 2014 national labour force survey (RoMSSO 2014a) and the socio-economic baseline (Section 14, Annex 3). Modelling results include an assessment of the Project's direct, indirect and induced effect on the following:

- Population;
- GDP and total gross economic output by industry;
- Taxes and government revenues;
- Employment by industry; and
- Labour income by industry.

Economic and population effects can have cascading implications for other aspects of the socio-economic environment. Therefore, the quantitative analysis of the Project's economic and population effects informs the qualitative analysis of other socio-economic effects. For example, where the Project has the potential to cause population change, a qualitative analysis is conducted of the associated changes in community structure and demographics, demand for services, use of infrastructure, traffic, and migration. Similarly, while the Project's procurement by country and region is calculated to identify where spending is predicted to occur, estimating where specific goods and services can be purchased from requires qualitative data gathering, including analysis of where the Project has made purchases to date.

The Project's effect on the health, safety and quality of life of people who live in the primary and secondary affected communities is determined qualitatively using information from the Project description and understanding of how the Project is being planned (Section 4) and the results of other relevant effects analyses (e.g. noise, visual aesthetics, water, air quality, traffic). Where changes to the biological and physical environments occur at a level that could potentially exceed guideline values, associated effects on community health are assessed. Where Project activities are expected to result in nuisance effects or changes in the day-to-day lives of people, an assessment or the impact on people’s quality of life is made. Potential health and safety effects related to accidents are discussed further in the Environmental Risks and Accidents assessment (Section 10).

The Project’s effect on land and resource use considers both the potential for the Project to directly affect land use opportunities through land acquisition, as well as the environmental effects that change the land that is used (e.g. changes in soil suitability, air quality, water quality and quantity, or ambient noise levels). To this end, the results of the bio-physical effects analyses have been incorporated into the socio-economic impact assessment where related to land and resource use.
5.12.6.2 Results

5.12.6.2.1 Economics

The economic effects analysis predicts the direct, indirect and induced effect of the Project on aspects of the economy of the Republic of Macedonia. Direct effects are those generated by the Project itself and reflect expenditures that will be made by the Project during construction and operations. Indirect economic effects are prompted by the Project’s demand for goods and services from supplier industries and are a measurement of the secondary business transactions resulting from direct expenditures. Induced effects occur as direct and indirect incomes associated with the Project are spent in the economy.

Direct expenditures

The total capital cost of Project construction is preliminarily estimated at €425 to €450 million. The procurement of construction and mining equipment is expected to account for the majority of expenditures. Labour, fuel and light vehicles will represent smaller, but still significant, capital costs during construction. Preliminary estimates for local spending indicate that approximately €10 million (2%) of total capital expenditures will accrue to the LSA, with most of this spending occurring in Strumica on goods and services. A further €190 million (46%) of capital spending will occur in other parts of Macedonia (i.e. outside of the LSA). International procurement accounts for the remaining €225-€250 million (53% to 56%) of preliminary estimates of capital expenditures, and will be largely concentrated in European purchases of items not produced in Macedonia (e.g. some types of equipment).

Operational expenditures are expected to be approximately €95 to €100 million per annum. Mine operation, including equipment and labour, will account for nearly a third (€30 million) of total annual operational expenditures. Reagents and power represent a further third (€36 million) of annual operational costs, while consumables, maintenance materials, equipment and laboratory costs are anticipated to cost €16 million. The remaining annual operational costs for the Project are in additional labour and administration expenses. The precise distribution of operational expenditures by geographic source location has not yet been determined.

Gross domestic product

Gross domestic product represents the monetary value of all goods and services produced by a nation over a specific period of time, and acts as the measure of the “size” of an economy. The Project’s GDP effects are, therefore, an indicator of its value added to the Macedonian economy.

During construction, direct Project contribution to national GDP is predicted to be €31.5 million annually, or 0.3% of the projected national GDP (IMF, 2015). Annual indirect and induced GDP effects during construction are less pronounced at €15 million, but increase the Project’s overall effect on GDP to €46.5 million, or 0.5% of the national GDP projected in 2017. Over the entire elapsed construction period, the Project is predicted to result in a total direct GDP contribution of €63 million to the national economy. Indirect and induced GDP contributions of €30 million will grow the overall total GDP effect of Project construction to €93.0 million.

During the first full year of operation (2019), direct Project contribution to the national GDP is predicted to be €82.9 million, or 0.8% of the national GDP (IMF, 2015). Project-related indirect and induced GDP contributions yield a further €23.8 million, bringing the Project’s overall GDP contribution to €106.7 million. For a single Project, this represents a substantial contribution (1%) to national GDP. This performance is expected to continue as the Project’s average annual GDP contribution during operation, though the relative proportional importance of this contribution will fluctuate annually during operation with shifts in the Macedonian economy and associated increases or reductions in the national GDP. The Project’s total direct (€1,657.8 million), indirect and induced (€475.8 million) GDP contribution over the operational life of the mine is predicted to total over €2.13 billion.

Table 5-99 provides a breakdown of the Project’s direct, indirect and induced GDP effects to the Republic of Macedonia, and compares the relative effect of Project construction and operation on national GDP.
Table 5-99: Project contribution to national gross domestic product

<table>
<thead>
<tr>
<th>GDP Contribution Source (€, million)</th>
<th>Construction</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average annual</td>
<td>Total construction</td>
</tr>
<tr>
<td>Direct</td>
<td>31.5</td>
<td>63.0</td>
</tr>
<tr>
<td>Direct as % of National GDP(a)</td>
<td>0.3%</td>
<td>n/a</td>
</tr>
<tr>
<td>Indirect</td>
<td>9.7</td>
<td>19.3</td>
</tr>
<tr>
<td>Induced</td>
<td>5.3</td>
<td>10.7</td>
</tr>
<tr>
<td>Total</td>
<td>46.5</td>
<td>93.0</td>
</tr>
<tr>
<td>Total as % of National GDP(b)</td>
<td>0.5%</td>
<td>n/a</td>
</tr>
</tbody>
</table>

(a) Source: IMF 2015.
(b) Source: IMF 2015.

The Project’s total (direct, indirect and induced) effect on GDP during construction and operation can be broken out by industry. The Project’s total direct GDP contribution (€63.0 million) during construction occurs, as would be expected, within the construction industry. Indirect GDP effects are felt most strongly in those industries supplying goods, services and other inputs in support of the construction and manufacturing industries, namely wholesale trade, which benefits from the margin on imported manufactured supplies and equipment required for Project construction. This industry is expected to experience the bulk of indirect construction GDP effects. GDP effects induced by the spending of direct and indirect incomes are concentrated within the retail trade, food and production, and service industries where consumer spending occurs.

Just as the direct GDP effect of Project construction occurs within the construction industry, the direct GDP effect of Project operation (€82.9 million annually) occurs in the mining industry. The distribution of indirect GDP effects will vary from that of construction, as Project operation is expected to require a different distribution of goods and services. Supporting the Project’s demand for electricity, water, and other utilities, the utilities industry is expected to experience the greatest induced GDP effect during Project operations (over €9 million annually). Operational GDP effects to the wholesale industry are expected to be less than those of construction, as Project equipment procurement will have reduced. The industry will, however, still benefit from equipment repair and some ongoing purchase of imported manufactured goods. Other industries servicing Project operations (e.g. accommodation and food service, finance and insurance, transport, real estate) will experience less pronounced, but still proportionally large, GDP effects. As in construction, the induced GDP effect of Project operation is expected to be most greatly felt in industries where consumer spending occurs.

Government revenues

Fiscal benefits to the Republic of Macedonia will be in the form of Project-paid corporate taxes (10% of incremental profits), income taxes collected on employment income (10% of income), sales and excise taxes (taxes on products and net production taxes), and resource royalties (2% of net smelter returns) (Table 5-100). Excluding resource royalties, all government revenues as a result of the Project include direct, indirect and induced inputs. Resource royalties are derived directly from the Project and are split between the nation and the municipalities at a rate of 22% to the nation and 78% to the municipalities (Euromax, 2015a).

Table 5-100: Project-generated government revenues (€ million)

<table>
<thead>
<tr>
<th>Revenue source</th>
<th>Construction (total)</th>
<th>Operation (average annual)</th>
<th>Operation (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal income tax</td>
<td>7.3</td>
<td>2.1</td>
<td>42.0</td>
</tr>
<tr>
<td>Corporate income tax</td>
<td>1.4</td>
<td>8.6</td>
<td>172.0</td>
</tr>
<tr>
<td>Sales and excise taxes</td>
<td>0.6</td>
<td>3.3</td>
<td>66.0</td>
</tr>
<tr>
<td>Sub-total taxes</td>
<td>9.3</td>
<td>14.0</td>
<td>280.0</td>
</tr>
<tr>
<td>Royalties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National royalties</td>
<td>0.0</td>
<td>0.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Municipal royalties</td>
<td>0.0</td>
<td>2.8</td>
<td>56.0</td>
</tr>
</tbody>
</table>
During construction, the Project is predicted to generate a total of €9.3 million in government revenue. Government revenues are based on personal (€7.3 million), corporate (€1.4 million) and sales/excise (€0.6 million) taxes, and will accrue at the national level. No resource royalties are expected during construction.

During operation, the Project is predicted to generate €17.7 million in government revenue annually, or a total of €354.0 million over the operational life of the mine. This average annual revenue payment would represent nearly 6% of national budget revenues. The majority of this revenue (i.e. €14.0 million annually, or €280.0 million total) is derived from corporate, income and sales and excise taxes, and will, as in construction, accrue at the national level. Resource royalties paid during operations will amount to €3.6 million in government revenue annually, or €72.0 million during the total operation phase. Of this, €2.8 million will accrue to the municipalities of Bosilovo and Novo Selo annually, for a total municipal government revenue stream of €56.0 million over the Project’s operational life. This represents substantial growth in the budgets of each municipality. The Project’s overall total effect on government revenues from construction to end of operation is predicted to be over €360 million.

Export
The Project has the potential to contribute substantially to exports from the Republic of Macedonia. During its operational life, the average annual value of exports is expected to be nearly €200 million (Euromax 2015). Compared to baseline exports, this amounts to approximately 5% of total national exports annually for the life of the mine and would be nearly 60% of the country’s total export of ore, slag and ash (ITC, 2015).

Local economic development
Much of Euromax’s early prefeasibility planning and investment activity occurred outside of the Republic of Macedonia, meaning that the majority of early Project costs to date have been incurred internationally. However, as the Project has advanced in development, Euromax has shifted Project spending to within the Republic of Macedonia, maximising national and local procurement wherever possible. Including early-stage Project costs, such as those related to international environmental and engineering services, the Project has conducted over €1.3 million of procurement spending within the Republic of Macedonia, with over €390,000 occurring locally within Strumica and the municipalities of Bosilovo and Novo Selo.

Locally, hospitality services (e.g. hotels, restaurants), suppliers of consumables (e.g. office supplies, food and beverage), and transportation services (e.g. taxis, shipping and receiving) have been used heavily to meet Project needs, with half or more of Project procurement in these areas occurring in Strumica or the municipalities of Bosilovo and Novo Selo (Table 5-101). While representing a smaller portion of total procurement related to Project costs, 5.3% of spending in this category has occurred locally, representing over €215,000 invested in the local economy since 2013. Combined with other local spending (i.e. Ilovica Project’s costs), total Project procurement investment in the local economy as of September 2015 amounted to nearly €400,000.

Table 5-101: Project procurement (January 2013 to September 2015)

<table>
<thead>
<tr>
<th>Revenue source</th>
<th>Construction (total)</th>
<th>Operation (average annual)</th>
<th>Operation (total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Total royalties</td>
<td>0.0</td>
<td>3.6</td>
<td>72.0</td>
</tr>
<tr>
<td>Total revenue</td>
<td>9.3</td>
<td>17.7</td>
<td>354.0</td>
</tr>
</tbody>
</table>

Note: Some totals do not exactly reflect annual averages summed over the life of the Project due to rounding.

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9 Based on a 2017 projected national budget of approximately €3 billion (Government of Macedonia, 2014)

41 This is based on the 2014 national exports and does not include a projection of export change over the life of the Project (Euromax, 2015).
It is expected that the Project’s demand for goods and services in the Republic of Macedonia, and in the LSA, will increase during construction throughout 2017, growing the amount of goods and services procured in-country and locally. As noted above, Project construction is expected to result in a total of €200 million in capital expenditures within the Republic of Macedonia, of which approximately €10 million is expected to be spent in Strumica and the municipalities of Bosilovo and Novo Selo during the construction period. This represents a substantial increase in investment in the local economy over early exploration and planning activities.

Project operation is expected to continue this pattern of investment in the Macedonian and local economies, with average annual operational expenditures projected to be between €95 million and €100 million. While the exact distribution of this spending within the Republic of Macedonia has not been determined at this stage of Project development, it is expected that a portion of these expenditures will be sourced locally. Consumables, maintenance materials and equipment, transportation services, real estate, and hospitality expenditures will represent a sizable portion (i.e., 10 to 15%) of average annual expenditures. The local economy has, as noted in Table 5-101, proven ability to supply many of these goods and services to the Project already. This ability is anticipated to grow during construction in response to increased Project demand, meaning that the local economy will likely be better positioned to supply the Project during operations.

There are no plans to build a construction camp; rather, expatriate and out-of-area construction staff will stay in hotels and rental accommodation near the Project. Of the 1,200 construction positions, 154 are expatriates and will be staying in hotels or rented villas, likely in Strumica. Based on a per diem of 51€ (31€ for accommodation and 20€ for food), the accommodation and food service industry input (regional and national) to the construction process will be 2.87€M. The non-local or out-of-area Macedonian construction workforce (430) requiring food and accommodation during the construction phase will have these expenses covered as part of their employment contracts however expenditures for food and accommodation will still accrue locally. Combined expat and local/national accommodation and food spending during the construction phase is expected to total 3.9€M nationally and 3.1€M locally, inducing 248 FTEs and 199 FTEs, respectively. A survey of available accommodation facilities indicates that there is sufficient capacity in the region to absorb the additional demand.
5.12.6.2.2 Employment, incomes and education

Employment is discussed in terms of direct, indirect and induced employment. Direct employment refers to employment specifically related to the construction and operation of the Ilovica Project and includes those hired as employees of Euromax and construction contractors working at the Project. Indirect employment is employment created in industries where the Project procures goods and services as a result of increased demand. Induced employment is generated through consumer spending of incomes earned through direct and indirect employment.

Direct employment and incomes

Direct Project employment will require workers from a variety of fields and skill levels. Unskilled employment does not require a specific vocation, trade or technical skill set and includes positions focused on general labour or housekeeping. Semi-skilled positions are those that require past experience in an industry and on-the-job skills development and may involve obtaining certifications (e.g., some operator positions, administrative clerks). Skilled employment requires a trade, vocation or designation, such as welders, nurses, or mechanics, or those that have a supervisory role. Professional employment generally requires university-level education and includes positions such as geologists, engineers, metallurgists, doctors, and environmental officers. Managerial employment is associated with positions responsible for overseeing a particular aspect of construction or operations, such as security, logistics, training, maintenance, or environmental compliance.

Most positions at the Project will require some level of training, without which, employment opportunities would not be accessible. To address this barrier, Euromax will be training mobile mining plant and process plant operators, and will consider candidates that do not have previous vocational training or experience alongside those who do. Further, Euromax intends to begin training promising candidates prior to the start of operations to put in place the necessary workforce. During this period, Euromax will staff expatriate professionals to train the prospective operations workforce, and will develop and implement training simulators and programmes to provide hands-on pre-operational experience. These training strategies are expected to maximise local involvement in Project employment.

The Project will draw a large majority of its direct workforce from within Macedonia. Total construction workforce requirements are estimated at about 1,200 Full Time Equivalents (FTEs), 1,046 (87%) of which are expected to be filled by Macedonian workers. Approximately 154 construction FTEs will be filled by expatriates as needed. Around a third of these expatriate FTEs are associated with management positions. Similarly, the majority of operation FTEs are expected to be filled by Macedonians (469 FTEs, or 96%), with a small number (18) of managerial roles being filled by expatriates during early mining activities. Expatriate managers will gradually be replaced by local managers mentored and trained during the early years of Project operation. Table 5-102 provides a breakdown of construction and operation employment, by skill level and workforce nationality.

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Local</th>
<th>Macedonian</th>
<th>Expatriate</th>
<th>Total</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>21</td>
<td>10</td>
<td>137</td>
<td>64</td>
<td>55</td>
</tr>
<tr>
<td>Professional</td>
<td>26</td>
<td>26</td>
<td>64</td>
<td>64</td>
<td>10</td>
</tr>
<tr>
<td>Skilled</td>
<td>115</td>
<td>64</td>
<td>46</td>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td>Semi-Skilled</td>
<td>169</td>
<td>64</td>
<td>68</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Unskilled</td>
<td>285</td>
<td>64</td>
<td>115</td>
<td>26</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>616</td>
<td>51</td>
<td>430</td>
<td>36</td>
<td>154</td>
</tr>
<tr>
<td>Operations (average per annum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 5-102: Direct employment (full time equivalents) by phase, skill level, and point of origin
It is expected that a portion of employment in each skill level group will be sourced from the Southeast Region and Strumica where suitable candidates are identified. Managerial and professional positions are most likely to be filled by candidates from larger centres within the Southeast Region (e.g. Strumica and Shtip), given the presence of larger labour pools of people with managerial and professional credentials. Skilled, semi-skilled and unskilled employment opportunities, however, are expected to be taken up largely by the local labour force, most of which will come from Strumica, and the municipalities of Bosilovo, Novo Selo and Vasilevo. Given that, when combined, these employment categories account for the large majority of opportunities during both construction and operation, this represents a substantial employment benefit to the local economy. The majority of skilled FTEs would be expected to accrue to Strumica, as it is here that the appropriately trained labour force is expected to reside.

Ilovica and Shtuka are the villages in closest proximity to the Project. Over two thirds (68%) of the population over the age of 18 in the villages have not completed secondary school, many having attained elementary schooling as their highest level of education (Euromax, 2015d). This low educational attainment could, as noted above, prove to be a barrier to obtaining employment with the Project. Euromax intends to target suitable employment and training programs to residents of Ilovica and Shtuka, as well as those of other nearby communities, in order to boost their ability to participate in the Project. For those with higher levels of relevant education, employment opportunities will be more accessible. Roughly a quarter of the combined population of Ilovica and Shtuka over the age of 18 has completed secondary school, largely in the technical and vocational streams that emphasise skills pertinent to industry. Some of these individuals may be able to gain employment with the Project or with the Project’s contractors during the construction and operations phases.

With a very small portion (i.e. about 3%) of the population over 18 in Ilovica and Shtuka possessing higher education (e.g. college, trades or university programs; Euromax, 2015d), it is not expected that managerial, professional or skilled employment opportunities would be taken up by a significant portion of the working age residents of either village or people in the other rural villages near the Project.

Construction of the Ilovica-Berovo OHL requires a specialized workforce. Local employment will involve a small number of positions likely for land clearing and will be short term, during construction. There are few operational positions for an OHL other than those related to regular maintenance; however, there may be a few opportunities associated with access road maintenance (e.g., cutting grass). The OHL construction workforce will stay in local commercial accommodation (e.g., hotels, rental housing). A modest number of employment positions and spending on accommodation and meals will accrue locally.

Direct incomes generated by Project employment will be substantial when compared to the national and local average gross incomes (approximately €6,300 and €2,500, respectively) (RoMSSO, 2015a; Euromax, 2015d), and compared to the average national gross income for those employed in the metal ore mining industry (€8,500) (RoMSSO 2015b). Unskilled positions during construction and operation are expected to yield average incomes nearly twice the national average and five times the local average income. Positions of increasing skill level will be paid higher wages. Unskilled positions at the Project are expected to have an average annual wage of around €10,000, while wages for semi-skilled and skilled positions are expected to be around €20,000 to €40,000, depending on the technical nature of the position. Professional positions are

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Local</th>
<th>Macedonian</th>
<th>Expatriate</th>
<th>Total</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>Professional</td>
<td>6</td>
<td>15</td>
<td>36</td>
<td>85</td>
<td>42</td>
</tr>
<tr>
<td>Skilled</td>
<td>86</td>
<td>85</td>
<td>15</td>
<td>15</td>
<td>101</td>
</tr>
<tr>
<td>Semi-Skilled</td>
<td>192</td>
<td>85</td>
<td>34</td>
<td>15</td>
<td>226</td>
</tr>
<tr>
<td>Unskilled</td>
<td>80</td>
<td>85</td>
<td>14</td>
<td>15</td>
<td>94</td>
</tr>
<tr>
<td>Total</td>
<td>365</td>
<td>75</td>
<td>104</td>
<td>21</td>
<td>487</td>
</tr>
</tbody>
</table>

Source: Euromax Resources (2016).
fewer in number and require higher education and mining-related experience, and are expected to have average annual wages of around €50,000. A very limited number of senior management positions are expected to have annual wages of up to €100,000.

Total direct labour income as a result of the Project’s construction period is expected to be over €63 million. During operation, the Project is expected to generate approximately €14 million in direct labour income annually. The total direct labour income as a result of the Project’s 20 year operational life is, therefore, estimated at over €280 million.

Indirect and induced employment and incomes

The Project’s demand for goods and services will generate indirect employment in industries and businesses supplying the Project with goods and services, as suppliers hire additional staff to meet Project demands. The consumer spending of incomes generated from direct and indirect Project employment will induce further employment growth within the Macedonian economy. It is expected that indirect employment will be substantial, given that the Project will procure a large portion of goods and services from within the Republic of Macedonia, particularly during operations. Induced employment is, similarly, expected to be high, as direct employment at the Project is expected to result in relatively high incomes that will likely be spent in-country.

During construction, the Project is estimated to result in 1,909 indirect employment positions, and to induce a further 1,003 positions, for a combined total of 2,912 positions\(^\text{42}\) (in addition to direct employment of approximately 1,200 FTEs). The majority of these employment opportunities (60%, or 1,735 positions) would occur in the wholesale, retail, and motor vehicle repair industries. A further 306 positions (11%) would be created in the agriculture, forestry and fishing industry, while 248 (9%) would occur in the accommodation and food service industry. The remaining 20% of indirect and induced employment positions would be spread out across other industries, with finance, insurance and real estate, arts, entertainment and recreation services, information and communication, and utilities seeing the largest employment effects. Induced employment is, similarly, expected to be high, as direct employment at the Project is expected to result in relatively high incomes that will likely be spent in-country.

During operation in 2019, the Project is predicted to generate 940 indirect employment positions, and to induce a further 845 positions, for a total of 1,785 positions (in addition to direct employment of 487 FTEs). The majority (62%, or 1,115 positions) of this employment would be spread across three industries: utilities (28%, or 506 positions); wholesale, retail and motor vehicle repair (21%, or 375 positions); and agriculture, forestry and fishing (13%, or 234 positions). These industries are expected to supply goods and services to the Project or to be the receptor of direct and indirect employment income spending. The remaining 38% of indirect and induced employment positions would, as in the case of construction effects, be spread across other industries, with food, beverage and tobacco production, metal fabrication, electronics, finance and insurance, transportation and storage services, information and communication, and accommodation and food services seeing the greatest indirect and induced employment growth.

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The regional distribution of indirect and induced employment and associated incomes cannot be reliably quantified with accuracy; however, some level of these types of employment is expected to be generated in the Southeast Region, particularly in Strumica. Indirect employment positions would be expected in industries servicing or providing goods to the Project and that are well developed in the city. Food processing and associated agriculture production, wholesale, vehicle repair, accommodation, and transportation and storage businesses may see increased employment due to the Project’s demand for goods and services. Additional (induced) employment would be expected in consumer industries and in places where the direct and indirect workforces spend their incomes. As much of the Project’s workforce is expected to be sourced locally, a large portion of their consumer spending would be expected to occur in Strumica, the main economic and service hub of the region.

In the LSA villages, indirect and induced employment will be limited, as the goods and services sourced for Project construction and operation are not available at the required scale. Further, consumer spending of incomes generated by direct and indirect Project employment will not likely occur in the villages and will not,

\(^{42}\) Figures are estimates, but appear precise as they are the direct outputs of the economic input/output model.
therefore, induce employment growth. While there is little ability for the Project to influence where workers choose to spend their incomes, and thus the generation of induced employment, the Project’s local procurement policy can play an important role in mandating local purchase of goods and services, thus encouraging employment growth in the villages.

Indirect and induced labour incomes are expected to be in line with those for their respective industries and the national average income as a whole, as wages will be set by the suppliers of goods and services to the Project and consumer industries (rather than the Project itself). While indirect and induced employment is expected to exceed direct Project employment in terms of the number of positions created, this does not translate into the same effect on labour income, given the relatively lower incomes in industries supplying goods and services to the Project. As a result, the total indirect and induced labour income generated by Project construction is predicted to be approximately €11 million. During operation, the Project is expected to generate approximately €9 million in indirect and induced labour income per annum, or €182 million during its operational life.

Total project employment and labour income

The Project’s total impact on employment in the Republic of Macedonia, including direct, indirect and induced employment, is expected to be over 4,100 over the two-year construction period, and nearly 2,300 per annum during operation. During construction, employment will be concentrated in the construction industry, while in operation, total employment impacts will be felt most in the mining and quarrying industry and those industries supplying goods or services to the Project, namely utilities, wholesale, retail, vehicle repair, and agriculture.

Total labour income during Project construction, including direct, indirect and induced, is predicted to be around €74 million. During its operational life, the Project is predicted to generate a total of approximately €462 million in labour income. The combined Project effect on total labour income is, therefore, approximately €536 million.

Education

Without targeted benefit enhancements, the Project does not have a direct effect on educational attainment. However, through strategies identified in Section 6.12, the Project is expected to bring about positive effects on educational attainment in the LSA. The Project’s impact on education, while not addressed further in the effects analysis, is discussed in greater detail in the benefit enhancement section.

5.12.6.2.3 Population

During construction, the majority of the Project’s workforce (i.e. 1,046 FTEs) is expected to be drawn from the existing Macedonian labour force experienced in the construction industry. Much of this workforce is expected to come from Strumica, the municipalities of Bosilovo, Novo Selo and Vasilevo, and from other parts of the Southeast Region. Some foreign contractors with specialist construction skills will also be retained and some managerial positions will be filled by expatriates. Euromax is currently evaluating options for housing some of the Project’s construction workforce. During the construction period, approximately 430 out-of-area Macedonian construction workers and approximately 150 expatriates will be housed in the local area, mainly in Strumica. An assessment of commercial accommodations was undertaken, finding more than 750 hotel rooms in the local area.

Given the short duration of Project construction, it is not expected that the construction workforce from outside of the LSA would relocate permanently with their families. While some positions will last for several months only and out of area workers will use temporary accommodation, rather than move into the LSA. Project construction is, therefore, not expected to bring about a change in the permanent population of the LSA. Construction is, similarly, not expected to offset the current trend of out-migration from LSA villages such as Ilovica and Shtuka.

During operation, most (i.e. over 90%) of the Project’s workforce is expected to be drawn from Macedonia’s existing and available labour force possessing skills and experience associated with the mining industry. Project housing is not being explored as an option for the accommodation of operations workers and workers will most likely already reside within commuting distance of the Project. For those relocating from other parts
of Macedonia, it is anticipated that they will choose to reside in Strumica rather than Ilovica, Shtuka or other LSA communities, given the relative condition of infrastructure, availability of amenities, and access to housing.

Incremental population effects to the LSA are expected to be a function of where the Project’s operations workforce is sourced from. Much of the Project’s operational workforce (i.e. 75%, or 365 FTEs) is expected to be sourced locally and so is not assumed to migrate. The expatriate workforce (4%, or 18 FTEs) is also not expected to in-migrate to the LSA permanently and will instead reside in temporary accommodations while in country. The remaining 21% (104 FTEs) of the Project's operational workforce is expected to be drawn from parts of Macedonia outside the local area and so are expected to relocate permanently to the LSA, most likely to Strumica.

Assuming that all workers relocate with their families, and an average family size of 3.4 people, this would result in an incremental population increase of 354 people due to Project-induced in-migration. As noted above, it is anticipated that this effect will be concentrated in Strumica, a town of over 45,000 inhabitants with the ability to accommodate what is a relatively small number of people. The population in-migrating is not expected to alter the demographic composition of the city, as they are expected to be from within Macedonia. As the population moving into the LSA is employed with the Project in high quality jobs, this in-migration is considered positive for the LSA.

The Project’s relatively small, positive incremental population (i.e. 0.4% to 0.5% of the baseline population) impact during the first year of operation is not projected to offset the current trend of out-migration from the LSA. The local population is expected to continue to decline with the continuation of net out-migration to larger centres in Macedonia (urbanisation) or, increasingly, to other parts of Europe in pursuit of employment. Out-migration to Slovenia, Italy, Germany and other European nations has been occurring for many years and these countries have established Macedonian communities, a factor that is expected to draw Macedonian out-migrants. Given the length of time out-migration has been occurring, it is reasonable to suggest that it will continue to be a viable option for those seeking higher incomes. The trend of out-migration, while not offset, could be slowed by the Project assuming that new direct employment opportunities created by attrition are filled by local candidates.

Table 5-103 breaks down incremental population effects in the LSA as a result of the Project and projects the population of the LSA throughout the life of the Project.

### Table 5-103: Population forecast: Strumica and the Municipalities of Bosilovo and Novo Selo

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline population forecast</th>
<th>Population forecast with the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>79,918</td>
<td>79,918</td>
</tr>
<tr>
<td>2017</td>
<td>79,723</td>
<td>79,723</td>
</tr>
<tr>
<td>2018</td>
<td>79,513</td>
<td>79,869</td>
</tr>
<tr>
<td>2019</td>
<td>79,286</td>
<td>79,642</td>
</tr>
<tr>
<td>2020</td>
<td>79,041</td>
<td>79,397</td>
</tr>
<tr>
<td>2021</td>
<td>78,776</td>
<td>79,131</td>
</tr>
<tr>
<td>2022</td>
<td>78,492</td>
<td>78,846</td>
</tr>
<tr>
<td>2023</td>
<td>78,188</td>
<td>78,541</td>
</tr>
<tr>
<td>2024</td>
<td>77,863</td>
<td>78,215</td>
</tr>
<tr>
<td>2025</td>
<td>77,518</td>
<td>77,869</td>
</tr>
<tr>
<td>2026</td>
<td>77,145</td>
<td>77,496</td>
</tr>
<tr>
<td>2027</td>
<td>76,747</td>
<td>77,097</td>
</tr>
<tr>
<td>2028</td>
<td>76,324</td>
<td>76,672</td>
</tr>
</tbody>
</table>

Note: the baseline population forecast has been based on the 2014 out-migration and natural population growth rates of Strumica and the municipalities of Bosilovo and Novo Selo (RoMSSO, 2014b).
5.12.6.2.4 Community health, safety and security

The main pathways for the Project to affect the physical health and safety of the public, including Project employees, is through potential for contamination of water sources used for drinking beyond applicable water quality guidelines, reductions in water quantity available for users, changes in air quality beyond EDC, and through accidents associated with Project traffic collisions, or on-site construction or operations-related injuries. It is not appropriate to attempt to accurately predict the severity of accidental injuries or traffic collisions and then assign an impact ranking; however a risk analysis and management consideration has been completed in Section 10. No further assessment of physical health effects associated with accidental injury or traffic accidents is presented in the socio-economic assessment. Population increases have the potential to affect access to healthcare services; however, as Table 5-103 above shows, overall population numbers are predicted to decrease during the life of the Project due to continuing out-migration.

Physical health

During construction and operations, the Project is not expected to change the predicted environmental concentration of chemicals of potential concern beyond the EDC for human health as determined by both Macedonian and European Union air quality standards. The Project is, therefore, not expected to have an effect on physical health as it relates to air quality.

During construction and operations, negligible changes to groundwater quality at community receptors in Ilovica or Shtuka are predicted, relative to both maximum baseline values and drinking water standards. Surface water sources of concern related to public health and security of water supply identified by the water quality assessment (Section 5.3) include the Ilovica reservoir and the intakes on the Jazga and Shtuka Rivers, upstream of Ilovica and Shtuka. Residual effects on community water supplies are expected to be negligible following mitigation. With effective mitigation in place, the Project is, not expected to adversely affect physical health as related to drinking water quality and supply security.

Healthcare services

Adverse effects on healthcare services could be brought about by population change and the associated increase or decrease in demand for existing services, or through increased incidences of disease or need for medical treatment. Positive effects on healthcare services could include any support for the development or improvement of existing services.

The Project is predicted to result in a small incremental population impact in Strumica (i.e. 354 people in 2019, or less than 1% of the city's population). This incremental impact does not, however, offset the current trend of population decline in the local area serviced by the hospital in the city. Demand for healthcare services as a result of Project-induced in-migration is, therefore, not expected to be outside of the capacity of existing services. As a result, the Project is expected to have a neutral, perceptible, effect on medical services.

As the Project is not expected to result in changes in air quality or water quality at potable water sources that would exceed guideline values, no associated changes are expected in the health of the population that would increase demand for healthcare services beyond the capacity of the current system.

The Project will provide on-site medical services to employees and contractors via a medical clinic and paramedic services. It is expected that workers would use these medical services for non-emergency medical needs. This could reduce pressure on community medical services during construction and operations. The Project, therefore, has the potential to have a positive effect on community medical services.

The Project has the potential to increase demand on existing emergency healthcare services in the event that Project traffic is involved in a collision or workers injure themselves while on-site. Given the unlikelihood of either occurrence, the relatively small number of individuals that would be impacted by an accident, and the capacity of the existing emergency healthcare system to deal with the occurrence of accidental injury, this effect is not expected to be pronounced and will be further minimised through mitigation identified in Section 6.12.
5.12.6.2.5 Quality of life

Community development

The Project has the potential to have a positive effect on communities through community development initiatives in Ilovica, Shtuka and the broader LSA. Euromax has developed a draft Community Investment Framework, which evaluates areas of community investment and has been drafted with a view to:

- Develop sustainable community programmes (i.e. that can be maintained by the community independently of Euromax) that benefit the wider community;
- Develop educational and skills-related programmes;
- Support initiatives that promote active, healthy lifestyles;
- Support environmental awareness initiatives, including water, forestry and waste management; and
- Support cultural heritage events.

At this point in project planning, community development delivery mechanisms have not been decided upon and budgets have not been determined. Euromax intends to consult local communities and the Municipalities of Bosilovo and Novo Selo on priorities for community development. Projects that have been completed during exploration are described in the Stakeholder Engagement Plan (Annex 2).

Project incomes

As noted in Section 5.12.6, incomes earned through direct employment with the Project during construction and operations will be relatively high compared to local averages. Indirect and induced employment, while not generating incomes at the same magnitude as direct employment, will grow over time and will further improve employment income in the Republic of Macedonia and in the local area. Project incomes are expected to have a positive effect on the quality of life of the employed and those depending on them for support (e.g. household and family members). Increased incomes will enhance the accessibility of housing, education, consumer goods and services, and savings.

Vibrations and noise

Blasting activity at the Project is expected to result in measurable vibrations in Ilovica and Shtuka that may be noticeable to village residents (i.e. may give rise to complaint), but that are not predicted to be intolerable and are not expected to affect structural stability or to move/shake objects. Project construction and operations may, therefore, have a nuisance effect on people living in the two villages. Vibrations due to blasting are not expected to affect the quality of life of residents in other LSA communities. Project traffic is not expected to result in vibrations affecting the quality of life of people in the LSA.

The Project will generate noise through:

- Noise from the mine pit, processing plant and tailings management facility:
  - Site clearance and felling (construction and operations);
  - Power generation (construction and operations);
  - Excavation (construction and operations);
  - Tipping of material (construction and operations);
  - Conveying (operations);
  - Crushing and milling (operations);
  - Traffic movements on haul roads (construction, operations and closure);
Noise from traffic movements on access road (construction, operations and closure);

Noise from trucks during construction of the OHL Illovica-Berovo and Sushica area; and

Noise from Project-related traffic movements on the regional highway M6 (transport route) (construction, operations and closure).

The mitigation presented in Section 6.5 is expected to reduce the Project’s residual noise impacts to low or negligible for most of the construction phase and all of operations and closure. Moderate residual effects are predicted for the communities of Shtuka, and Sekirnik during construction of the off-site access road (early in the construction phase). The Project is therefore expected to temporarily affect quality of life for residents in these communities who are close to the access road. The short duration of the off-site access road construction works will limit the disturbance and sensitive timing of noisy works will aid in reducing annoyance. The selection and siting of low-noise plant during the construction works will further assist in minimising impacts. During planning for the construction of the access road, the proposed schedule will be discussed with the municipalities and local residents. Any additional actions deemed necessary will then be put in place to minimise noise impacts.

Visual disturbances

The Project will be visible throughout the LSA. The landscape and visual assessment (Section 5.11) concluded that the Project will have a high magnitude effect on the mountain forest landscape, given the removal of forested areas and the presence of an open pit mine, the tailings management facility (TMF), and associated Project infrastructure. The materials contained within the TMF would not be compatible with deep-rooting vegetation such as timber-producing trees and so reforestation would not be expected in the indefinite future, although reclamation to pasture and scrub, as found in parts of the LSA, will be the favoured end use for the TMF.

The Project’s effect on the landscape of the agricultural plains in the Strumica Valley and undulating pastures/scrubland in the hills approaching the Ograzhden Mountains is expected to be low, with the only changes to the landscape being the addition of the access road.

Visual disturbance will vary by the viewer’s location, with some villages affected by permanent changes in the skyline associated with the TMF or pit, whereas lower disturbance is associated with the temporary presence of Project infrastructure. The TMF will be visible from the Drvosh area, for example, and the haul roads and workshop area would, from most locations, still be visible on the face of Cukar. Visual disturbance decreases with distance, so villages that are closer and affected by permanent changes will have a greater degree of disturbance than those at a distance or where views are temporary (e.g. views from a road). The landscape and visual assessment concluded that visual effects will be low due mainly to the temporary nature of the development in these areas. Given their proximity to the Project, Illovica, Shtuka, will experience the greatest visual disturbance and other areas such as parts of Radovo, Sekirnik and Turnovo will experience some impact to their views.

Presence of temporary workforce

Just over half (i.e. 51%) of the Project’s direct construction employment will be filled by candidates from the local area, and within commuting distance to the Project. The remaining construction labour force (430 from other parts of Macedonia and 154 expatriates) temporarily residing in the LSA will be housed in existing rental and commercial accommodations in Strumica. Given that the bulk of the temporary construction workforce is expected to come from within Macedonia, and so will have a similar background to the local population, their presence is not expected to noticeably change the day-to-day lives of local residents in Strumica. The remaining expatriate workforce expected to temporarily reside in Strumica during construction is small (i.e. 0.2%) relative to the city’s population, and all will be held to a worker code of conduct (See Annex 3, Chapter 14 for further discussion of expectations of workers expectations). The expatriate workforce temporarily residing in Strumica is, therefore, not expected to interfere with the day-to-day lives of local people.
During operations, the majority (96%) of Project personnel will already reside in the local area. A limited number of expatriate workers (18) will reside temporarily in existing rental and commercial accommodations in Strumica, and are not expected to interfere with the day-to-day lives of local people. The presence of a temporary workforce is, therefore, not assessed further.

**Perceptions of harm**

The Project is not, as noted above, expected to yield exceedances of Macedonian and European Union air quality guidelines, and no odours are expected to be detected in communities associated with Project construction and operation. Similarly, the Project is not expected to affect human health as a result of drinking water quality changes in groundwater sources (e.g. wells). During operation, human health is not expected to be affected by changes in surface water quality in sources used for drinking water. Mitigation aimed at removing the interaction between isolated water quality effects due to Project construction and closure, and the users of affected water sources, is expected to remove the risk of human health effects related to drinking water contamination.

Despite these conclusions, a perception that the Project is negatively affecting air or water quality, and thereby posing a health risk to those near the Project, may persist. This perception of harm can result in people avoiding the use of their typical sources of drinking or agricultural water, and the deterioration of their quality of life. Similarly, the perception that vegetation and livestock are contaminated by the Project’s activities, despite no evidence to this effect, can result in people not consuming local produce, meat and dairy products. Farmers have expressed concern that the stigma of being in the vicinity of a mine could affect agricultural sales. The Project therefore has the potential effect of fostering perceptions of harm.

**5.12.6.2.6 Infrastructure**

**Transportation**

As detailed in Section 4.6.1, the Project will generate the following types of traffic:

- Commuter vehicle traffic on the M6 highway and local roads between worker residences and the turnoff to the Project access road;
- Bus traffic on the M6 highway and local roads between temporary worker accommodations (e.g., hotels, rentals) and the turnoff to the Project access road;
- Supply truck and diesel fuel tanker traffic on the M6 highway between Strumica and the turnoff to the Project access road and between Novo Selo and the turnoff to the Project access road;
- Heavy trucks will transfer construction materials and supplies during construction of the OHL;
- Copper concentrate export traffic on the M6 highway between the Project access road and the Bulgarian border; and
- A combination of all three aforementioned forms of traffic on the Project access road between the concession and the turnoff onto the M6 highway in Turnovo (during construction) and Sekirnik (during operations).

Project commuter vehicle and bus traffic is not expected to increase physical wear and tear of roads beyond their intended capacity. Similarly, it is not expected that supply truck or diesel fuel tanker traffic would overburden the M6 highway. Heavy trucks travelling on the R1302 highway between Illovica and Berovo during construction of the OHL Illovica-Berovo will operate on the road alongside local traffic, but will adhere to appropriate speed limits and the Project’s traffic management plan. This traffic is not expected to degrade road conditions on the highway. The Project access road will be designed to accommodate all types of Project traffic and so is not likely to deteriorate unexpectedly. Heavy vehicles for the transportation of copper concentrate will be limited, but will be used daily for the operational life of the mine, and will have the potential to place additional wear and tear on the M6 highway between the Project and Bulgaria. Currently, between 106 and 120 heavy trucks are reported to cross the Bulgarian border via the M6 daily. Transportation planning...
is underway which will determine whether or not increased truck traffic will noticeably degrade road conditions, and the traffic and infrastructure controls needed for the Project.

The transport of Project goods via rail and expatriate staff via air will not exceed the capacity of the existing rail or air transport infrastructure in the Republic of Macedonia or have an adverse effect on other users. Project use of rail and air infrastructure is, therefore, not expected to alter these forms of transportation.

**Power**

During construction, diesel generators will be used to meet the Project’s power supply demands until the site is linked to the Macedonian high voltage (110kV) electricity transmission network (permanent power supply). During later construction and operation, the Project is expected to meet most of its electricity needs through a 110 kV connection to the national high voltage transmission network owned and operated by the Macedonian transmission network operator MEPSO. To facilitate this, a utility corridor will be constructed to link local power distribution infrastructure with the Project. The transmission line will remain under the ownership and management of MEPSO throughout project life. This permanent infrastructure will become part of the Macedonian national grid which will be owned and operated by MEPSO and will considerably augment security of power supply in the region for all users. The Project will use diesel generators for emergency power supply during operations.

**Water and sewage**

**Water Supply and Quality**

The Project will source water from the Turija Reservoir via a new pipeline to the Ilovica Reservoir, and potentially from groundwater sources in the Strumica valley. The Project's potential use of groundwater is still under investigation. The possible effects of the use of groundwater on water supply in communities (e.g. wells) are, therefore, not considered further in this assessment.

Euromax currently plans to use the Ilovica Reservoir as a water storage reservoir and will share the reservoir with existing users, including SPWMC (Strumichko Pole Water Management Company) which supplies irrigation water to Ilovica and Shtuka and PUE (Ograzhden Public Utility Enterprise) which supplies seven villages in the Municipality of Bosilovo with treated water for domestic purposes.

During operations, water for mine supply will be pumped from the Ilovica Reservoir to a water storage facility at the process plant site. In-flows from the reservoir’s catchment will provide the primary water resource. The Project will augment the Ilovica Reservoir with water from the Turija Reservoir to maintain the reliability of water supplies to the Project and other water users. The Project will seek to maximise reclamation of water for project supply, thereby minimising fresh water demand.

Mining activities will reduce the availability of drinking water from the intake in the Jazga River and may affect drinking water quality at the intakes in the Shtuka River. With the implementation of mitigations identified in the Water Quality Assessment (Section 6.3) and the Water Quantity Assessment (Section 6.2) Euromax will ensure the secure provision of water supplies to the villages currently reliant on water supplies from the Shtuka River, Jazga River and the Ilovica reservoir. Euromax commits to ensuring that new/extended water supply systems will be commissioned and the river intakes decommissioned before the mine construction stage starts (see below under Water Distribution).

The Turija reservoir currently supplies irrigation water to an area downstream of Euromax’s proposed abstraction point on the proposed refurbished Turija pipeline. Euromax is committed to ensuring irrigation water supply reliability in the area downstream of Euromax’s abstraction point to a level that is acceptable to SPWMC. It is anticipated that the acceptable level of non-availability of irrigation supplies will be 25% of the time or less. To achieve this, Euromax will operate the abstraction from the Turija pipeline at Ilovica to a prescribed flow. This means that the abstraction rate would be controlled to ensure a flow that is agreed between SPWMC and Euromax remains in the pipeline downstream of the abstraction point an agreed proportion of the time.
Water Distribution

The Project has been working with the Municipality to plan to replace water reticulation infrastructure in Ilovica and Shtuka which will influence the source of irrigation and drinking water. Irrigation water for agricultural activity will come directly from the Ilovica Reservoir, while reticulated drinking water will come from the Ilovica Water Treatment Works (WTW). Village wells and the springs are expected to be unaffected and will remain as alternative sources of water for domestic use.

Euromax, working together with Bosilovo Municipality and Strumichko Pole Water Management Company (SPWMC), is committed to mitigating these impacts before mine operations start by:

- Supplying water to Ilovica Water Treatment Works from Turija Reservoir instead of Ilovica Reservoir, thereby securing supplies to the treatment works;
- Installing a new, clean, water distribution network in both villages;
- Permanently connecting Ilovica Water Treatment Works to the new distribution networks; and
- Permanently supplying both Ilovica and Shtuka as well the existing seven villages with treated water.

The replacement of the water infrastructure will improve the existing water distribution system and will be beneficial, providing users with access to higher-quality water. The replacement of the water reticulation system in Ilovica and Shtuka is not expected to increase the cost of water which is already sourced from the Ilovica WTW during dry months (i.e. a rate of 30 denar/m³, plus 18% Value Added Tax (VAT)). However, with the decommissioning of the Jazga and Shtuka River intakes following the replacement of the water reticulation system, users will no longer have access to these water supplies during the wet months. Villagers currently obtaining their water from these untreated sources at a rate of 10 denar/m³ plus VAT will move to the use of treated water from the Ilovica WTW year-round, resulting in increased costs of 20 denar/m³ during months where villagers would normally source water from the river intakes. Including VAT, and assuming average monthly household consumption of 12 m³/month, this represents an increased monthly cost of around 290 denars (i.e. less than 2% of the total average monthly income of an individual [Euromax Resources 2015d]). This will be in line with what other communities in the Municipality of Bosilovo currently pay for year-round water supply from the Ilovica Water Treatment Plant.

Waste Water Treatment

Site runoff will be collected and reused with run-off and seepage water collected in sediment ponds and the pit pumped to the process water pond. Sewage effluent will be treated on-site and treated water will be pumped to the process water pond. As a result, the Project is not expected to alter water quality in the existing water system in Ilovica and Shtuka or adversely affect water treatment infrastructure (i.e. the Ilovica Water Treatment Plant) in the communities.

The Project will construct two sewage treatment plants in the concession that will treat effluent from all Project facilities. Treated effluent will conform to the relevant Macedonian waste water regulations and the European Union’s Urban Wastewater Directive. Treated wastewater will be reused on site. At closure, and subject to consultation, the sewage treatment plant at the mine workshop could remain in place for use by the households of Ilovica and Shtuka, under the ownership and management of the Municipality of Bosilovo and the Bosilovo Public Utilities Company. This beneficial possibility has not, however, been planned to a level where assessment can be conducted. No further assessment of the Project’s effects on waste water treatment has been made.

Waste

The Project will generate waste during construction and operations. Wherever possible, the Project will seek to avoid waste generation by efficiently managing resources, controlling inventories, and recycling. Despite waste avoidance and recycling measures, the Project is expected to generate some level of hazardous and non-hazardous waste.
The Project will use an off-site waste management facility (as described in Section 4.7.2). Waste will be sorted and stored on site at a waste transition yard, before transport to the off-site facility. The final component of the waste management facility will be a salvage yard for the storage of scrap equipment and materials not representing an environmental risk due to degradation, corrosion or deterioration. A waste management contractor will be appointed to manage the waste disposal system for the project in compliance with all applicable project requirements, best practice and applicable legislation. All contractors and their subcontractors and workforce are required to effectively implement all waste management programmes. Appropriate waste streams will be transported off site to an appropriate nearby licenced waste disposal facility.

Given that the Project’s waste management needs are contained to a designated facility and handled by a waste management contractor, the Project is not expected to have either an adverse or a positive effect on public waste management infrastructure.

5.12.6.2.7 Land use

Project land acquisition

The mine concession is largely on state-owned land, with only a small number of privately owned and some mixed ownership parcels affected. Discussions are in progress between Euromax and relevant agencies currently using the concession, such as the forestry company. The mining footprint will disturb approximately 503.3 ha within the 1,546 ha concession boundary. Land uses in this area include both licensed and unlicensed timber harvesting, beekeeping, and cattle grazing.

Outside of the concession, the Project will acquire land for the construction of the Project access road, and some components of the OHL Illovica-Berovo and possibly the water pipeline from the Turija reservoir to the mine site (although this may be entirely within the easement of the existing canal). Euromax has prepared a Land Acquisition and Resettlement Framework (LARF) which will conform to both Macedonia law and EBRD policy. The LARF outlines the potential land take effects of the Project components, and associated impacts on land owners and users.

While the development of the access road will occur largely on private land, it is not expected to require the resettlement of households (i.e. physical displacement). The access road will require the acquisition of the following types of land:

- State-owned and operated;
- State-owned and operated by state companies or municipalities;
- State-owned and operated by private companies or individuals; and
- Privately-owned.

Most of the land required for the access route is currently used for agricultural production. The Project, therefore, has the potential to economically displace** affected land owners and users. At present, the proposed land acquisition for the road could involve over 200 parcels of land. The majority of parcels are privately held by individuals, with a small number held by the Republic of Macedonia. The majority of title holders have a single parcel of land (amongst those affected). Field planting is the most common use for privately held parcels. Vineyards are the next largest land use, while grasslands make up a smaller portion of privately held parcels.

The OHL Illovica-Berovo will require approximately 100 m² of land for the estimated 150 towers supporting the line, in addition to land needed for wayleaves and easements associated with access. In the hilly stretches of the proposed OHL route, land uses include largely state-owned forests and mainly privately-owned pastures and meadows. In the flatter parts of the route, privately owned croplands, orchards and meadows prevail.

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**Economic displacement refers to the loss of assets or access to assets that results in the loss of income sources or livelihoods.
A Livelihood Restoration Plan (LRP) is being developed which includes procedures to offer affected persons compensation for lost land and crops and immovable assets and other forms of assistance. The EBRD requires the Project to undertake a census and asset survey and a socio-economic survey of affected households, with particular attention paid to vulnerable households (e.g. elderly, female headed). Early and extensive consultation with local government and affected land owners is necessary to confirm entitlements, grievance procedures and LRP implementation.

Agriculture

The Project’s potential effects on agriculture are related to the removal of agricultural land due to acquisition and changes to the physical and biological environments impacting agricultural activity. Many land uses are compatible with the OHL’s and will not be disrupted permanently by the presence of the lines, instead only experiencing temporary construction effects. Where land is required for access roads and other development, compensation agreements will be reached with affected land owners and users. The LARF includes a detailed identification of land acquisition activities associated with Project components and Associated infrastructure.

The Project will acquire agricultural land, largely for the development of the access road. Assuming that the land acquired for the access road will not adhere entirely to parcel boundaries (i.e. only a portion of some plots will be affected) the total land take will be spread over a larger number of parcels. Where agricultural land take removes enough of a parcel to leave the remaining land insufficient for the production of crops at a level that would sustain the household’s income, the entire parcel will be acquired. Preliminary land acquisition planning estimates that around 215 parcels of agricultural land will be taken by the Project. Of these, 187 are privately held. The remaining 28 parcels are state owned. Of the private parcels, 79% are used for growing crops, while 19% are used for vineyards. The remaining 2% are used for grasslands and private gardens. The extent of the Project’s effect on farmers via land take will be finalised through the LRP.

The Project will remove a maximum of 507 ha of land potentially suitable for grazing. It is not yet known how much of this land is actively grazed. As Project land acquisition activities advance, a better understanding of how many graziers will be affected by Project land take, and to what extent, will become apparent. Land acquisition planning will include graziers in consultations and developing mitigation.

Dust deposition and soil acidification can affect the quality of soil for agricultural purposes both in terms of changes in heavy metal (e.g. copper) concentration and productivity. Dust deposition in the highland area nearest the Project is expected to yield surface soil copper concentration in exceedance of EDC but within the natural range of variability. Dust deposition is not expected to elevate copper concentration in lowland areas on the Strumica Plain. No other metal concentrations are expected to exceed EDC levels. Dust deposition is not expected to interfere with agricultural production, or influence produce quality in the local area.

Agricultural land in the LSA is sensitive to acidification. Cumulative changes in soil chemistry over the life of the Project may have a small, but perceptible, effect on soil productivity. This effect will be mostly confined to highland areas in close proximity to the Project (i.e. grazing land). These changes are not, however, expected to be at a level that would change agricultural land use and production on the Strumica Plain.

The Project has the potential to affect the availability of water for agricultural use. However, Euromax, working together with Bosilovo Municipality and Strumichko Pole Water Management Company (SPWMC), is committed to mitigating these impacts before mine operations start by:

- Pumping sufficient water from Turija Reservoir and additional sources into Ilovica Reservoir and operating Ilovica reservoir with approximately 0.5 m freeboard throughout the life of mine so that the baseline reliability of irrigation supplies by SPWMC from Ilovica Reservoir is maintained.
- Extending the irrigation water distribution system (pipe network) to all unserved properties in Ilovica and Shtuka.

Assuming an average parcel size of 0.2 ha, this represents a loss in the region of 40 Ha of agricultural land.
Ensuring the pumping and pipeline infrastructure remains at mine closure to enable SPWMC to continue to pump water into Ilovica Reservoir if required. Euromax will also establish a financing mechanism that will funds operation and maintenance and replacement of an energy supply to provide power for the augmentation of Ilovica Reservoir from the Turija pipeline following mine closure, as well as during operations. A hydro-electric generating facility should be considered.

Operation of the abstraction from the Turija pipeline at Ilovica to a prescribed flow. This means that the abstraction rate would be controlled to ensure an agreed flow remains in the pipeline downstream of the abstraction point to satisfy an agreed proportion of the irrigation demand.

The above design and mitigation will offset any potential changes in the provision of irrigation water. Project operation is therefore not expected to result in a reduction in the availability of water for agricultural uses.

**Forestry**

Current planning indicates that the on-site access road will result in 9.4 ha loss of highly and moderately suitable forestry land.

The Project’s land take for the Project footprint, including access roads, will remove 465 ha of land suitable for forestry that currently may be used to harvest timber and fuel wood. Of these suitable lands, 252 ha (52%) are at least of moderate suitability. The construction of the TMF will remove 284 ha of forestry land. Given the incompatibility of deep rooting trees and the material contained within the TMF, this removal of forestry land is considered permanent as the TMF surface could not be reforested at closure. The Project is, therefore, expected to have both a reversible effect on the availability of forestry resources due to clearing for the Project footprint, and a permanent effect on the availability of forestry resources due to the presence of the TMF.

Euromax is currently in discussion with the Forestry Management Company regarding the development of a timber salvage plan. Private timber and fuel wood harvesters will be identified and consulted through land acquisition activities.

**Other land uses**

Through its land take, or through noise and vibrations generated during construction and operations, the Project will affect the following isolated land uses:

- Mushroom and annual religious plant (of geranium genus) harvesting will not be permitted within the concession area and suitable habitat will be lost through vegetation clearance for the Project footprint. Euromax is currently engaged in consultation with the Forestry Management Company and will hold discussions with mushroom and religious plant harvesters with an aim to provide access to other suitable and accessible areas for harvesting.

- Beekeeping and associated honey production of two beekeepers operating on the slopes of Ograzhden Mountain may be adversely affected by vibrations from Project traffic and blasting activities which may disturb bees. Euromax is currently in consultation with the beekeepers regarding the relocation of the hives.

- A limited number of recreational fishers using the Ilovica Reservoir could be affected by the environmental stigma that the fish in the reservoir is contaminated. The water quality impact assessment has shown a negligible impact to water quality in the reservoir, while the water quantity impact assessment includes a mitigation that water levels in the reservoir will be managed to mimic baseline levels. As such, impacts to fish in the reservoir are expected to be minor and the impact to recreational fishers is likely to only be an issue of perception.

Hunting will not be permitted in the concession and hunted species may avoid the area around the Project where noise levels reach 45 dB and higher (refer to Section 5.7 for a full discussion of the effect of noise on

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45 Less than 0.3% of the population participates in recreational fishing for consumption (Euromax Resources 2015d).
wildlife). However, the hunting areas around the Ograzhden Mountains are extensive and effects are predicted to be limited to areas within close proximity to the concession. Further engagement with the hunting associations is required.

### 5.12.7 Impact Classification

The assessment of impacts takes the results of the effects analysis and applies the impact assessment methodology described in Section 1.

#### 5.12.7.1 Magnitude of the effect

Table 5-104 presents the parameters used for the classification of socio-economic effects assessment. Combined, these parameters are used to determine the impact classification.

#### Table 5-104: Impact assessment classification criteria for socio-economics

<table>
<thead>
<tr>
<th>Direction</th>
<th>Magnitude</th>
<th>Geographic Extent</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect is beneficial</td>
<td><strong>Negligible</strong></td>
<td>An effect that does not result in a discernible change from baseline conditions</td>
<td>Local&lt;br&gt;Socio-economic local study area communities</td>
</tr>
<tr>
<td>Effect is adverse</td>
<td><strong>Low</strong></td>
<td>A discernible effect that is not expected to materially alter the socio-economic feature in question</td>
<td>National&lt;br&gt;The Republic of Macedonia</td>
</tr>
<tr>
<td>Effect is neither positive nor negative</td>
<td><strong>Moderate</strong></td>
<td>A discernible effect that is potentially detrimental but manageable, or potentially beneficial to the socio-economic feature in question</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>High</strong></td>
<td>A discernible effect that is expected to substantially interfere with or enhance the socio-economic feature in question</td>
<td></td>
</tr>
</tbody>
</table>

Sensitivity is not evaluated for features of the socio-economic environment.

Unlike other disciplines, socio-economic assessment identifies negligible and low positive socio-economic impacts and carries them forward for residual effects assessment. This approach is taken because negligible and low positive impacts can, through benefit enhancement measures undertaken by the Project, become moderately or highly beneficial to people. Details on all socio-economic impacts, their direction, and their classification are found in Table 1 in Annex 5K.

#### 5.12.7.2 Determination of impact

The Project is expected to have a highly positive effect on the economies of Macedonia, the city of Strumica, and the Municipalities of Bosilovo and Novo Selo. The Project's effects on national GDP, national government revenue, and the growth of the mining sector will persist over the medium-term and will be of high magnitude. The same is true of the Project's local effects on municipal government revenues and business development. Consumer spending of employee incomes, while a less pronounced effect, is still expected to result in a moderate magnitude effect on local economic activity over the medium-term.

As with economic effects, the Project's employment effects are positive. Nationally (i.e. outside of the local area), the impact of Project employment (including direct, indirect and induced), while positive, is low, given that most employment is expected to accrue locally. The Project's direct and indirect effect on local employment is expected to be of high impact, representing a substantial increase in the availability of high-quality, permanent employment. The effect of consumer spending by employees is expected to generate
induced employment growth locally, but at a lower magnitude. All of the Project’s impacts on employment will be realised in the medium-term.

Incomes earned from direct, indirect and induced employment associated with the Project will have a positive impact on incomes at the national and local scale. At the national scale, the impact of Project-generated direct incomes outside the local area is low. While direct incomes will be relatively high, the number of individuals impacted is relatively small compared to the national labour force. Indirect and induced employment will also be generated outside the local area, but incomes associated with these positions are expected to be in line with those in industries in which employment occurs. The Project is not expected to influence wages in sectors outside of mining. As a result, the impact of national indirect and induced incomes is expected to be low.

Locally, the relatively high incomes paid to direct employees are expected to have a high impact, given the Project’s maximisation of local employment and high direct wages paid. Project-related indirect and induced employment incomes, while similarly affecting a large number of people locally, will be in line with those in the industries in which employment occurs. As a result, their impact is expected to be less prominent, but still of moderate magnitude. As all income effects are related to Project-generated employment, the impact of incomes will persist over the medium-term (the life of the Project).

The Project’s ability to influence population increase or decrease in the local area is limited: most of the workforce is expected to already reside locally. The Project will not result in substantial in-migration that would offset the current trend of out-migration from the region. The Project’s effect of slowing out-migration through the provision of employment opportunities is expected to have a negligible impact on population, but one that is permanent.

The Project’s effects on community health, safety and security are mixed in direction. The small amount of in-migration will result in continued demand for healthcare services. This is neither positive, nor negative, and is of negligible magnitude given the Project’s negligible population impact. The effect of potential accidental injuries (assessed in Section 10) on the demand for healthcare services, on the other hand, could be considered adverse given their unplanned nature and unknown severity and extent. The impact on health care services is, however, expected to be low given the capacity of the system and presence of an on-site medical clinic. This on-site clinic could potentially result in a positive effect on local healthcare services, providing for the medical needs of employees. Given the number of people employed by the Project, this would be a moderate impact.

Effects to quality of life as a result of the Project are similarly mixed in direction. The Project’s positive effects on community investment and income generation are moderate to high (respectively) and will persist in the medium-term, throughout the life of the Project. The Project’s adverse effects of increased noise and heavy truck traffic, alteration of the visual environment, and generation of perceptions of harm are expected to be of high impact when taken together, given that they have the potential to alter people’s day-to-day lives and that they cannot be fully mitigated. The impact of increased noise in communities beyond guideline values will persist into the medium-term, but not at unacceptable levels given the mitigation/management applied in the noise impact assessment. Perceptions of harm may extend beyond operations into the long-term due to perception that the environment is contaminated, and some people may not accept that reclamation has addressed any potential environmental issues. The impact of the alteration of the visual environment for those in the viewshed of the mine (particularly the TMF) is expected to be permanent.

The Project’s effect on transport infrastructure is expected to be of low impact, not substantially changing current conditions. The construction of the OHL Illovica-Berovo will add to utility infrastructure in the region. The replacement of the water recitation system in Illovica and Shtuka has the potential to have a moderately positive impact on treatment and water distribution in both villages, and a negligible adverse impact on the cost of water for users.

Project effects on land use in the local area are expected to have a negative impact on agriculture, forestry, and other land uses. The removal of arable and grazing land due to Project land-take is expected to have a high impact on those who currently use that land, given the relative lack of suitable alternative grazing land with access to water in the area. The temporary removal of forestry land base will yield a similar moderate
impact reversible in the medium-term. The removal of forestry land base for the TMF, however, is expected
to have high impact on users. Though the Forestry Management Company and other users (e.g. fuel wood
collectors) will be able to continue operating in other forested parts of the Ograzhden Mountains, the land over
the TMF will no longer produce forestry resources, effectively removing forestry land base permanently. The
Project’s land take will also temporarily displace other land users (e.g. recreational hunters in the concession
area, beekeepers on the slopes of the Ograzhden Mountains, and mushroom harvesters in the forested areas).
The number of individuals affected by these displacements is small and in most cases they are not primary
livelihood activities. Effects on other land users are, therefore, of low impact and medium-term duration.

Table 5-105 presents the moderate and high adverse impacts and all positive impacts to socio-economic
features. Table 1 in Annex 5K presents the route to the classification of the impacts, presenting the direction,
magnitude, geographic extent and duration for each impact.

Table 5-105: Impact classification for socio-economics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Effect</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Direction</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>The Project will contribute to the GDP of the Republic of Macedonia</td>
<td>Construction, operation</td>
<td>Capital and operational expenditures</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute to the importance of the national mining</td>
<td>Operation</td>
<td>Export of copper concentrate and</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>industry in international trade</td>
<td></td>
<td>gold doré</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Project will contribute annual revenue to the national government</td>
<td>Construction, operation</td>
<td>Tax and royalty payments</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute annual revenue to the municipal governments</td>
<td>Operation</td>
<td>Royalty payments</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>of Bosilovo and Novo Selo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Project will contribute to local business development and economic</td>
<td>Construction, operation</td>
<td>Local procurement of goods and</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>growth</td>
<td></td>
<td>services</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Project will result in an induced effect on economic activity as</td>
<td>Construction, operation</td>
<td>Spending of employment income</td>
<td>Positive</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>employees spend their incomes locally</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>The Project will create new direct employment outside the local area</td>
<td>Construction, operation</td>
<td>Direct workforce demand</td>
<td>Positive</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>in construction and mining</td>
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</tr>
<tr>
<td></td>
<td>The Project will create new direct local employment opportunities in</td>
<td>Construction, operation</td>
<td>Direct workforce demand</td>
<td>Positive</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>construction and mining</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>The Project will indirectly result in employment outside the local area</td>
<td>Construction, operation</td>
<td>Purchase of goods and services</td>
<td>Positive</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>in industries servicing the mining industry</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>The Project will indirectly result in employment at the local level in</td>
<td>Construction, operation</td>
<td>Purchase of goods and services</td>
<td>Positive</td>
<td>High</td>
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<td>industries servicing the mining industry</td>
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<tr>
<td></td>
<td>The Project will induce employment as direct and indirect workers</td>
<td>Construction, operation</td>
<td>Spending of employment income</td>
<td>Positive</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>spend their incomes outside the local area</td>
<td></td>
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<tr>
<td></td>
<td>The Project will induce employment as direct and indirect workers</td>
<td>Construction, operation</td>
<td>Spending of employment income</td>
<td>Positive</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>spend their incomes locally</td>
<td></td>
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</tbody>
</table>
### Topic | Effect | Project phase | Key source of impact | Direction | Impact classification
---|---|---|---|---|---
**Incomes** | Project employment will generate incomes outside the local area that are high in comparison to average annual incomes | Construction, operation | Employment incomes and contracting | Positive | Low
| Project employment will generate incomes in the local area that are high in comparison to average annual incomes | Construction, operation | Employment incomes and contracting | Positive | High
| Project-related indirect employment will generate incomes outside the local area in line with industry standards | Construction, operation | Purchase of goods and services | Positive | Low
| Project-related indirect local employment will generate incomes in line with industry standards | Construction, operation | Purchase of goods and services | Positive | Moderate
| Project-related induced employment outside the local area will generate incomes in line with industry standards | Construction, operation | Spending of employment incomes | Positive | Low
| Project-related induced local employment will generate incomes in line with industry standards | Construction, operation | Spending of employment incomes | Positive | Moderate
**Population and Health** | The Project will result in in-migration to Strumica and an incremental increase in population in 2019 | Operation | Direct workforce demand | Positive | Negligible
| Project on-site medical clinic will provide services to workers, removing some pressure on existing healthcare services | Construction, operation | Requirement to provide medical services | Positive | Moderate
**Quality of Life** | Project community investment can support community development initiatives | Construction, operation | Community investment | Positive | Moderate
| Project incomes can enhance access to housing, education, consumer goods and services, and savings | Construction, operation | Employment incomes and contracting | Positive | High
| Project noise will exceed baseline and guideline values in some communities | Construction | Construction, operation and traffic | Negative | Moderate
| Project components will alter the visual character of forest and agricultural plains | All phases | Project land take, infrastructure and TMF | Negative | Moderate to High
| Perception of harm may change day-to-day life for those concerned about water, soil and air pollution | Construction, operation | Stigma of environmental effects of mining | Negative | High
**Physical Infrastructure** | Project construction of the OHL will add to existing regional utility infrastructure | Operation, post-closure | Addition of power infrastructure | Positive | Moderate
| Project support of replacement of the water reticulation system in Ilovica and Shtuka will improve distribution infrastructure | All phases | Replacement of water reticulation system | Positive | Moderate
| Project support of replacement of the water reticulation system in Ilovica and Shtuka will improve access to treated water | All phases | Replacement of water reticulation system | Positive | Moderate
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<tr>
<th>Topic</th>
<th>Effect</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Direction</th>
<th>Impact classification</th>
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</thead>
<tbody>
<tr>
<td>Land use</td>
<td>The access road and OHL will remove arable land suitable for agricultural production and under cultivation</td>
<td>Construction, operation</td>
<td>Project land take</td>
<td>Negative</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Project land acquisition will remove grazing land</td>
<td>Construction, operation</td>
<td>Project land take</td>
<td>Negative</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Project land acquisition will remove productive forestry land</td>
<td>Construction, operation</td>
<td>Project land take</td>
<td>Negative</td>
<td>Moderate</td>
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<tr>
<td></td>
<td>The Project will result in the permanent loss of productive forestry due to the TMF</td>
<td>All phases</td>
<td>TMF</td>
<td>Negative</td>
<td>High</td>
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6.0 MITIGATIONS

6.1 Geomorphology, Terrain and Soils

The moderate and high impacts to grazing land use and forestry land use, respectively, require additional mitigations to reduce Project impacts. As the moderate and high impact classifications are driven by soil quality (rather than soil quantity); mitigation will focus on soil quality meeting the EDC and/or the range of natural variation. The area requiring action on soil quality is the closure landscape of the TMF.

Reclamation will be accomplished through replacement of:

- Approximately 65,000 m$^3$ of soil identified as available for salvage during construction of the Project (Section 3, Annex 3);
- An additional volume representing up to 20 ha that may be available for salvage opportunistically during construction that wasn’t considered in the baseline report (Section 3, Annex 3) due to logistical limitations to salvage; and
- 25,000 m$^3$ of dredged sediment (meeting EDC values) from the Ilovica Reservoir that may be used to supplement reclamation efforts.

The following presents additional mitigation that Euromax is committed to:

- Capping the TMF with a layer of growth medium at least 50 cm thick, composed of reclaimed waste rock, fertilisers and alternative substrates, (requires approximately 1.25 Mm$^3$ of material);
- Conducting soil enhancement and vegetation trials to investigate necessity for soil amendments;
- Undertaking selective replacement of available topsoil or alternative substrates (determined through soil enhancement trials) in either a continuous cover or in ‘islands’ distributed strategically over the waste rock cap layer, acting as ‘nurse’ sites for vegetation establishment and subsequent encroachment to surrounding lands;
- Seeding with native or desirable forage grasses and undertaking irrigation when required in the first two to three growing seasons to establish a stable ground cover;
- Establishing suitable vegetation species which will limit erosion and provide a herbaceous forage cover for grazing;
- Preventing tree species from establishing and having coarse roots degrade the integrity of the cap layer; and
- Establishing long-term soil and ecological health and risk assessment plots during the operational phase of the Project, and monitoring for changes in the surface soil quality relative to the EDC over several decades (3 to 5 year monitoring intervals), including the post-closure phase.

Upon the successful implementation of mitigation measures, the residual impact is expected to be lowered, as the magnitude of effects will not be driven by soil quality concerns, and the TMF would be returned to a landscape capable of supporting a grazing land use. The impact to forestry land use will not be alleviated; however, with the impact driven by quantity of areal ground disturbance loss and not soil quality, the residual impact classification is reduced, as summarised below.

The Project description (Section 4) states that it is preferable for deep rooting trees to be prevented from becoming established on the closure landscape of the TMF, in order to maintain the integrity of the capping layer planned for the TMF at the closure and post-closure phases of the Project.

The following additional commitments apply:

- Erosion control measures will be installed at the commencement of the construction period. They will include silt fences, ditches, rock check dams, temporary surface water diversions and small sediment ponds as required;
A temporary sediment pond/sump within the pit area will be developed during early construction to manage runoff from the prestrip area;

During operations, the site will operate on a zero discharge basis, and, at closure, revegetation will be established before removal of the drainage system and sediment ponds;

Topsoil removed during construction will be stockpiled at a similar elevation as where it is removed from;

Waste rock to be used for reclamation of the TMF will be stockpiled at suitable location, so reclamation will not result in significant material movement from lower elevations; and

Stockpiles will be seeded with native grasses to establish a ground cover and minimise erosion.

6.2 Water Quantity

Mitigation measures for those impacts which are classified as Moderate and Major in Section 5.2 are presented in Table 6-1. Further summary details on the re-evaluation of impacts, given proposed mitigation measures, are described in Annex 5B (Appendix D).
<table>
<thead>
<tr>
<th>Project phase</th>
<th>Potential impact</th>
<th>Proposed mitigation measure</th>
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| Operations (Yr 20) and Closure (Yr 27) | Ilovica Reservoir 1. Change in frequency of failure due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply scheme is under construction. 2. Change in mean water level due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply scheme is under construction. | To mitigate potential impacts to the mean reservoir operating water level and yield of Ilovica Reservoir in the construction stage, Euromax commits to the following:  
  i. Minimising abstraction of water from Ilovica Reservoir for construction purposes;  
  ii. Developing alternative sources of water supply for construction, such as:  
    a. Construction of runoff collection dams early in the construction stage and use of collected runoff for construction;  
    b. Trucking water abstracted from a source in the Strumica valley to site. |
| | Jazga River at Ilovica village intake Change in Q95 flow due to induced loss of flow to pit as pit is excavated below river bed level from Year ~5 onwards. The reduction in flow (the induced flow to the pit) is predicted to continue after mine closure until the pit lake fills up to elevation of river bed in Year ~110. | To mitigate potential impacts to village water supplies from the Jazga (and Shtuka) rivers, Euromax Resources commits to assisting Bosilovo Municipality (PUE) and SPWMC to:  
  i. Supply all households in Ilovica and Shtuka villages with clean, safe, potable water produced at Ilovica Water Treatment Works (WTW), which is managed by PUE, and  
  ii. Supply all currently unserved households in Ilovica and Shtuka with untreated water for agricultural purposes from Ilovica Reservoir, which is managed by SPWMC.  
This assistance will involve provision of sufficient funds to design, construct and commission:  
  • A new potable water distribution network to all households in Ilovica and Shtuka, to be operated by PUE;  
  • A permanent connection between Ilovica WTW and the new distribution networks;  
  • An extension of the existing agricultural water distribution network to unserved households from Ilovica Reservoir, operated by SPWMC;  
  • Decommissioning of Ilovica and Shtuka intakes on the Jazga and Shtuka rivers.  
Euromax Resources commits to ensuring that the new/extended water supply systems will be commissioned and the river intakes decommissioned before the mine construction stage starts.  
The Municipality will decide who will fund the household potable water connections and the tariffs to be charged by the PUE. SPWMC will decide who will fund the household agricultural water connections and the tariffs to be charged by the SPWMC. |
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<tr>
<th>Project phase</th>
<th>Potential impact</th>
<th>Proposed mitigation measure</th>
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<tbody>
<tr>
<td>Operations (Yr 20)</td>
<td>Change in Q95 inflow due to induced loss of water from Jazga River during excavation of the mine pit below river bed level and pit dewatering from Year ~5 onwards.</td>
<td>Euromax Resources will agree with SPWMC that they will pump water into Ilovica Reservoir from Turija to augment low inflows (Q95) from the Jazga River.</td>
</tr>
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</table>
| Closure (Yr 27) | Change in frequency of supply failure, caused by reduced Q95 inflows to reservoir due to losses to pit until, in post-closure the pit lake level reaches the elevation of the Jazga river bed adjacent to the pit (predicted to be Year ~110). | To mitigate potential impacts to the yield of Ilovica Reservoir in closure, Euromax Resources commits to provision of sufficient funds to:  
  i. During the mine construction stage, design, construct and commission a water supply pipeline, with a new water storage (balancing) tank, to Ilovica WTW with a capacity equal to the treatment capacity of the WTW (144 m$^3$/h) from the pipeline linking the refurbished Turija irrigation pipeline with Ilovica Reservoir;  
  ii. Ensure an energy supply is in place at closure to provide power for the augmentation of Ilovica Reservoir from the Turija pipeline following mine closure, as well as during operations. A hydroelectric generating facility should be considered.  
  iii. During mine operations, establish a fund that will provide financial resources for the maintenance of infrastructure to augment Ilovica Reservoir from the Turija pipeline during closure and post-closure;  
  iv. At closure, not decommission (maintain operational) the water supply infrastructure linking the Turija pipeline with Ilovica Reservoir and Ilovica WTW.  
These mitigation measures will ensure:  
- From the start of operations, Ilovica WTW will receive from Turija Reservoir a reliable supply of good quality water for treatment to potable standard for public supply, and the infrastructure will permit the future expansion of potable supplies from Ilovica WTW.  
- From the start of closure until approximately Year 110 when the treated pit lake discharge will reach Ilovica Reservoir restoring its yield, SPWMC may, if required, augment Ilovica Reservoir from Turija pipeline to increase reservoir inflows and yield. |
| Operations (Yr 20) and Closure (Yr 27) | Jazga River directly downstream of Ilovica Reservoir and at Radovo  
Change in Q50 (median flow) during operations and closure due to reduced frequency and magnitude of spills at Q50 flow from Ilovica Reservoir which results from the management of the reservoir water level with a ~0.5m freeboard in operations and from reduced mean reservoir operating level (caused by reduced inflows at the Q95) during closure until Year ~110. | To mitigate the reduced flow at the Q50-percentile flow downstream of Ilovica Reservoir during operations, Euromax commits to agreeing with SPWMC a limited number of releases of water of agreed magnitude (flow) and limited duration (a few days) at certain times of the year, including summer, during operations, from Ilovica Reservoir via its low level outlet, to mimic artificial floods that overflow the spillway. The releases will aim to increase the Q50 flow at Radovo (JZGS03) to the baseline Q50.  
Following closure until the pit lake discharge reaches Ilovica Reservoir, SPWMC may make discharges from Ilovica Reservoir to maintain the Q50 (and Q95) as required. |
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<th>Proposed mitigation measure</th>
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| **Post Closure (Yr 110+)** |                                                                                  | **Jazga River through Ilovica Village**  
Spilling pit lake exacerbates flood risk in Ilovica both with and without potential Climate Change effects                                                                                                               | To mitigate the enhanced flood risk in Ilovica village, Euromax is committed to designing the provision of storage and attenuation for flood waters up to the 100-year flood generated within the closed pit by modifying the drainage outlet from the restored pit. Ilovica Reservoir alone is unable to provide sufficient flood attenuation without significantly changing its functionality and operational regime. The proposed mitigation works will need to dovetail with proposals to collect and treat low to normal outflows from the pit lake for water quality reasons (Section 6). The water quality mitigation will be adapted to also manage flood risk. Outline details on proposed mitigation measures to negate enhanced flood risk are given in Annex 5B (Section 8.4.6). |
| **Post Closure (Yr 110+)** |                                                                                  | **Shtuka River at the intake (STGS01)**  
Following the diversion channel falling into disrepair, low flows will be lost to evaporation and infiltration on the surface of the TMF and will not discharge downstream                                                                 | The engineering design of water management on the TMF will ensure one of the following, depending on a feasibility study:  
  a) the diversion channel will be maintained and convey the Shtuka River in perpetuity (or until water quality in the SCF improves so it can be discharged to the environment without treatment);  
  b) the Shtuka River will be routed across the surface of the tailings in an engineered channel to the TMF spillway and flows less than or equal to the Q50 will be able to drain freely via a culvert into the TMF spillway without ponding or attenuation on the TMF (the culvert having a capacity equal to or greater than the Q50)  
  c) Shallow groundwater in the TMF cap (layer of growth medium at least 50 cm thick of reclaimed waste rock and alternative substrates), recharged from direct rainfall, the upper Shtuka and diversion channel in disrepair, will be discharged under control via a culvert to maintain Q95 downstream of the SCF. |
| **Operations (Years 1 to 20)** |                                                                                  | **Turija irrigation area downstream of Euromax's proposed abstraction point on the proposed refurbished Turija pipeline.**  
A predicted moderate increase in the percentage of days when irrigation demand is not met by water supplies from Turija Reservoir.                                                                                          | Euromax is committed to reducing the predicted moderate impact on irrigation water supply reliability in the area downstream of Euromax's abstraction point on the Turija pipeline to a level that is acceptable to SPWMC. It is anticipated that the acceptable level of non-availability of irrigation supplies will be 25% of the time or less. To achieve this, Euromax will work with PUE and SPWMC to ensure that abstraction from the Turija pipeline at Ilovica to a prescribed flow. This means that the abstraction rate would be controlled to ensure a flow that is agreed between SPWMC and Euromax remains in the pipeline downstream of the abstraction point an agreed proportion of the time. The operation will be based on control rules to be agreed between SPWMC and Euromax. Flow meters will be installed on pipelines upstream and downstream of the abstraction point and at Ilovica Reservoir and Ilovica WTW and a SCADA*-style automated abstraction flow control system will be installed to control flows. |

*SCADA (Supervisory control and data acquisition) is a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, and uses peripheral devices such as programmable logic controllers to interface to process plant (adapted from: https://en.wikipedia.org/wiki/SCADA).
Mitigation of impacts on aquatic ecology is considered in Section 6.8.

6.3 Water Quality
Mitigation measures for those impacts which are classified in Section 5.3 as moderate or major are presented in Table 6-2. Additional studies following the results of detailed design will be carried out in order to ensure the most appropriate approach is utilised. Since many of the mitigations are not required until post mine closure this will allow information on water quality collected during operations to be considered. The conceptual mitigation designs referred to below allow a reasonable framework for the more detailed designs to be carried out.
### Table 6-2: Proposed mitigation measures for water quality impacts

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<th>Project phase</th>
<th>Potential impact</th>
<th>Mitigation measure</th>
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| Post-Closure (Year 110) | Jazga River at Ilovica water supply intake (JZGS01), Ilovica reservoir (ILWT01), Jazga River at Radovo (JZGS03) | Change in water quality due to pit lake overflow of poor quality (low pH, elevated metals and sulphate) affecting water supply security and other receptors. The water level within the pit is predicted to rebound to a spill point within 90 years following the end of operations. To mitigate potential impacts to village water supplies from the Jazga (and Shtuka) River, Euromax Resources commits to co-funding works with Bosilovo Municipality (PUE) and SPWMC to:  
  iii. Supply all households in Ilovica (and Shtuka) village with clean, safe, potable water produced at Ilovica Water Treatment Works (WTW), which is managed by PUE, and  
  iv. Supply all currently unserved households in Ilovica (and Shtuka) with untreated water for agricultural purposes from Ilovica Reservoir, which is managed by SPWMC.  
This assistance will involve provision of sufficient funds to design, construct and commission:  
  • A new potable water distribution network to all households in Ilovica (and Shtuka), to be operated by PUE;  
  • A permanent connection between Ilovica WTW and the new distribution networks;  
  • An extension of the existing agricultural water distribution network to unserved households from Ilovica Reservoir, operated by SPWMC;  
  • Decommissioning of Shtuka and Ilovica intakes on the Shtuka and Jazga rivers respectively.  
Euromax Resources commits to ensuring that the new/extended water supply systems will be commissioned and the river intakes decommissioned before the mine construction stage starts. The Municipality will decide who will fund the household potable water connections and the tariffs to be charged by the PUE. SPWMC will decide who will fund the household agricultural water connections and the tariffs to be charged by the SPWMC.  
To mitigate the potential impact on water quality in the Jazga River that is predicted to occur following commencement of spill of the pit lake, Euromax commits to the following:  
  i. Treatment of the pit lake discharge to neutralise the pH and remove metals and sulphate to acceptable discharge limits. The predicted discharge flow rate is relatively low (<10 l/s) so a passive system is a viable option (GARDGuide, 2017). The predicted water chemistry has low pH, Fe and Al greater than 5 mg/l and elevated concentrations of other metals and sulphate. Proven passive treatment technology for treatment of this water chemistry to within acceptable limits includes vertical flow wetlands followed by a settling/aeration pond. Further recirculation or chemical treatment may be required to ensure the system meets discharge criteria. This will be defined during the design stage and pilot testing. A water treatment system will need to be in place prior to the pit lake spill, currently predicted at 90 years post-closure. The fill rate will be reassessed by Euromax following initial pit dewatering data in the first 5 – 10 years of mine life. It is assumed that a passive system will be more feasible for management of the spill following mine closure. Several active treatment systems (such as neutralisation HDS technology) would also be suitable to treat the water chemistry to within acceptable limits, but would require greater expenditure and management, so a passive system (such as the one described above) is likely to be the more viable option. Space may be a limiting factor for a passive treatment system close to the pit and this will be considered during further design steps for the water treatment system. Should it pose a problem, active treatment systems will be assessed as alternative options. Should active treatment be deemed most appropriate, treated water should discharge to Ilovica Reservoir. If passive treatment is the viable option, treated water would likely be discharged to the Jazga River downstream of the Ilovica Reservoir. |
### Project phase | Potential impact | Mitigation measure
--- | --- | ---
Operations (Year 20)  
Closure (Year 21)  
Post-Closure (Year 220)  
Shtuka River at Shtuka water supply intakes (STGS01)  
Shtuka River at Sekirnik road bridge (STGS02)  
Change in water quality due to poor quality TMF seepage not captured by the SCF during operations and following closure and poor quality overflow from the SCF into the Shtuka River following closure, affecting water supply security and other receptors

ii. To ensure the appropriate mitigation and treatment system can be implemented the following steps will be outlined in more detail as part of the environmental management plans:
   a. Conceptual design of the most appropriate treatment option (based on point i). This design will be reviewed on a regular basis during operations to ensure the best available technologies are still being considered for the water treatment system.
   b. Bench scale and pilot studies of technologies required to confirm the conceptual design will be implemented and completed within the first 10 -15 years of mine life.
   c. A plan and schedule to complete the pilot studies within the early years of mine life and how to develop this into a full treatment system by the end mine life.
   d. High level schedule towards detailed design.
   e. Conceptual plan for a system to maintain intellectual capital, suggested to be a tripartite planning team comprising the mine, the University of Shtip and the relevant local and national authorities.

To mitigate potential impacts to village water supplies from the Shtuka (and Jazqa) River, Euromax Resources commits to co-funding works with Bosilovo Municipality (PUE) and SPWMC to:

i. Supply all households in Shtuka (and Ilovica) village with clean, safe, potable water produced at Ilovica Water Treatment Works (WTW), which is managed by PUE, and

ii. Supply all currently unserved households in Shtuka (and Ilovica) with untreated water for agricultural purposes from Ilovica Reservoir, which is managed by SPWMC.

This assistance will involve provision of sufficient funds to design, construct and commission:
   - A new potable water distribution network to all households in Shtuka (and Ilovica), to be operated by PUE;
   - A permanent connection between Ilovica WTW and the new distribution networks;
   - An extension of the existing agricultural water distribution network to unserved households from Ilovica Reservoir, operated by SPWMC;
   - Decommissioning of Shtuka and Ilovica intakes on the Shtuka and Jazqa rivers respectively.

Euromax Resources commits to ensuring that the new/extended water supply systems will be commissioned and the river intakes decommissioned before the mine construction stage starts. The Municipality will decide who will fund the household potable water connections and the tariffs to be charged by the PUE. SPWMC will decide who will fund the household agricultural water connections and the tariffs to be charged by the SPWMC.

To mitigate the potential impact on water quality in the Shtuka River at STGS01, Euromax commits to the all of the following:

i. Maintaining the negligible impact on flow in the Shtuka River at STGS01 predicted in the operations and closure phases. This is required for dilution of contaminated groundwater flowing under the SCF. Maintaining the negligible impact on flow may be achieved by one of two options:
   a. Maintaining the diversion channel and the diversion of the Shtuka River around the TMF in perpetuity, or
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<th>Project phase</th>
<th>Potential impact</th>
<th>Mitigation measure</th>
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<tr>
<td>b.</td>
<td>Closing the diversion channel and routing the Shtuka River across the surface of the TMF in an engineered channel to the TMF spillway where low flows are allowed to drain into the spillway without attenuation. The channel will be constructed in low permeability materials to prevent interaction between the stream and its bed and banks (loss of flow).</td>
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<td>ii.</td>
<td>Constructing a grout or gel curtain at the SCF to reduce the flow of contaminated groundwater under the SCF. This will reduce the contamination load in the Shtuka River channel downstream, enabling sufficient dilution by the (maintained) Shtuka River flow (above). Groundwater modelling carried out to date (Annex 5B) indicates that in the absence of a grout curtain the SCF captures about 75% of groundwater flow. In order to reduce the residual impact to ‘Low’, the SCF (with a grout curtain) must capture 95% of the groundwater flow. It is assumed in the residual impact analysis (Table 7-1) that a grout curtain captures 95% of the groundwater flow and, further, that it is possible to achieve 95% capture of groundwater with a grout curtain throughout operations and following closure.</td>
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<td>iii.</td>
<td>Re-assessing at the detailed design stage potential seepage rates and pathways and modeling the reduction in seepage post-closure.</td>
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<td>iv.</td>
<td>Assessment of the feasibility (both volumes and timings) for encapsulating ARD producing material in the TMF embankment and the efficiency of hydroseeding for stabilizing and reducing infiltration into and runoff on the TMF surface. Pilot scale trial studies for assessing the most appropriate method of rehabilitation of the TMF will be completed within the first 10 – 15 years of mine life to allow implementation at the beginning of the closure period.</td>
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<td>v.</td>
<td>Monitoring of the water quality of seepage collected in the SCF during operations and closure.</td>
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<td>vi.</td>
<td>If monitoring results during operations and closure indicate that water quality is as predicted in this ESIA, then Euromax will treat seepage captured in the SCF that is not suitable for discharge in a treatment plant. The plant should ideally be situated relatively close to the SCF, and the treated water should be discharged back into the Shtuka River channel, ideally between the SCF and STGS01, so minimising impacts on the river reach in between. Owing to assumptions currently used, modelling does not predict a future improvement in water quality, suggesting that treatment may be required in perpetuity. Modelling of the SCF spills indicates that the SCF is likely to spill at a rate of around 21 l/s within 2 years of mine closure. This rate is equivalent to the rate of inflow of groundwater to the SCF and the chemistry of the spill is likely to be dominated by groundwater (as described in Table 7-17, Annex 5B). The water is predicted to be above project discharge standards for Fe, Cu, Zn and sulphate, and to have a low pH. The treatment system will need to be sized to take higher flows than 21 l/s, as some runoff events above the median flow will not be suitable to discharge. An active treatment system is likely to be required since the flow rate is too high for a passive system if the water also has low pH (GARDGuide, 2017). Based on the water chemistry of net acidity, high iron, copper and sulphate a viable treatment system to improve the water chemistry to within discharge standards would include a high density sludge (HDS) process or activated iron solids process (neutralisation and precipitation of metals), followed by a clarifier. Depending on the efficiency of the HDS neutralisation step the water may also need a parallel bioreactor or alkali dosing system to reduce residual metals. Other treatment set-ups may also be appropriate and this will be assessed as part of the environmental management plans.</td>
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Long term monitoring of the quality of SCF water will be used to identify when treatment of SCF water may cease and the SCF can be allowed to overflow to the Shtuka River downstream without treatment.

The SCF will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted to comply with project water quality standards.

To ensure the appropriate mitigation and treatment system can be implemented the following steps will be outlined in more detail as part of the environmental management plans:

a. Conceptual design of an appropriate mitigation measure (based on point iv). This design will be reviewed on a regular basis during operations to ensure the best available technologies are still being considered for the water treatment system.

b. Bench scale and pilot studies of technologies required to confirm conceptual design will be implemented and completed within the first 10 years of mine life.

c. A plan and schedule to complete pilot within early years of mine life and how to develop this into a full treatment system will be in place by the end of mine life.

d. A high level schedule towards detailed design for implementation by the end of mine life.

e. A conceptual plan for a system to maintain intellectual capital, suggested to be a tripartite planning team comprising the mine, the University of Shtip and the relevant local and national authorities.
Further mitigations that are not listed above involve:

- Management of ammonia arising from blasting; and
- Management of the TMF pond towards end of mine life.

Ammonia contamination from mine blasting in the pit area has not been quantitatively modelled. The extent of this potential contamination is dependent on blasting technique and site practice. Euromax Resources commits to implementing good industry practice so that ANFO use is carefully managed and minimal residual ammonia remains after blasting. During operations water in the pit will be pumped to the processing plant and will be re-used, as committed to in the engineering considerations document.

The TMF pond should be managed so that it is minimized at the end of mine life. Euromax will ensure the volume of the pond is reduced to the greatest extent possible during the final years of operations. This could involve treatment of the supernatant to a quality that is suitable for discharge to the environment. Alternatively, the TMF pond will be pumped into the open pit at closure at a rate that does not induce water loss to groundwater from the pit. More information can be found in Annex 5B.

Mitigation of impacts on aquatic ecology is considered in Section 6.8.

### 6.4 Sediment

Sediment dams, surface water drainage, surface water storages and sediment control infrastructure will be in place prior to pre-stripping and the start of construction. Euromax will ensure these meet best practice to minimise erosion and control the discharge of sediment laden runoff. Erosion control measures will include silt fences, ditches, rock check dams, temporary surface water diversions, soakaways and small sediment ponds as required. In addition, flocculation will be undertaken as required in the SWD. The SWD will, under normal operations, operate dry and will be drained following larger storm events to maximise the retention capacity and provide sufficient storage for future storm runoff from the mine area within the Shtuka River catchment.

In addition, Euromax will plan for tree removal and vegetation stripping to be phased in order to minimise the extent of exposed surfaces, and clearing will only be undertaken immediately before construction work takes place (ideally this should be during periods of low rainfall). Vegetated buffer zones around watercourses will be developed, where practicable, to act as a sediment trap and reduce the quantity of suspended sediment being conveyed to the downslope watercourses.

During operations, the site will operate on a zero discharge basis and at closure revegetation will be established before removal of the drainage system and sediment ponds. Environmental water quality and flow monitoring will continue during construction, operation and closure, with TSS sampling also being undertaken to both monitor current levels and also provide the information to develop flow vs TSS relationships. Where there is a notable increase of TSS above baseline and/or regular exceedance of 250 mg/l for 95% of the time, the cause will be investigated and mitigated if occurring as result of mining activities.

The following sections present additional mitigation that will be implemented to manage the potential increase in erosion attributed primarily to stripping and construction of the pit and TMF. Additional measures for the other mine infrastructure are also outlined.

#### 6.4.1 Pit Mitigation

Pit stripping and phasing during construction will maintain a vegetated buffer between the pit and Jazga River; the buffer will minimise the amount of sediment laden surface runoff entering the watercourse. The volume of runoff from the pre-strip area during a 1 in 25 year 24 hour event is estimated to be approximately 10,000 m$^3$. The 95%ile TSS discharged from the pit pre-strip area is estimated to be 750 mg/l, which exceeds the IFC 50 mg/l standard and also the current TSS level of 250 mg/l at the 95%ile. However development of a temporary sediment management within and downstream of the pit as described in Section 4 during a 1 in 25 year 24 hour rainfall event will manage the finer sediment that would otherwise require flocculation.
6.4.2 TMF Area Mitigation

To manage sediment from the TMF area, silt fences will be installed on contours within the cleared area of the TMF starter dam and also around the down-slope boundaries. The distance between the fences will be 50 m where the surface gradient perpendicular to the silt fence is 2% or less. On steeper slopes the distance between the fences will be reduced to around 30 m. These silt fences will minimise sediment transport until the construction of this facility is completed and allow the eroded material to be largely retained within the footprint of the construction areas (up-slope of the silt fences).

To capture remaining eroded material, the SWD downstream of the TMF will be developed prior to stripping of the upstream catchment. SWD capacity will be designed to manage the 1 in 25 year 24 hour rainfall event from the upstream catchment during construction. Full containment of surface water runoff from such an event will ensure sediment laden runoff has time to settle within the sediment pond before discharging to the downstream environment.

To minimise the discharge from the SWD of clays and any fine silts remaining in the water, the storage will be flocculated following larger storm events and as required based on sampling. The following provides some options for application of flocculants in the SWD:

- If the flocculant is in the form of solid bars, these could be placed in a series of wire baskets along the main inflows streamlines up-slope of the maximum water level of the SWD. As water flows into the storage the flocculant would be dissolved and the treated water would then discharge into the storage. As the storage will be drained following inflow events, these wire baskets could also be strategically placed around the boundary of the SWD at elevations below the maximum water level so that as the storage level rises the water flows above the baskets and the flocculant is dissolved.

- A number of pumps could be placed in purpose-built sheds around the perimeter of the SWD as well as on the embankment wall. Pipes would be placed into the SWD to draw water from the storage and pump it back in. An injection line would be placed in the intake side of the pump (suction line) and liquid flocculant injected. This could be a manual operation initiated after larger inflow events when the turbidity of the water was deemed to be sufficiently poor to require flocculation. The flocculant will work better once in the dam and diluted through the water body.

- A series of baskets could also be placed downstream of the SWD such that the discharge from the SWD to the Shtuka River flows through them. This would provide a final ‘back up’ system to at least ensure any remaining flocculants in the discharged water settle within a short distance downstream of the SWD.

6.4.3 Mitigation for Other Infrastructure

Mitigation measures for other infrastructure including haul and access roads, process plant, mine workshop and conveyor and ROM pad include diversion channels to convey non-impacted up-slope runoff around these infrastructure areas and silt fences along the down-slope boundaries. In addition, culverts will be located at appropriate locations along the haul and access roads to convey up-slope runoff under the roads. The outlets will include drop boxes and rip-rap, as required, to minimise the likelihood of erosion at these locations.

6.5 Noise and Vibration

Mitigation measures have been specified to limit the impacts at receptor villages where moderate or major impacts have been identified.

6.5.1 Shtuka

Noise from off-site access road construction

Moderate impacts associated with the access road construction will be mitigated through sensitive timing of the highest intensity works (i.e. avoiding times when people may be sleeping or resting). Construction of a permanent acoustic barrier prior to construction of the road itself will not be feasible, however dependent on consultation with local communities, temporary noise protection will be considered. Local residents likely to
be affected will be consulted prior to construction commencing and the grievance mechanism will be explained. Should activities prove to be unacceptable to neighbouring residents, Euromax will consider additional noise protection for properties close (less than 50 m) to construction activities and screening for noisy activities.

**Noise from traffic on off-site access road and site preparation works – construction phase**

An acoustic barrier will be constructed alongside the access road where it passes Shtuka. The barrier will be in close proximity to the edge of the carriageway. The acoustic barrier will seek to remove the line of sight between receptor properties and the roadway, thereby expected to provide up to 5 dB reduction in noise levels at the closest properties. The cut-fill profile of the road will also be used to maximise screening of the road. The predicted noise levels following the implementation of the acoustic barrier are presented in Table 6-3.

### Table 6-3: Predicted residual noise levels – Shtuka (Mine Construction)

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dB L_{Aeq 1 hour}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Measured Baseline</td>
<td>40.9</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td>40</td>
</tr>
<tr>
<td>Predicted noise level due to mine construction activities, plus traffic on access road</td>
<td>40.7</td>
</tr>
<tr>
<td><strong>Exceedance of baseline</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>Exceedance of noise limit</strong></td>
<td>0.7</td>
</tr>
</tbody>
</table>

Mine construction activities are predicted to be below the baseline during all periods with the implementation of the acoustic barrier.

Construction activities at the plant site, particularly the use of heavy equipment will be confined to the daytime and evening periods, and good practice will be used to minimise unnecessary noise. This will include "soft-start", in which the commencement of works each morning will be staged, switching off plant when not in use, and sensitive timing of noisy works.

**Truck movements on access road – operations phase**

Truck movements on the access road have been identified as a source of major impacts during the daytime and night-time periods. The acoustic barrier erected during the construction phase will be retained to provide screening at receptor properties close to the road. If required in addition to the acoustic barrier, where possible, night-time use of the haul road by HGVs will be minimized and/or avoided, and vehicle movements will be confined to the daytime and evening periods when ambient noise levels are expected to be higher. The predicted noise levels following the implementation of the acoustic barrier are presented in Table 6-4.

### Table 6-4: Predicted residual noise levels – Shtuka (Mine Operation)

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dB L_{Aeq 1 hour}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Measured Baseline</td>
<td>40.9</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td>40</td>
</tr>
<tr>
<td>Predicted noise level due to mine operations, plus traffic on access road</td>
<td>39.9</td>
</tr>
<tr>
<td><strong>Exceedance of baseline</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>Exceedance of noise limit</strong></td>
<td>-</td>
</tr>
</tbody>
</table>

Mine operation activities are predicted to be below the baseline during all periods with the implementation of the acoustic barrier.
6.5.2 Sekirnik

**Noise from permanent off-site access road construction**

Moderate impacts associated with the construction of the permanent off-site access road have been identified at Sekirnik during the daytime and evening periods. Noise will be mitigated through sensitive timing of the highest intensity works. Local residents likely to be affected will be consulted prior to construction commencing and the grievance mechanism will be explained. Should activities prove to be unacceptable to neighbouring residents, Euromax will consider additional noise protection for properties close to construction activities.

**Truck movements on permanent off-site access road – operations phase**

Truck movements on the permanent off-site access road during the night-time period have been identified as a source of major impacts at Sekirnik. An acoustic barrier, similar to the one for Shtuka, will be constructed adjacent to the road to reduce impacts during the night-time period. If required in addition to the acoustic barrier, where possible, night-time use of the haul road by HGVs will be minimized and/or avoided, and vehicle movements will be confined to the daytime and evening periods when ambient noise levels are expected to be higher. The predicted noise levels following the implementation of the acoustic barrier are presented in Table 6-5.

<table>
<thead>
<tr>
<th>Item</th>
<th>Noise level, dB L_{Aeq 1 hour}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td>Measured Baseline</td>
<td>37.9</td>
</tr>
<tr>
<td>Noise limit (rural areas)</td>
<td>40</td>
</tr>
<tr>
<td>Predicted noise level due to mine operations, plus traffic on permanent access road</td>
<td>32.5</td>
</tr>
<tr>
<td>Exceedance of baseline</td>
<td>-</td>
</tr>
<tr>
<td>Exceedance of noise limit</td>
<td>-</td>
</tr>
</tbody>
</table>

Mine operation activities are predicted to be below the baseline during all periods with the implementation of the acoustic barrier.

6.5.3 Truck Movements on M6 Transport Route

In areas of Sekirnik, Novo Selo, Samuilovo and Novo Konjarevo, located close to the M6 transport route, negligible impacts are predicted during the daytime, evening and night-time periods. The proposed schedule of truck departures has been assumed as a maximum of up to 5 HGV per hour truck movements along the M6 transport route during all periods. Mitigation may be required if additional project HGV truck movements are anticipated.

6.5.4 Vibration (all vibration receptors)

Blasts will occur during the daytime period only and the proposed blasting schedule will be clearly communicated to neighbouring communities in advance.

Table 6-6 summarizes the vibration monitoring proposed to support the Project and confirm the findings presented in the ESIA. The table describes what should be monitored, the method for completing the monitoring and the frequency proposed for the monitoring.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration level monitoring from blasting operations to develop site-specific vibration attenuation</td>
<td>Establishing a series of seismographs at varying distances from blasts and keeping a detailed record of the explosives loading parameters</td>
<td>Monitoring campaign; from a minimum 12 blasts at 6 sites during each blast, set up at distances varying from about 100 m to 1,500 m from the blast</td>
</tr>
</tbody>
</table>
A clear channel of communication between communities and Euromax will be established and additional vibration monitoring will be undertaken in the event that complaints arise.

In addition, following a request from community members at the open house event in Ilovica, Euromax are committed to undertaking a condition survey of all properties in Ilovica and Shtuka prior to commencement of any blasting.

Mitigation measures for blast vibration impacts on the Cultural Heritage receptors are discussed in Section 6.10.

### 6.6 Air Quality
Beyond the engineering measures presented in Section 5.6.2, no further mitigation is required to manage the impacts the Project may have on air quality.

### 6.7 Greenhouse Gas
Greenhouse gas emissions over the lifetime of the mine are predominantly from the purchase of electricity. Therefore the largest impact on the GHG emissions from the project could be from managing electricity usage (Section 5.7.6.4). Nevertheless, minimising emissions is also an important consideration, as described in Sections 5.7.

Mitigation measures will be stated as commitments in the Transport management plan and the Resource Efficiency plan (Annex 6).

#### 6.7.1 Mobile Combustion Emissions
A reduction in emissions will be seen through a reduction in diesel consumption. Minimising fuel consumption is an economic and an environmental driver for the Project and a number of good practice measures to achieve this are already accounted for in the scenario under which the emissions calculations are derived. These measures include the following:

- Haul Roads will be strategically located to minimise haulage distances;
- Loading and unloading points will be located to minimise haulage distances;
- Overburden management is designed to minimise haulage quantities and distances;
- Optimising ore and waste handling processes to minimise the need for multiple handling;
- Vehicle and equipment movements will be scheduled to minimise idle time and distances travelled;
- Purchased vehicles and equipment will be selected to be as fuel-efficient as possible, and regular maintenance will occur to keep emissions within the required range; and
- All machinery and vehicles will be maintained in accordance with the manufacturers specifications to maximise fuel economy.
6.7.2 Stationary Combustion Emissions
Emissions can be further reduced by managing diesel consumption in stationary sources:
- The back-up generators will only be tested for as long as necessary and not left running for extended periods; and
- The back-up generators will be maintained in accordance with manufacturers’ specifications in order to maximise fuel efficiency.

6.7.3 Blasting
Euromax are committed to using the minimum quantity of ANFO needed for the required blasting.

6.7.4 Purchased Electricity
Euromax will seek to reduce power consumption and resulting GHG emissions at the mine by implementing a number of good practice measures which include:
- Energy efficiency procedures will be implemented around the Site;
- Training will be provided to all employees to make them aware of their responsibilities;
- Where practicable, equipment will be turned off when not in use and timers will be fitted where appropriate, and
- All energy usage will be metered and audited annually. Energy use reduction measures will be investigated and implemented where possible.

6.7.5 Offsetting
In the IFC guidance, there is no requirement for carbon offsetting. There is a focus on mitigation and carbon reduction measures (as described in Section 5.7.6.1 to 5.7.6.4).

Nevertheless, due to the level of carbon emissions estimated to occur from the site, carbon offsetting options could be quantified and should be considered in future resource efficiency planning. These can include actions which can be undertaken on site and also through the purchase of carbon offset credits. On site options could include the possibility of using low carbon energy sources for parts of the plant where it is practicable and financially feasible to do so.

6.8 Biodiversity & Ecology

6.8.1 Approach
Mitigation is needed if the effect will result in a measurable change to the receptor that is outside the bounds of normal variation. The Project mitigation strategy for biodiversity is based on the objective of achieving “no net loss” (NNL) for biodiversity and net gain (NG) for effects to critical habitat. This will be achieved through application of the mitigation hierarchy. A number of design mitigations have been previously presented (Section 5.8.2). These are aligned with general construction good practice and include avoidance as the primary focus during project design.

In order to achieve a NNL/NG outcome for biodiversity features, any receptor exposed to a measurable adverse effect must either recover spontaneously without the need for any intervention, or it must be restored to pre-effect levels or condition through mitigation. The resilience of a receptor and its ability to recover has a bearing on the need for mitigation to achieve NNL/NG and depends on the source of effect being considered (its type, magnitude, frequency and duration), as well as the characteristics of the receptor and its ability to recover from any stress attributed to the Project.

For example, species that are mobile, habitat ubiquitous, adaptable and breed readily are more resilient than species with slow population growth that are highly specific in their niche habitat requirements and relatively
immobile. It is also generally easier for populations to recover if only a small fraction of the original population is lost as a result of an effect. In this assessment, a “resilient population” has been defined as one that is able to recover at a speed, and to a level, within the bounds of normal population variation without mitigation. Similarly, resilient habitats are able to re-establish through natural regeneration, without restoration. If receptors are not judged to be resilient in this way, mitigation is required and if there is any uncertainty, further assessment may be needed in the pre- or early construction phase of the Project to confirm the need for mitigation.

The ability to achieve a NNL/NG outcome in relation to the identified ecological receptors and indicators includes analysis of the following key points:

- Whether the receptor will be exposed to a Project activity or its effects during construction, operation or closure;
- The sensitivity of the receptor to the activity or its effects (will it respond positively or negatively?);
- The vulnerability of the receptor to effects (will it decline, fragment or be irreversibly damaged?);
- The ability of the receptor to recover independently, without intervention in the form of mitigation, compensation or enhancement;
- The effectiveness and confidence (track record) of mitigation, including reclamation, in reducing effects to a point where it can be concluded, with confidence, that there is NNL/NG; and
- If residual effects remain moderate or high after mitigation, the ability to compensate or offset so that NNL or a “net gain” can be demonstrated with a high degree of confidence.

6.8.2 Mitigation of Effects to Jazga River

The Jazga River upstream of the Ilovica reservoir will lose flow during construction, operation and closure to such an extent that aquatic habitat will be entirely degraded. As such, the mitigation strategy must focus on de-watering efforts including fish and decapod rescue and translocation. A sample of released individuals will be marked to enable success of relocations to be determined. Site options for release will be planned in congruence with reclamation planning.

6.8.3 Mitigation of Effects to Ilovica Reservoir and Downstream (Jazga)

The proposed mitigation will enable regular flushing of the river, maintaining environmental flows and meeting (or improving upon) baseline water quality in this stretch of the river which has high nutrient levels associated with surrounding land use (e.g. agriculture and waste disposal).

6.8.4 Mitigation of Effects to Shtuka River

Assuming the implementation of commitments made in Section 6.3, additional ecological mitigation required in the Shtuka catchment is needed to address the permanent loss of aquatic habitat and definition of design criteria for the proposed gel grout curtain.

The permanent loss of aquatic habitat in the Shtuka River is a key driver of the ‘Major’ impact consequence. As such, similar to the upper Jazga, the mitigation strategy must focus on de-watering efforts including fish and decapod rescue and translocation. A sample of released individuals will be marked to enable success of relocations to be determined. Site options for release will be planned in congruence with reclamation planning.

Consideration will be given to methods by which the diversion channel could be naturalised at closure, to enable aquatic or indeed terrestrial habitat to re-establish. The diversion channel is likely to eventually fall into disrepair. Whilst the structural integrity of this feature may fail, the feature is likely to become colonised by semi aquatic and terrestrial vegetation.

Fauna such as small mammals and herpetofauna will be removed from the Shtuka River valley during construction by a suitably qualified environmental technician. In addition, earthworks will be scheduled, where practicable, to avoid herpetofauna and mammal hibernacula to avoid mortality. Where this is not possible,
hibernacula (log and stone piles) will be carefully dismantled during April to October inclusive in order to safely disperse species.

The design of the gel or grout curtain and the discharge of treated water from the SCF post closure must be driven not only by drinking water standards for human and livestock consumption, but consideration for aquatic habitats downstream of the TMF. The 95% efficiency of the curtain proposed should be verified with quantitative analysis and efficiency will be improved if it does not meet the design criteria, in order to minimise ecological impact to sensitive flora and fauna.

6.8.5 Conceptual Revegetation Strategy and Biodiversity Offsets

Habitat restoration and revegetation will occur at the earliest opportunity through the operation and closure phases of the Project to assist in achieving NNL of natural habitat. A conceptual re-vegetation strategy has been developed to describe the proposed mitigations which will reduce impacts to terrestrial habitats and SoCC. Re-vegetating the TMF with forest is not feasible or desirable given the properties of the TMF at closure (a cap of inert materials over the tailings which may contain potentially phytotoxic levels of metals and a low pH), which would be unsuitable for deep-rooted plants.

A focus on pasture re-vegetation will allow for the creation of habitat suitable for the Large Blue butterfly, as well as numerous other invertebrates which naturally occur on the site. The Large Blue butterfly therefore becomes the main faunal focus of the re-vegetation strategy as it is classified by the IUCN as Endangered at the European level and is one of the designating species for the Ogražden PBA. Aside from creation of Large Blue habitat, the strategy is to return areas to the pre-existing vegetation type, where feasible. Efforts to minimise adverse effects will therefore focus on impacts to habitat quantity and quality, protection and creation of ‘stepping stone’ habitat connectivity with the neighbouring Bulgarian PBA, consultation with local experts including butterfly conservation Europe and additional species distribution studies.

The conceptual revegetation strategy is shown in Drawing 5-25. At a high level, it includes:

- Creation of a grassland and scrub mosaic suitable for grazing on the surface of the TMF; and
- Planting native forest species to achieve a scrub and forest mosaic on restored footprint of haul roads, conveyor, upper benches of the open pit, plant site and the workshop site.

Based upon this conceptual revegetation strategy, the residual change in land cover has been recalculated (Table 6-7). This demonstrates that with successful mitigation, residual land change is lessened for the forest community with positive change for the pasture land cover which is of value to invertebrates, including the Large Blue butterfly, plus flora SoCC.
<table>
<thead>
<tr>
<th>Total lost due to project footprint (ha)</th>
<th>Proposed revegetation of project components</th>
<th>Residual change in land cover (ha)</th>
<th>As a % of available habitat within LSA</th>
<th>As a % of available habitat within RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pastures</strong></td>
<td>Open pit area &amp; ROM Pad</td>
<td>Haul road</td>
<td>Plant site &amp; Associated Buildings</td>
<td>Conveyor</td>
</tr>
<tr>
<td>49.24</td>
<td>283.78</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td><strong>Settlements and Fields</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>4.19</td>
<td>121.69</td>
<td>27.22</td>
<td>23.83</td>
<td>5.37</td>
</tr>
<tr>
<td><strong>Forest Communities</strong></td>
<td>450.22</td>
<td>0</td>
<td>121.69</td>
<td>27.22</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>503.65</td>
<td>283.78</td>
<td>121.69</td>
<td>27.22</td>
</tr>
</tbody>
</table>
Key actions necessary to create suitable habitat on the surface of the TMF include:

- Once dried out sufficiently to support vehicle traffic, the TMF will be capped with a layer of geochemically inert material such as crushed waste rock at least 500 mm thick. The waste rock layer will be suitable for vegetation establishment and will be crushed so as to be suitable for cattle, sheep and goat grazing;

- The waste rock layer will be seeded with native or desirable forage grasses to establish a stable ground cover. Particular species will be planted for their contribution to biodiversity objectives, such as thyme (Thymus polytrichus) which is the larval food plant of the Large Blue; and

- The establishment of vegetation species that will limit erosion and provide a scrub and grassland mosaic will be encouraged, which will benefit priority species of the Lepidoptera order.

Re-vegetation may be expedited if ‘hydro-seeding’ techniques are implemented. Hydro-seeding (hydraulic mulch seeding) is the process of spraying a specially mixed slurry comprising of water, seed, hydro-mulch, fertiliser plus organic soil binders in just one operation.

Soil enhancement and vegetation trials to investigate the necessity for soil amendments will be undertaken in consultation with in-country experts and NGOs such as Butterfly Conservation Europe. It is important to note that dialogue between the Project team and Butterfly Conservation Europe has been initiated during early 2016. This conceptual revegetation strategy will be refined through the development of the mine closure plan as part of the ESMS.

The fundamental challenge of creating a net gain for critical habitats associated with the presence of the PBA and Large Blue habitat are at the forefront of Project collaborative thinking. Receipt of written communication between the Project team (specifically Prof. Branko Micevski and Prof. Dr. Miguel Munguira (President of Butterfly Conservation Europe) has provided the following high level concepts to achieve net gain for critical habitat.

The following points are provided verbatim as defined by letter correspondence from Prof. Munguira to Prof. Micevski dated February 2016:

- The surface area which could be irreversible lost from PBA Ogražden, including the areas suffering from habitat fragmentation, should be compensated by enlargement of PBA, adding the appropriate neighbouring areas with similar or larger surface. This would ensure that the new PBA would meet the criteria set for the establishment of the network of conservation priority areas for butterflies and, if possible, could be linked to the larger PBA Ogražden on the Bulgarian side of the border;

- The area that would be irreversible lost as appropriate butterfly habitat should be excluded from the new PBA Ogražden;

- In the process of enlargement of PBA Ogražden we recommend that not only the surface area but also the habitat quality should be considered, therefore a field study is essential in order to achieve “net gain and no net loss” to the biodiversity of the newly defined PBA. For that purpose we propose an appropriate seasonal inventory to be done in the neighbouring areas with special focus on distribution of the target butterfly species;

- BCE would request ENTOMAK to report on the above mentioned activities and prepare and deliver all relevant data according to already accepted methodology for the enlarged PBA Ogražden, including GIS file for proper area delineation; and

- The new PBA Ogražden could then be included as an update to the existing PBA network.

The concepts provided by Prof. Dr. Miguel Munguira will be defined in detail within an offsite ‘offset biodiversity strategy’ which will continue to utilise the services of National experts and will also involve current land managers/owners such as the Forestry Company at local and national level and National Agency for Pastures. This strategy will focus on the protection and favourable conservation management of upland species-rich
grasslands which support biodiversity assemblages of intrinsic value at the local, regional and national scale. Additionally, the potential for habitat creation to occur in congruence with vegetation clearance associated with the OHL will be assessed. The clearance of vegetation may create habitat mosaics along the OHL route, this may offer optimal habitat for species such as the large blue butterfly.

The design and implementation of the biodiversity offset will be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the development project’s impacts and preferably in perpetuity. As such, loss/gain metrics for critical habitat will be defined so that positive or negative adaptive monitoring and management can be implemented. It should be noted that commitments to enlarge the existing PBA in perpetuity should be driven by statutory in-country regulators and agencies with support from stakeholders such as Butterfly Conservation Europe. Investment from Euromax is not considered to be obligatory in terms of the delineation of protective boundaries and on-going protection of this feature.

6.8.6 Biodiversity Management Plan

In order to protect features of recognised nature conservation importance and to avoid impacts on protected and other SoCC, a Biodiversity Management Plan (BMP) will be prepared. The BMP will describe the way in which the Project will be managed to satisfy the general requirements to safeguard the environment and mitigate potentially adverse effects of the Project. The BMP will include all mitigations incorporated within the Project design, plus additional mitigations noted in this ESIA, separated by project phase. Mitigations will cover the complete mitigation hierarchy from avoidance through minimisation and ecological restoration to offsetting to achieve the goal of NNL/NG.

The BMP will provide details of required actions, procedures for documentation and communication, plus a description of implementation and monitoring needs. The BMP will be structured to ensure adaptive management can be followed with monitoring results providing feedback to earlier stages in the BMP development process. Mitigations can be refined through both adaptive management plus additional consultation with stakeholders and additional input from local specialists who have already assisted with the ESIA.

A series of Method Statements will be produced as part of the BMP. Method Statements in addition to mitigations included in Project design will include:

- Species of Conservation Concern (species action plans). These will be developed where multiple mitigations are planned and consolidation of actions including monitoring is required to coordinate a taxon or species-specific approach. One will be for the Large Blue butterfly, which will include additional regional surveys to better put the population impacted by the project in a regional context. This will aid in confirming mitigations in a regional context. This action plan will benefit from further consultation with local specialists.

- De-watering including fish and decapod rescue and translocation. A sample of released individuals will be marked to enable success of relocations to be determined. Site options for release will be planned in concert with management plan delivery.

- Identification of amphibian migration conflict points with road and infrastructure. Efforts to mitigate impacts and avoid road casualties will be deployed including the use of wildlife culvert crossings where practicable along with fences to divert animals toward the culverts. Additionally, the maintenance of habitat corridors facilitating ecological connectivity will be addressed to minimise fragmentation effects on species.

- Full biodiversity impact assessments pertaining to the OHL will be undertaken within an ESIA addendum. Any residual effects will be avoided where possible by undertaking site/vegetation clearance including OHL routes. Pre-clearing rapid surveys will be undertaken to check for the presence of faunal species of concern which would not be likely to move ahead of the disturbance. Focus would be on herpetofauna,

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67 The creation of culverts may be counter intuitive to minimising land take depending on the topography of the area in question. Bespoke solutions will be sought in consultation with Engineers.
birds and bats. As possible, individuals will be captured for relocation to suitable nearby habitat and released. A sample of individuals will be marked to allow success of any relocation to be monitored. Where possible, clearing will be in a direction that would push mobile species away from the Project as opposed to already cleared, or about to be cleared, sites. Additionally, seasonally appropriate vegetation clearance will be undertaken to minimise ecological impact.

- The option to salvage samples of flora of conservation concern, such as certain native grasses, orchids and the endangered bladder campion, will be discussed with local specialists.

- Protective fencing and signage will be used to ensure that the Project footprint and traffic does not encroach into identified ecologically sensitive areas and all Project personnel will be trained in the importance of these areas.

- Invasive flora and fauna. Invasive flora and fauna might be brought into the Project area during construction and operations. A list of potential invasive species will be drawn up with targeted mitigation actions to work to remove these should they be inadvertently introduced. Plant and machinery will be cleaned before coming to site and before leaving site. Invasives will be included in biodiversity monitoring, including for invasive flora during ecological restoration post closure.

- Placement of artificial bat roosting habitat (bat boxes). As discussed in Section 2.7, while many bats (including the vulnerable *Barbastella barbastellus*) were recorded in the LSA, no roosting sites were found away from settlements, likely owing to logging in the forested areas. Provision of artificial roosts would aid the conservation of this taxonomic group within the area surrounding the Project.

- Site lighting should make use of low pressure sodium lights wherever possible to minimise disturbance to biodiversity.

- Maintenance of access and existing grazing regimes on grasslands within the concession area, or replication of grazing regime through artificial means.

- Habitat creation through progressive restoration and re-naturalisation at closure and consultation with Butterfly Conservation Europe. More details are provided below on the conceptual re-vegetation and ecological restoration plan. Plans to obtain seeds or plants for re-vegetation, including nursery development options will be developed to fit with a progressive reclamation schedule. Any access roads used for construction that will not be needed during mine operations will be closed and reclaimed with natural vegetation. Other areas no longer required by the Project will be reclaimed as soon as possible.

- A biodiversity offset feasibility study. A feasibility study will take place to develop offsetting options for terrestrial and aquatic habitat to allow for achievement of NNL/NG. An initial options document will be prepared and shared with stakeholders for input prior to finalisation and implementation. The confidence in on-site habitat restoration within the TMF footprint will determine the likely extent of offsetting requirements to achieve net gain for CH. In essence, the higher the likely biodiversity value of the TMF post restoration, the smaller the biodiversity offset concepts and vice versa.

- Mandatory environmental training for all workers and contractors. This training will highlight habitat types and SoCC in the area and stress the need to follow designated practices (mitigations) that will minimise impacts to flora and fauna.

- Monitoring of Project footprint development and habitat reclamation/creation projects to assess the efficacy of restoration and steer adaptive management and NNL goals. GIS monitoring coupled with ground-truthing will be important to quantify net impacts.

Over and above specific mitigations, many of which will be contractually enforced with contractors and sub-contractors, additional conservation actions will also be pursued within the Concession to promote biodiversity away from the Project footprint area. However, to be successful this action would need to be integrated with broader actions to promote sustainable development in the region around the Project. Involvement with social development activities should aid in the realisation of positive biodiversity outcomes.
An Environmental Manager will be appointed to oversee the implementation of the BMP. All relevant Project personnel will be inducted by the Environmental Manager through Toolbox Talks and training in Standard Operating Procedures as part of the BMP. This will confirm awareness of the ecological constraints present, mainly in relation to SoCC, and also ensure an understanding of the habitat creation methods being implemented.

6.9 Ecosystem Services

IFC Performance Standard 6 requires clients to “maintain the benefits from ecosystem services” when designing and implementing projects, as well as to “implement mitigation measures that aim to maintain the value and functionality of priority services”. The overall goal is to mitigate project impacts on priority ecosystem services so that the benefits people derive from these services are maintained when the Project is developed, operated and then closed. Similarly, for services used and depended on by a Project, the goal is to ensure that there will be a sustainable supply throughout the Project’s planned operational life and thereafter.

Mitigation measures provided in the following sections include those from specialist studies that are specific to potential impacts on the supply of ecosystem services, and additional mitigation measures based on the commitments provided within the Euromax Land Acquisition and Resettlement Framework (LARF) and Livelihood Restoration Plan (LRP), Ilovica-Shtuka Project. Mitigation measures, including those detailed in the Project design are presented in Table 6-8.
Table 6-8: All Mitigation measures for impacts on Priority Ecosystem Services

<table>
<thead>
<tr>
<th>Mitigation Measures</th>
<th>Monitoring Indicators</th>
<th>Monitoring Frequency</th>
<th>Responsible Entity</th>
<th>Training Necessary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Livestock including Grazing provision</strong></td>
<td></td>
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<tr>
<td>Economic displacement experienced by impacted herding communities should be addressed in terms of the IFC Performance Standard 5 discussing the involuntary resettlement and compensation practices in project-affected communities through delivery of the LARF. The LRP has included a specialist livestock assessment and management component to address impacts to livestock.</td>
<td>As stipulated within the LARF/LRP and via community engagement action planning.</td>
<td>As stipulated within the LARF/LRP</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>Livelihood restoration assistance and plans will be developed to specifically formulate mitigation strategies for the loss of grazing land.</td>
<td>As stipulated in the LARF/LRP and via community engagement action planning.</td>
<td>As stipulated within the LARF/LRP and via actions prompted by community engagement policy.</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td><strong>Fruit vegetable and arable production</strong></td>
<td></td>
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</tr>
<tr>
<td>Economic effects experienced by farming communities should be addressed in terms of the IFC Performance Standard 5 discussing the involuntary resettlement and compensation practices in project-affected communities through delivery of the LRP.</td>
<td>As stipulated within the LARF/LRP and via community engagement action planning.</td>
<td>As stipulated within the LARF and LRP</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>Livelihood restoration assistance and plans will be developed to specifically formulate mitigation strategies for the loss of arable land.</td>
<td>As stipulated in the LARF/LRP and via community engagement action planning.</td>
<td>As stipulated within the LARF and LRP</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>The Project could support the local economy by sourcing food locally, where feasible.</td>
<td>Via community engagement action planning and according to the Local Content and Procurement plan.</td>
<td>As defined by community action planning and according to the Local Content and Procurement plan.</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td><strong>Wild Foods</strong></td>
<td></td>
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</tr>
<tr>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Responsible Entity</td>
<td>Training Necessary</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Supporting local communities in developing sustainable farming, eco/sustainable hunting tourism or other activities that provide alternative food sources and income.</td>
<td>As stipulated within the LARF/LRP and via community engagement action planning</td>
<td>As stipulated within the LARF/LRP</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Biomass fuel and timber</strong></td>
<td></td>
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<tr>
<td>Work with the Forestry company and local community groups to investigate other fuel sources. EOX is committed to making timber felled from the site available to the local communities of Ilovica and Shtuka. Progressive clearing and the seasoning and storage of harvested timber should mean that there is no demand for ‘new’ timber from these communities for at least 5 years, probably longer.</td>
<td>Via community engagement action planning</td>
<td>As defined by community action planning.</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Freshwater Type I</strong></td>
<td></td>
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<tr>
<td>Euromax to work with SPWMC and others to ensure a water pipeline will be constructed between Turija reservoir and Ilovica WTW, enabling the supply of water to the WTW to be switched from Ilovica reservoir to Turija reservoir. This will preserve the reliability and quality of water entering the WTW for treatment and supply to villages. Measures to reduce make up water requirements of Project activities through treatment and re-use of process water and waste water are already in place. Euromax will decommission water intakes on both Jazga and Shtuka Rivers and work with the municipalities to ensure alternative treated supplies. Euromax to agree with SPWMC to operate abstraction from the proposed Turija pipeline to ensure a prescribed flow (to be agreed) remains in the Turija pipeline downstream of Euromax’s abstraction point to maintain supply for irrigation downstream of the project. Active and or passive treatment of water discharge from the TMF following closure, plus active treatment of discharge form the pit lake once formed following closure. The project will continue to examine resource efficiencies during the life of the project to reduce make up water demand.</td>
<td>As specifically defined by Sections 6.2 and 6.3 and adherence to the water management plan.</td>
<td>As specifically defined by Sections 6.2 and 6.3 and adherences to the water management plan.</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Responsible Entity</td>
<td>Training Necessary</td>
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<td>---------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Freshwater Type II</strong></td>
<td>As specifically defined by Sections 6.2 and 6.3 and adherences to the water management plan.</td>
<td>As specifically defined by Sections 6.2 and 6.3 and adherences to the water management plan.</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>A water pipeline will be constructed between Turija reservoir and Ilovica WTW prior to the construction phase, enabling the supply of water to the WTW to be switched from Ilovica reservoir to Turija reservoir. This will preserve the reliability and quality of water entering the WTW for treatment and supply to villages.</td>
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</tr>
<tr>
<td><strong>Natural medicines perfumes and pharmaceuticals</strong></td>
<td>As stipulated in the LRP and via community engagement action planning</td>
<td>As stipulated in within the LRP</td>
<td>Euromax</td>
<td>-</td>
</tr>
<tr>
<td>Economic effects experienced by foraging communities should be addressed in terms of the IFC Performance Standard 5 discussing the involuntary resettlement and compensation practices in project-affected communities through delivery of the LRP.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Erosion control</strong></td>
<td>As specifically defined by Section 5.1 and adherences to Soils, Rehabilitation &amp; Reclamation Plan and the water management plan.</td>
<td>As specifically defined by Section 5.1 and adherences to Soils, Rehabilitation &amp; Reclamation Plan and the water management plan.</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
<tr>
<td>Installation of physical erosion control features such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting to control erosion (prior to the establishment of a protective vegetative cover). Temporarily disturbed areas will be graded, revegetated and reclaimed so that surface water run-off from these areas will, where feasible, be similar to natural or pre-mining conditions. Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible. Timely construction of the SWD.</td>
<td></td>
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<tr>
<td><strong>Regulation of water timing and flows</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mitigation Measures</td>
<td>Monitoring Indicators</td>
<td>Monitoring Frequency</td>
<td>Responsible Entity</td>
<td>Training Necessary</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
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<td>--------------------</td>
</tr>
<tr>
<td>As specifically defined by Sections 5.2 and 5.3 including the construction of the SWD and adherences to developing management plans.</td>
<td>As specifically defined by Sections 5.2 and 5.3 and adherences to the water management plan.</td>
<td>As specifically defined by Sections 5.2 and 5.3 and adherences to the water management plan.</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
<tr>
<td>Treatment of discharge to the Shtuka</td>
<td>The implementation of commitments made in Section 6.3.</td>
<td>As specifically defined by Sections 5.2 and 5.3 and adherences to the water management plan.</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Ethical and Spiritual Values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archaeological excavation, archaeological watching brief, relocation of receptors and photographic logging and preservation of sites (already in implementation).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is proposed that a photographic record is created for Shtuchki Vodopad and its surroundings prior to its loss. The cultural value of this site is derived in part from the plant gathered there around Easter by the local community which is widely available elsewhere in the landscape.</td>
<td></td>
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<tr>
<td>The Cultural Heritage Management Plan will include an outline method for identifying alternative accessible locations for this plant and methods of enhancing access to ensure it can be collected, thereby reducing the impact consequence. Although it will not prevent the loss of this receptor as a locally significant point of interest, preservation through photographic recording is considered a meaningful and appropriate mitigation for its loss.</td>
<td>As defined within section 5.10 and in the Cultural Heritage Management Plan.</td>
<td>As defined within section 5.10 and in the Cultural Heritage Management Plan.</td>
<td>Euromax</td>
<td>Yes</td>
</tr>
</tbody>
</table>
6.10 Cultural Heritage

Specific cultural heritage mitigation measures are proposed to reduce the impacts outlined in Table 5-94 and are presented by source of effect. These mitigation measures and the receptors affected are shown in Drawing 5-29.

6.10.1.1 Ground disturbance

Ground disturbance will have a moderate to major impact on nine receptors (two ‘living’ cultural heritage: SP-01, NF-01; and seven archaeological: AR-03, AR-05 to AR-08, AR-10 and AR-11) for which a variety of mitigation measures are proposed. A summary of these mitigation measures and the impacted receptors is presented in Table 6-8.

Table 6-8: Proposed mitigation measures for receptors impacted by ground disturbance

<table>
<thead>
<tr>
<th>Proposed mitigation</th>
<th>Impacted receptor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeological evaluation and excavation</td>
<td>AR-06, AR-07, AR-08, AR-10 and AR-11</td>
</tr>
<tr>
<td>Relocation of receptor</td>
<td>SP-01</td>
</tr>
<tr>
<td>Photographic recording and enhanced access to alternative plant sources</td>
<td>NF-01; AR-03</td>
</tr>
<tr>
<td>Archaeological watching brief</td>
<td>AR-05</td>
</tr>
</tbody>
</table>

As an additional precautionary mitigation measure, demarcation is also proposed for seven archaeological receptors to protect them from inadvertent damage prior to construction and/or archaeological excavation.

6.10.1.1.1 Archaeological Evaluation and Excavation

Detailed archaeological excavation and recording is proposed at five archaeological receptors where a direct impact as a result of ground disturbance is unavoidable. An initial archaeological evaluation of the five receptors will be undertaken by Strumica Museum to provide information about site extent, depth and preservation of archaeology, and the types and volume of archaeological finds present at each. This evaluation will be done through a considered and methodical series of test pits and trial trenches which will allow for targeted and efficient excavation of the sites.

The excavation and recording of known archaeological receptors will be conducted prior to construction, and will be scheduled to provide sufficient time to record a representative sample of all archaeological remains (and environmental remains, if required). In accordance with Article 59 of the Macedonian Law on Protection of Cultural Heritage, an excavation report will be produced and published to document this work.

Although excavation ultimately results in the disturbance of archaeological remains, the systematic mitigation approach will reduce the overall impact of this loss of in situ preservation. The comprehensive, transparent and objective approach to recording and the dissemination of results will have a positive effect, as the information obtained will improve the spatial resolution and chronology of the archaeological record in the wider region. Once the evaluation is complete and the results reported, a fully detailed excavation and finds recovery mitigation strategy will be developed in conjunction with Strumica Museum. This will be part of the Cultural Heritage Management Plan (CHMP) for the Project (Annex 6).

6.10.1.1.2 Relocation of Receptor

It is expected that the memorial stone at Preslop spring (SP-01) will be removed during construction. This memorial was dedicated to a local inhabitant, Stojan Cherkezov, who died in 1974 aged 24 during an accident whilst felling and gathering wood in the area. In consultation with Stojan’s son, it is proposed that the stone will be relocated to an area of the concession area where it will not be disturbed or damaged and will remain accessible to the family. A plan for relocation and related consultation is outlined within the CHMP. A photographic record of the stone in its current (original) context has already been made.
6.10.1.1.3 Photographic Recording and Enhanced Access to Alternative Plant Sources

It is proposed that a photographic record is created for NF-01 and its surroundings prior to its loss. The cultural value of NF-01 is derived in part from the plant gathered there around Easter by the local community. Bigroot cranesbill (Geranium macrorhizum) is widely available elsewhere in the landscape. The CHMP will provide a method for identifying alternative accessible locations for this plant and methods of enhancing access to ensure it can be collected, thereby reducing the impact consequence. Although it will not prevent the loss of this receptor as a locally significant point of interest, preservation through photographic recording is considered a meaningful and appropriate mitigation for its loss.

A photographic record is also proposed for the old adit/tunnel site at AR-03 prior to construction. The cultural value of this receptor is largely derived from anecdotal evidence linking the site with a gold crown produced for the Serbian king in circa 1926. This receptor will be lost during construction and, as there is no material to excavate, a photographic record documenting the receptor and its history is considered to be appropriate mitigation.

Copies of the photographic material will be deposited with Strumica Museum for long-term storage as outlined within the Project CHMP.

6.10.1.1.4 Archaeological Watching Brief

A precautionary approach has been adopted for AR-05. Although a moderate impact is predicted at this receptor, observations in the field indicate that this archaeological site is poorly defined and preserved. Strumica Museum archaeologists are also unsure of its exact location and extent, and sceptical of its antiquity. It is proposed, therefore, that monitoring of ground disturbance by an archaeologist will be conducted during construction (particularly during initial surface stripping), during which the site will be searched and any finds/structures recorded. In the event that significant archaeological remains are discovered during construction, an evaluation will be made by the supervising archaeologist as to whether further detailed excavation is required. The scope of this work, including reporting, will be outlined in the CHMP.

6.10.1.1.5 Demarcation and Avoidance of Archaeological Sites (Precautionary)

Demarcation and avoidance of seven archaeological sites will help protect archaeological remains from inadvertent damage as a result of unforeseen vehicle movements, stockpiling and the lay-down of construction equipment. This is a general good practice measure which should be applied as follows:

- The five archaeological sites to be evaluated and excavated (AR-06, AR-07, AR-08, AR-10 and AR-11) will be demarcated as part of the evaluation process, as well as AR-05 which will be subject to an archaeological watching brief. Until archaeological works are complete and the sites are excavated, vehicles should avoid the areas and no stockpiling should occur within these areas. Vehicular access required for vegetation clearance ahead of archaeological works should be restricted as far as is practicable.

- Archaeological sites within the concession area but outside the proposed development footprint, i.e. AR-04, should be demarcated and protected from vehicle access or stockpiling throughout the life of the mine or until such time that the site is excavated.

The type of demarcation required in each case (e.g. fencing and signage) will be defined in the CHMP. All staff should be informed as to the location of archaeological sites within and around the footprint prior to commencing work and should commit to avoiding them. Further details on the provision of on-site inductions, cultural heritage site avoidance (i.e. constraints maps) will be outlined in the CHMP.

6.10.1.2 Noise and vibration

The indirect effects of noise and vibration are predicted to have a moderate/major (noise/vibration) impact upon religious beliefs and practices, as well as minor impacts at a number of tangible cultural heritage receptors. A moderate impact is anticipated at Crkvishtë (AR-04) as a result of ground vibration. The measures proposed in Section 5.5 include mitigation for these impacts. The short-term nature of the construction-related noise also reduces the need to enact mitigation. Supplementary mitigations to address operational noise, and a number of precautionary measures, are presented in Table 6-9.
### Table 6-9: Proposed mitigation measures for receptors impacted by noise and vibration

<table>
<thead>
<tr>
<th>Proposed mitigation</th>
<th>Impacted receptor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympathetic construction schedule (to supplement proposed noise mitigation)</td>
<td>Religious beliefs and practices at CH-03</td>
</tr>
<tr>
<td>Sympathetic operational regimes (blasting and transport) and community liaison (to supplement proposed noise mitigation)</td>
<td>Religious beliefs and practices; CH-03 and RE-04; AR-04</td>
</tr>
<tr>
<td>Visual inspection and vibration monitoring</td>
<td>CH-03 and RE-04; AR-04</td>
</tr>
</tbody>
</table>

#### 6.10.1.2.1 Sympathetic Construction Schedule

A moderate impact on religious practices is expected as a result of construction noise. At CH-03, where the Nativity of Theotokos is celebrated annually by the people of Ilovica and Shtuka on 21 September, a sympathetic construction schedule would reduce this impact. It is proposed that, in liaison with stakeholders, construction activities are modified on that day to lessen the effects of noise disturbance. Liaison and good communication with stakeholders will also allow other individual events in these communities (such as a funeral or marriage) to be accommodated.

#### 6.10.1.2.2 Sympathetic Operational Regimes (Blasting and Transport) and Community Liaison

A number of receptors have the potential to be impacted by operational noise, such as blasting and the transportation of material along the access road. In all cases, these impacts can be avoided by liaising with the surrounding communities and developing a blasting/transport regime that is sympathetic to their cultural needs. This can also be used to minimise dust deposition during the Nativity of Theotokos. An outline programme for on-going community consultation is included within the CHMP.

- Religious beliefs and practices – in consultation with the relevant stakeholders, develop the blasting regime to accommodate religious festivals and religious services and to keep levels of disturbance to a minimum:
  - Modify time of blasting on Fridays (mosque) and Sundays (church) to avoid religious services.
  - Avoid blasting and reduce traffic volumes on major religious holidays, particularly Christmas and Easter, the Epiphany (19 January), Sts. Forty Martyrs (22 March), St. Athanasius’ Day (15 May), Sts. Cyril and Methodius Day (24 May), St. Elijah’s Day (2 August), St. Demetrius’ Day (8 September) and the Nativity of Theotokos (21 September).

To comply with the proposed vibration limits and protect CH-03, RE-04 and AR-04 from ground-borne vibrations, it is anticipated that a reduction in the maximum explosive weight detonated per delay period within each blast would be required. This will be dependent on the bench height and monitoring results (see Section 5.5). A sympathetic blasting regime will include any one, or combination, of the following in-design mitigation measures, which would reduce the maximum charge weight per delay:

- Reducing the borehole diameter with a corresponding reduction in drill pattern;
- Introducing decked charges within each borehole; and/or
- Reducing the borehole length (depth) by reducing the bench height.

#### 6.10.1.2.3 Visual Inspection and Vibration Monitoring

In conjunction with the proposed sympathetic blasting regime (to reduce the impact of ground-borne vibrations), mitigation measures are proposed to assess, record, monitor and preserve the potentially affected...
receptors at CH-03, RE-04 and AR-04. This is in acknowledgment of Article 79 of the Macedonian Law on Protection of Cultural Heritage. These measures will be outlined in the CHMP and will include:

- A visual inspection of each receptor will be undertaken before blasting commences. This will consist of a fabric condition survey to assess the current condition of the structures (e.g. existing cracks, cosmetic damage, erosion), which will be documented and supported with photographic evidence.

- The results of the fabric condition survey will inform a Monument Management Plan for each receptor in order to monitor the potential impact of ground-borne vibrations. This will include:
  - Details of the proposed installation of vibration monitors at each receptor;
  - Monitoring schedule and analysis of vibration results (e.g. to warn if vibration intensity exceeds the predicted levels);
  - Periodic visual inspection of receptors by an independent local archaeologist. If the recorded vibration intensity is higher than predicted, further inspections will be made to check that the structural integrity has not been/is not being compromised; and
  - Early consultation with Strumica Museum in the event that vibration effects are greater than those modelled and where the structural integrity may be compromised.

This Monument Management plan will remain ‘live’ and appended to the Project CHMP, allowing flexibility in the mitigation strategy so that it remains responsive to conditions on the ground. For example, archaeological evaluation and excavation of AR-04 may be required if monitoring reveals that, despite all efforts, vibration effects are causing damage to the receptor. A monthly review of the Monument Management Plan is therefore proposed during the first year of blasting (informed by ongoing monitoring). Review frequency will reduce throughout the life of the mine and as outlined in the CHMP.

**6.10.1.3 Visual**

For all cultural heritage receptors where there will be visual effects, a minor impact is predicted. The mitigation measures proposed in Section 6.11 will act as mitigation for these impacts.

Additionally, it is specifically proposed that existing vegetation is retained around RE-04, in order to provide as much visual screening as possible, this will be highlighted in the Project CHMP.

**6.10.1.4 Overhead Powerlines**

An assessment of impacts of the construction and operation of powerlines associated with the project will be included in an Addendum to the ESIA. Nevertheless, a range of mitigation measures may be employed, which could include, but not be limited to:

- Avoidance of direct impacts to known cultural heritage receptors through design (e.g. altering the location of the towers and angle points);
- Archaeological investigation and excavation prior to construction of any archaeological receptors to which direct disturbance cannot be avoided; and
- Archaeological watching brief during construction in areas with suspected archaeological potential where direct disturbance cannot be avoided.

Where indirect impacts as a result of noise or visual effects are anticipated then liaison with the relevant discipline specialists will be required to ensure an appropriate mitigation strategy is developed.
6.11 Landscape and Visual

The following mitigation measures (in addition to those listed in Section 5.11.2) will be incorporated into the construction, operational and closure management plans to reduce the adverse landscape and visual effects of the mine:

- Trees will be planted around the periphery of the mine workshop area to reduce the prominence of the elevated buildings/plant from Shtuka and the Monastery of St George. The dense belts of woodland planting will reflect the locally occurring indigenous species.
- Project lighting, which will comprise ten mast lights (30 m high) with 4x1000 W HPS lights (adjustable orientation), should be located away from the prominent summit and southern faces of Čukar. Elsewhere, ‘cut-off’ lighting (directional lights) will be used to minimise light pollution.
- Post-extraction selective blasting of the horizontal mine pit benches and the rock faces will be undertaken to soften the ‘man-made’ appearance of the open pit to aid landscape integration and to minimise the prominence of the residual angular landform.
- The outer face of the TMF embankment will be revegetated at closure to minimise the extent of bare earth visible from the surrounding areas. The establishment of trees and scrub in selected locations on the horizontal benches of the TMF dam will, in time, disguise the angular ‘man-made’ landform and will help assimilate the structure with the forested valley sides. Rapid establishment techniques including direct tree-seeding by hydraulic means may be appropriate.

6.12 Socioeconomics

To maximise positive effects and enhance the ability of local populations to capture benefits associated with the Project, targeted measures are undertaken; these are referred to as “benefit enhancement measures”. The benefit enhancement measures listed below are considered in the residual impacts assessment. Through them, the consequence of a positive effect is likely to increase.

Low consequence positive effects are carried forward for benefit enhancement to achieve a moderate or high consequence positive effect in the residual impacts assessment. Similarly, low consequence adverse effects are carried forward for mitigation as, while an effect may be of low consequence at a community or population scale, impacts to people (regardless of how few are impacted) require mitigation. For example, while beekeeping is not a prominent activity in Ilovica and Shtuka (i.e. only conducted by two individuals), the Project’s adverse effect on beekeepers must be mitigated.

Mitigation for social effects may be in the form of workforce management policies, operational policies and environmental mitigations aimed at reducing the Project’s effects on environmental conditions (e.g. air and water quality, noise and vibrations, soil productivity) that have influence on aspects of the socio-economic environment (e.g. health, quality of life, agricultural land use).

6.12.1 Economy

The Project’s economic effects are positive and do not require mitigation. In the case of some economic effects, no practical benefit enhancement measures exist. This is particularly true of the Project’s contribution to national GDP, which is bound by production and output, and to government revenues, which are based on established taxation and royalty regimes. The Project’s effect on local, regional and national economic development, however, will benefit from the following enhancement measures:

- Tailor contracting and procurement strategies to maximise economic development within local municipalities, to the extent feasible.
- Implement a process to identify potential local, regional and national suppliers of goods and services and analyse barriers to the ability to supply relative to Project procurement requirements.
Develop and implement a strategy to overcome these barriers in order to enhance uptake of business opportunities, considering Project operational quality and cost-efficiency requirements.

Give priority to local suppliers when sourcing raw materials, finished goods, and services, given equivalent quality and price.

Establish achievable targets for local, regional and national procurement (as a percent of total procurement) that grow over time.

Provide businesses with timely information on procurement requirements in areas that are mutually considered to be within the capacity of those businesses. Examples include road maintenance, catering, janitorial services, consumables supply, materials handling and expediting, and textiles.

Promote viable local sources for Project inputs by providing business development assistance.

Implement procurement contracting procedures that consider the potential need to break down procurement packages and accommodate financial constraints of small scale enterprises.

Provide explanations to interested businesses that may be denied an opportunity to bid on procurement requests, and to businesses that compete on bids unsuccessfully, as to the reason for their denial or unsuccessful bid.

Maintain a regularly updated Project database of potential local and regional suppliers or goods and services that identifies:

- Business interest, capacity and the nature of goods and services offered;
- Contact information;
- Contract performance record; and
- Requests for assistance to improve supply performance and assistance extended in support.

Include in the evaluation criteria for subcontractors the extent to which they commit to similarly prioritise use of local, regional and national businesses in meeting their contractual obligations.

Monitor and enforce subcontractor performance for compliance with these commitments and use monitoring results in decisions on contract administration and management.

6.12.2 Employment, Incomes and Education

Benefit enhancement measures are those steps taken by a Project to maximise the ability of the local labour force to benefit from Project employment opportunities. As noted in Section 5.12.6.2, Euromax intends to source approximately 90% of its construction and operations workforce from within Macedonia, including heavy reliance on Macedonian contractors and sub-contractors. Much of the operational Macedonian employment is expected to be taken up locally. There will be significant overlap between the operational and construction workforces, with a portion of the construction staff transitioning into operational roles.

To further enhance local employment, the Project will attempt, in conjunction with local administration, to address the root causes of the inaccessibility of Project employment to the local labour force. In the case of the LSA labour force residing in villages such as Ilovica and Shtuka, low educational attainment and mining skills development is the main barrier to obtaining employment beyond entry-level positions at the Project.

As Project construction is imminent, there is little opportunity for the Project to enhance the skills of the local construction labour force as related to mine construction. However, while construction occurs, and in the early years of operations, the Project has the potential to influence skills development in the existing labour force, and in students who will be entering the labour force as Project operations commence. Benefit enhancement measures to maximise local employment include:

- Develop a Training and Recruitment Plan that includes commitments to:
- Develop mining-related programs and to encourage careers in mining, trades and support industries;
- Training of semi-skilled and skilled positions prior to the commencement of and during operations, including comprehensive training in health and safety;
- Offer internships to students interested in mining employment;
- Communicate Project-related training opportunities to technical and vocational schools; and
- Provide scholarships for local students pursuing mining- or science-related higher education.

Create career development plans for employees that emphasise on-the-job training and skills development in pursuit of advancement;
- Include in the employment responsibility of senior staff the requirement to mentor more junior employees in a manner that encourages skills development and career advancement;
- Provision of training to senior staff aimed at improving their ability to coach and mentor junior staff; and
- Implement continuous education and training initiatives to enable people to obtain the job experience and skills necessary to find alternative employment at the time of closure.

To further maximise the opportunity for the local labour force to access Project employment, recruitment strategies aimed at maximising the participation of the local labour force will be carried out, including the following measures:

- Monitoring the performance of the recruitment policy at the senior managerial level to ensure that managers and supervisors are familiar with recruitment goals;
- Prioritise local (i.e. LSA) labour force with low levels of education for entry-level positions and local trades people for apprenticeship positions;
- Formal recruitment process that maximises local participation where possible, including accessible, timely job postings;
- Regular communication with local government on workforce requirements;
- Establish achievable targets for growing the local representation in the Project workforce over time;
- Establish achievable targets for growing the representation of women in the Project workforce over time;
- Include in the evaluation criteria for subcontractors the extent to which they commit to similarly maximise local labour as appropriate; and
- Enforce local content targets for subcontractors, and monitor performance.

Of these measures, those aimed at enhancing the education of the existing labour force and encouraging the pursuit of education amongst local students have the potential to have spill-over benefits in terms of the local population’s current and future ability to access indirect employment opportunities in industries servicing the Project. Conversely, the Project has no influence over how or where the employed spend their income and so no practical benefit enhancement measures are suggested with regard to induced employment.

No direct benefit enhancement measures are proposed for direct employment incomes, as Project employment is already anticipated to result in high incomes, relative to the national average for the mining industry. Incomes paid to employees in industries servicing the Project (indirect employment incomes), and to those in industries where direct and indirect employment incomes are spent (induced employment incomes) are determined by their employer and are outside of the control of the Project. Thus, there are no practical benefit enhancement measures associated with indirect and induced incomes.
6.12.3 Population

The Project has prioritised local hiring to meet construction and operation workforce requirements. While this has a positive effect on local employment and incomes, it lessens the Project’s ability to influence the existing pattern of out-migration and population decline from the local area through the relocation of out-of-area workers. No practical benefit enhancement measures are recommended to improve the Project’s ability to offset this pattern.

6.12.4 Community Health, Safety and Security

The following mitigation will minimise adverse effects on community health, safety and security:

- Monitor environmental conditions (e.g. air and water quality) and keep local authorities updated regarding any potential environmental incidences or exceedances of air and water quality guidelines that have the potential to adversely influence physical health;

- Establish an Emergency and Preparedness Response Plan, with a primary aim to:
  - Raise awareness within local communities of how to react should an accident or emergency occur;
  - Deal with emergencies contained within the project site boundary as well as those that occur outside or extend beyond project boundaries affecting external resources; and
  - Establish, in partnership with local authorities, an agreed plan with appropriate roles, actions, coordination and communication to deal with accidents and emergencies arising from project activities or natural hazards (such as flooding or avalanches) that involve the operation and the local community.

- Fence and/or install signage at the Project site to prevent public access and provide public education programs on risks present within the Project site boundary;

- Establish a Traffic Management Plan that:
  - Identifies potential bottlenecks, narrow shoulders, and sharp turns on public roads;
  - Plans Project traffic flows to avoid peak periods of daily traffic;
  - Requires the maintenance of Project vehicles at proper working standard to avoid fuel or other fluid leaks or maintenance issues while in transit;
  - Requires that speed limits be monitored and enforced; and
  - Requires that defensive driving training be provided to Project vehicle operators and make personnel aware of the zero-tolerance of unsafe driving behaviour.

- Achieve the highest standards of health and safety in all the activities in which Euromax is engaged, including, but not limited to:
  - Maintaining a clean workplace that is designed with safety standards in mind and with appropriate signage, easy access and clearly marked egress routes;
  - Providing basic first aid training to all employees and specialist training to supervisors or selected individuals; and
  - Maintaining first aid stations and treatment rooms, including eye-wash and shower equipment, where appropriate.

- Establish the workforce discipline which encourages health, safety, learning, retention and advancement of employees, train employees on and enforce policies related to:
  - Proper equipment operation and maintenance;
Proper care and maintenance of personal protective equipment;

Fire safety, emergency preparedness and other general workplace-safety;

Maintaining a clean and safe workspace;

Zero-tolerance policy on the abuse of controlled substances or alcohol while at work, or arriving at work under the influence of either substance; and

Zero-tolerance policy regarding workplace harassment and discrimination.

Provide recrimination free opportunities for workers to express concerns, including those related to health and safety, and bring to light conflicts such that grievances are addressed promptly;

Include in the evaluation criteria for subcontractors the extent to which they commit to manage their workforces through similar measures;

Provide assistance to improve the existing Illovica health clinic facilities (in addition to the on-site health clinic for workers provided during construction and operation, to minimise potential increases in demand for local health services); and

Monitor and enforce subcontractor performance for compliance with these commitments and use monitoring results in decisions on contract administration and management.

6.12.5 Quality of Life

The Project’s positive effects on quality of life do not require mitigation and no additional benefit enhancement measures are recommended. The following mitigations are recommended to minimise adverse effects on quality of life and enhance potential positive impacts:

Prepare a Community Investment Plan in support of community development initiatives, with the following good practice in mind:

- Identify and prioritise community needs through engagement with community members;
- Invest in community development schemes that reflect core business activities;
- Mobilise internal core competencies, such as human resources, skills training, financial management, as well as the Euromax political and business network, to promote community development;
- Begin with small, realistic projects to build on success and gain mutual trust and confidence;
- Work in partnership with the community, take the lead in building community capability and self-reliance;
- Choose relevant areas of focus for community investments (e.g. education and training, health and safety, sustainability, and environment);
- Set clear goals;
- Establish clear and equitable selection criteria;
- Establish a transparent project funding process;
- Determine roles and responsibilities; and
- Aim to eventually provide backing that avoids dependency on Euromax following closure.

Ensure requests for community investments adhere to Euromax’s Community Investment Framework and fall under at least one of the company’s funding categories: Culture and Art, Education and Environment, or Community and Sports;
Use the community development initiative to address any evolving impacts as these may become evident through consultations, grievances and/or environmental monitoring results;

Establish and enforce a code of conduct guiding the behaviour of non-resident workers while working in or travelling through local communities and the region for work related activities. The code of conduct will include:

- Standards for behaviour in support of good community relations and sustainable development;
- Prohibitions against illegal activity, harassment, verbal and physical abuse, negligence in driving company vehicles, and other behaviours that may be identified by people in communities as offensive or problematic; and
- Sanctions to be applied in the event of non-compliance with the code.

Implement a public education program to ensure that perceived effects are well understood to reduce perceptions of harm.

6.12.6 Infrastructure

The Project's positive effects on infrastructure do not require mitigation and no additional benefit enhancement measures are recommended. The Project's adverse effect on road conditions on the M6 highway will be minimised through road improvements identified through the development of a Project Traffic Management Plan, which will include a survey of the road's existing condition, an assessment of the incremental impact of Project traffic on road degradation, and road improvement measures.

6.12.7 Land Use

Project land acquisition will be mitigated through implementation of the Land Acquisition and Resettlement Framework (LARF) and Livelihood Restoration Programme (LRP) in accordance with EBRD policy and requirements.

The Project's effects on agricultural land use are expected to be limited to the direct land-take and removal of cropland (via the access road) and grazing land (via the footprint within the mine concession and the TMF). The LARF and LRP are expected to mitigate the effect on cropland agriculture through compensation to affected farmers.

The Project's effect on the loss of forestry-resources, including fuel wood, will be mitigated through the LARF and LRP, including through compensation agreements reached with the Forestry Management Company regarding salvageable timber. Reclamation and revegetation of the mine footprint with suitable timber species will mitigate any long-term effect of the Project on the availability of productive forest land. It is expected that timber and fuel wood collectors holding licences for small-scale harvesting within the areas affected by the Project will be relocated to suitable and accessible areas for harvesting. Timber harvested as part of Project clearing activities will be salvaged for local use, with a proportion going to the villages of Ilovica and Shtuka to fulfil their annual timber needs for up to 5 years, due to the phased clearance of the site and storage for seasoning. The remainder will be sold by the Forestry Company.

Graziers and holders of private forestry licences in the Project concession area should be provided with suitable alternative land and associated improvements (e.g. watering location for graziers) on which to conduct their activities during Project construction and operation.

The following mitigation related to specific, incidental land uses affected by the Project's land acquisition are expected to remove potential residual impacts:

- The beehives on the slopes of Ograzhdnen Mountain will be relocated to a suitable and agreed upon location;
- Harvesters of special crops, including mushrooms and plants used in religious ceremonies, will be consulted and should they be without alternative areas for harvesting, mitigation will need to be considered and negotiated; and
Implement a public education program to ensure that perceived effects on fish in the Ilovica Reservoir are well understood to reduce perceptions of harm.

Euromax will meet with the Hunting Associations to explain areas that will be inaccessible. As hunting can be carried out in other parts of the two hunting zones and in a large area, project effects on hunting are deemed to be low, and will not require mitigation. Euromax is open to explaining results of the impact assessments with any and all land user groups.
7.0 ASSESSMENT OF RESIDUAL IMPACTS

7.1 Geomorphology, Terrain and Soils

Using the decision matrix presented in Annex 1, Table 7-1 presents the classification of the residual impact. Table 7 in Annex 5A presents the route to the classification of the residual impacts.

Table 7-1: Assessment of residual impacts for geomorphology, terrain and soils

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Phase of the Project</th>
<th>Source of impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural land use</td>
<td>Construction, operations,</td>
<td>Spatial ground disturbance due to road construction</td>
<td>Moderate</td>
<td>Construction of the road will be routed to minimise loss of productive agricultural land.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>closure, post-closure</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Grazing land use</td>
<td>Construction, operations,</td>
<td>Spatial ground disturbance (Loss of suitable grazing land use in the Shtuka Valley and Jazga Valley)</td>
<td>Moderate</td>
<td>Reclamation of the TMF to EDC and grazing land uses at and above the tailings capping layer. Long-term monitoring of soil quality, including ecological health and risk assessment post-closure (Section 6.1).</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>closure, post-closure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestry land use (fuel, timber)</td>
<td>Construction, operations,</td>
<td>Spatial ground disturbance (Loss of suitable forestry land use capability in the Shtuka Valley and mine pit area)</td>
<td>High</td>
<td>Capping of the TMF with a layer of soil or waste rock material that meets EDC. Long-term monitoring of soil quality, including ecological health and risk assessment post-closure (Section 6.1). Although forestry land is not returned, the magnitude of impact is low because the high magnitude due to quality is mitigated, and the low magnitude due to quantity remains.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>closure, post-closure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control of erosion/ sediment</td>
<td>Construction</td>
<td>Spatial ground disturbance</td>
<td>Moderate</td>
<td>Erosion control measures incorporated into the project design during construction (Section 6.1).</td>
<td>Low</td>
</tr>
<tr>
<td>loading</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The following provides responses to issues identified during the stakeholder engagement process (described in Section 1):

- Impacts to soils (agricultural land and pastures) due to the Project, including dust and air emissions (Municipal Leaders Focus Group 26 March 2015; Open House 16 September 2015):
  - Addressed in Section 5.1.6.2, Results.
- Suspected use of illegal pesticides and herbicides, but no soil monitoring programs to verify (Municipal Leaders Focus Group 26 March 2015):
  - Monitoring will be defined in detail in the management plans. Monitoring will continue at the locations where EOX already conducts those activities.
What the level of protection is for citizens in terms of soil contamination (standards and thresholds) (Agricultural Representatives Focus Group 28 March 2015):

- The level of protection in terms of soil contamination is provided in the Environmental Design Criteria for the Project.

Loss of grazing land for cattle (Open House 16 September 2015):

- Addressed in Section 5.1.6.2, Results.

Loss of forestry land for use as fuel wood (Open House 16 September 2015):

- Addressed in Section 5.1.6.2, Results.

Will the area for agricultural use be reduced?

- Agricultural land will be taken for the construction of the access road. As a mitigation measure; it is considered that the access road will be marked in a way that will provide reduced loss of the agricultural land. The losses to agricultural land are addressed in Section 5.1.6.2.

Will the forestry area be reduced?

- The forestry area will be reduced due to the construction of the mining infrastructure. But, after the closure, those locations will be covered with topsoil and after certain soil quality analyses, those locations will be revegetated.

When will the grazing area be reduced?

- The grazing area will be reduced before the beginning of the preparation works for the construction of the mining infrastructure.

Will there be a negative impact on Strumica River course, i.e. pollution of the soils in the surroundings of Zubovo village?

- No. The pollution of the soils can occur in two ways, either by air emissions and dust, or by the sediments in the river. According to the studies conducted, the analyses show that the air emissions and dust in the Zubovo village will not occur as the wind blows in opposite direction, so according to that, the soils pollution by dust will not occur. Adverse effects to soil by the sediments in the Strumica River is not expected to occur because sediment control infrastructure on the water courses in the concession will be designed and constructed to minimize these effects. Euromax is committed to conducting monitoring of the river water quality, and can react in a timely manner if water quality parameters exceed the proscribed limits.

What is the radius of dust deposition?

- The radius of dust deposition is provided on Drawing 5-2.

- As a result of the baseline conditions of the wind and the worst case scenario taken in consideration, dust cannot reach the communities/villages. There might be a minimum impact in Sushica, but it would be low.

What will the impacts on soil acidity be?

- As a result of the baseline conditions of the wind and the worst case scenario taken in consideration minor changes in soil chemistry are predicted; however, these changes would not impact the land use.

Is monitoring planned?

- Monitoring will be defined in detail in the management plans. Monitoring will continue at the locations where EOX already conducts those activities.
Euromax does the monitoring in all different fields. Does any other entity carry out additional control?

- The monitoring is conducted by Euromax, but everyone can independently do their own monitoring and compare the results. The University of Shtip is also included in collecting monitoring data. They have their own practice of data processing. The data of all research is publicly available and they will continue so in the future. These can be reviewed and compared by anyone and by any governmental institution. Both Macedonian guidelines and the international regulations for the investors are complied with. Investors engage independent experts. An international company named D’Apollonia has been evaluating our monitoring and the entire ESIA on behalf of some of our Lenders.

- Post consultation note: A Framework for land acquisition is under development by Euromax. Affected land owners and households will be consulted. The Framework will identify how compensation will be defined for economic displacement, where land acquisition is required.

Stakeholder concerns are used to guide the methods and the assessment completed within the ESIA. The following provides a response to stakeholder concerns which do not require action, or commitment by Euromax:

- The management of use of illegal pesticides and herbicides is the responsibility of the government to manage and regulate. However, throughout the life of the Project, Euromax will continue to monitor chemical properties of soil and water in the study area for any effects from the Project. Should elevated levels relative to the baseline occur that exceed the EDC; these will be identified to the relevant government agency immediately.

7.2 Water Quantity

Using the decision matrix presented in Annex 1, Table D-2 in Annex 5B presents the route to the classification of the residual impacts. Table 7-2 presents a summary of the classification of the residual impacts.
<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
</table>
| Jazga River at Ilovica water supply intake (gauging station JZGS01) | Operations (Yr 20) | Change in Q95 flow due to induced loss of flow to pit and pit dewatering as pit is excavated below river bed level from Year ~5 onwards. | Major | Euromax to assist funding new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, comprising:  
  - New potable water distribution network to all households in Ilovica and Shtuka;  
  - Permanent connection between Ilovica WTW and the new distribution networks;  
  - Extension of existing agricultural water distribution network to unserved households from Ilovica Reservoir;  
  - Decommissioning of Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. | Negligible |
|          | Closure (Yr 27) | Change in Q95 flow due to induced loss of flow until the pit lake fills up to elevation of river bed in Year ~110. | Major | None                                                                                                                                     | Negligible |
|          | Operations (Yr 20) | Change in number of days per year Ilovica village would need to be supplied by Ilovica WTW as a result of reduced flow at water supply intake from Year ~5 onwards. | Major | None                                                                                                                                     | Negligible |
|          | Closure (Yr 27) | Change in number of days per year Ilovica village would need to be supplied by Ilovica WTW as a result of reduced flow at water supply intake until the pit lake fills up to elevation of river bed in Year ~110. | Major | None                                                                                                                                     | Negligible |
| Jazga River at gauging station JZGS01 | Operations (Yr 20) | Change in wetted perimeter due to induced loss of flow represented by Q95 due to excavation of pit below river bed level and pit dewatering from Year ~5 onwards. | Major | None                                                                                                                                     | Major* |
|          | Closure (Yr 27) | Change in wetted perimeter due to induced loss of flow to pit is predicted to continue until the pit lake fills up to the elevation of the river bed in Year ~110. | Major | None                                                                                                                                     | Major* |
| Ilovica reservoir | Construction (Yr - 1) | Change in mean water level due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply scheme is under construction | Moderate | Euromax to minimise abstraction of water from Ilovica Reservoir for construction purposes. Develop alternative sources of water supply for mine construction. | Negligible |
|          | Operations (Yr 20) | Change in frequency of failure due to (assumed) demand on Ilovica Reservoir to supply water for mine construction while the Turija water supply scheme is under construction | Moderate | Euromax to pump water into Ilovica Reservoir from Turija Reservoir to augment river inflows. | Negligible |
|          | Operations (Yr 20) | Change in Q95 inflow due to induced loss of water from Jazga River during excavation of the mine pit below river bed level and pit dewatering from Year ~5 onwards. | Major | Euromax to assist funding new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, comprising:  
  - New potable water distribution network to all households in Ilovica and Shtuka;  
  - Permanent connection between Ilovica WTW and the new distribution networks;  
  - Extension of existing agricultural water distribution network to unserved households from Ilovica Reservoir;  
  - Decommissioning of Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. | Negligible |
## ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure (Yr 27 onwards)</td>
<td>Change in Q95 inflow due to induced loss of water from Jazga River to pit lake until the pit lake fills up to the elevation of the river bed in Year ~110.</td>
<td>Major</td>
<td>Euromax to work with SPWMC and others to design, construct and operate (i) Transfer supply of Ilovica WTW to Turija Reservoir (ii) Power plant on Turija pipeline to power pumps to enable augmentation of Ilovica Reservoir from closure until inflows to reservoir re-established in Year ~110. (iii) Capital replacement and maintenance of water supply infrastructure linking Turija pipeline with Ilovica Reservoir. (iv) At closure, do not decommission water supply infrastructure linking Turija pipeline with Ilovica Reservoir. (v) During closure, if necessary, SPWMC to pump water into Ilovica Reservoir from Turija Reservoir to augment river inflows.</td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Closure (Yr 27)</td>
<td>Change in frequency of failure due to reduced Q95 inflows caused by induced loss of water from Jazga River to pit until the pit lake fills up to the elevation of the river bed in Year ~110.</td>
<td>Major</td>
<td></td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Jazga River downstream of Ilovica reservoir and at Radovo (JZGS03)</td>
<td>Operations (Yr 20)</td>
<td>Change in Q50 flow due to management of reservoir water level with at 0.5m freeboard.</td>
<td>Major</td>
<td>EOX to agree with SPWMC that they will make a limited number of releases of water from Ilovica Reservoir of agreed magnitude (flow) and duration (a few days) at agreed times of the year, including summer, sufficient to increase the Q50 flow at Radovo (JZGS03) to the baseline Q50.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Jazga River through Ilovica</td>
<td>Post Closure (Yr 110+)</td>
<td>Spilling pit lake exacerbates flood risk in Ilovica both with and without Climate Change effects</td>
<td>Moderate</td>
<td>Euromax to design provision of storage and attenuation for flood waters up to the 100-year flood generated within the closed pit by modifying the drainage outlet from the restored pit.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Shtuka River at the intake (STGS01)</td>
<td>Post Closure (Yr 27+)</td>
<td>Following the diversion channel falling into disrepair, low flows will be lost to evaporation and infiltration on the surface of the TMF and will not discharge downstream</td>
<td>Major</td>
<td>The engineering design of water management on the TMF to (a) maintain the diversion channel in perpetuity (or until water quality in the SCF improves) (b) the Shtuka River will be routed across the surface of the tailings in an</td>
<td>Minor</td>
</tr>
<tr>
<td>Receptor</td>
<td>Project phase</td>
<td>Impact</td>
<td>Impact classification before mitigation</td>
<td>Mitigation</td>
<td>Residual impact classification</td>
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<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Turija irrigation area downstream of Euromax’s proposed abstraction point on the proposed refurbished Turija pipeline.</td>
<td>Operations Years 1 and 2-20</td>
<td>Change in the percentage of days when irrigation demand is not satisfied by water supplies from Turija Reservoir.</td>
<td>Moderate</td>
<td>Engineered channel to the TMF spillway. Or (c) shallow groundwater in the TMF cap will be discharged under control to the Shtuka.</td>
<td>Minor</td>
</tr>
</tbody>
</table>

*The impact on the wetted perimeter in the section of the Jazga between the pit and the Ilovica reservoir will be evaluated in the biodiversity section (Section 5.8)*
In consideration of the issues raised during the stakeholder engagement exploring the effect of mining activities on water quantity in rivers and Ilovica reservoir as raised during Round 3 Stakeholder Engagement:

**The effect of mining activities on water quantity in rivers and Ilovica reservoir:**

- Effects on water quantity are described throughout this document. Where effects have been identified the ESIA has committed Euromax to ensuring that water users will experience no unacceptable impact on water supplies through a number of measures, which will be put in place under the water management plan associated to this ESIA and located in the Environmental and Social Management System (ESMS). Euromax, working together with Bosilovo Municipality and Strumichko Pole Water Management Company (SPWMC), is committed to mitigating these impacts before mine operations start by:

  - Supplying water to Ilovica Water Treatment Works from Turija Reservoir instead of Ilovica Reservoir, thereby securing supplies to the treatment works;
  - Installing a new, clean, water distribution network in both villages;
  - Permanently connecting Ilovica Water Treatment Works to the new distribution networks;
  - Permanently supplying both Ilovica and Shtuka as well the existing seven villages with treated water;
  - Closing the village water supply intakes on the Jazga and Shtuka rivers, thereby avoiding any risk to water supplies posed by reduced flows;
  - Pumping sufficient water from Turija Reservoir and additional sources into Ilovica Reservoir and operating Ilovica reservoir with approximately 0.5m freeboard throughout the life of mine so that the baseline reliability of irrigation supplies by SPWMC from Ilovica Reservoir is maintained;
  - Extending the irrigation water distribution system (pipe network) to all unserved properties in Ilovica and Shtuka; and
  - Ensuring the pumping and pipeline infrastructure remains at mine closure to enable SPWMC to continue to pump water into Ilovica Reservoir if required. Euromax is committed to installing a hydroelectric generating station on the refurbished Turija pipeline that will generate the power to pump the water during operations and thereafter during closure and post-closure. Euromax will also establish a financing mechanism that will fund operation and maintenance and replacement of engineering infrastructure through to the predicted end of the impacts in Year 110.

**The potential influence of the Jazga and Shtuka rivers on the Strumica River and Novo Selo:**

- Sections 5.2.6.4.12 and 5.2.6.4.13 address these concerns respectively. They show the results of predictive modelling which confirm that the magnitude of effect on median flow contribution to the Strumica is negligible throughout the mine scheme and post closure.

**The effect of mining activities on drinking water quantity:**

- Effects on drinking water quantity are described throughout this document, whether at intakes, groundwater under Ilovica and Shtuka villages, from springs or associated to the Ilovica reservoir. Where effects have been identified the ESIA has committed Euromax to ensuring that water users will have no unacceptable impact on water supplies through a number of measures, which will be put in place under the water management plan associated to this ESIA and located in the Environmental and Social Management System (ESMS).

**The current water quantity in Ilovica and Shtuka:**
- Effects on irrigation water, drinking water and non-potable water are described throughout this document. Where effects have been identified the ESIA has committed Euromax to ensuring that water users will have no unacceptable impact on water supplies.

- The number of days per year that the Shtuka’s water supply from the river has to be augmented by Ilovica water treatment works:
  - This information is presented in the baseline Annex 3 for the baseline (existing) case and as a predictive scenario in Section 5.2.6.4.6 for the different phases of the project.

- What changes will occur in water supply after the mine starts operating:
  - Effects on irrigation water, drinking water and non-potable water are described throughout this document for the entire life of the mine.

- Whether the water distribution system network will be completely or partially refurbished:
  - A description of the commitment to mitigate predicted water supply impacts at the Shtuka and Jazga intakes is presented in Section 6.2. Euromax is committed to working with the Municipality of Bosilovo and SPWMC to improve the availability (pressure in the pipe networks) and the quality of the water supplied to households in Ilovica and Shtuka. Supplies from Ilovica Water Treatment Works for domestic use and drinking will improve as a result of the works listed above that the Municipality is carrying out with Euromax’s support.

- Further information regarding simultaneous inputs of water from both the Ilovica Reservoir and the Turija Reservoir to the Ilovica water treatment plant:
  - A description of the commitment to augment supply in Ilovica reservoir with water from Turija reservoir is provided in the project description (Section 4.5). In addition commitments to mitigate localised impacts are presented in Section 6.2.

- Will water be pumped constantly:
  - A description of the water supply network and pumping required is provided in the project description (Section 4.5). In addition commitments to mitigate localised impacts are presented in Section 6.2.

- Whether the availability of water in Ilovica will decrease or improve:
  - Effects on irrigation water, drinking water and non-potable water are described throughout this document. Where effects have been identified the ESIA has committed Euromax to ensuring that water users will have no unacceptable impact on water supplies.

Euromax is committed to working with the Municipality of Bosilovo and SPWMC to improve the availability (pressure in the pipe networks) and the quality of the water supplied to households in Ilovica and Shtuka. Supplies from Ilovica Water Treatment Works for domestic use and drinking will improve as a result of the works listed above that the Municipality is carrying out with Euromax’s support.

- How the new water distribution system will affect the cost:
  - The cost of the new water supply to consumers in Ilovica and Shtuka will be set by the Municipality.

- Who will invest in the individual connections to the water supply network:
  - The new water supply system infrastructure will be funded by the Municipality and Euromax. The municipality will implement the network. Who pays for individual household connections will be a decision for the authorities.

- Who will provide funds for construction for the pipeline from Turija Reservoir to Ilovica Reservoir:
Euromax is planning, together with SPWMC, to refurbish the Turija canal as a pipeline from the point the Turija canal emerges from the Petrovka-Dobrashinci tunnel exit as far as the Shtuka River, a distance of 13.75 km. The pipeline will convey water for mine supply and also for the Turija irrigation scheme. SPWMC plans to abstract water at Ilovica from the Turija pipeline and pump it in a second pipeline to Ilovica Reservoir for supply to the mine and other users of the reservoir and, through a branch pipeline and new storage tank, to Ilovica Water Treatment Works. Euromax plans to provide funds and carry out the refurbishment of Turija canal and the construction of pumps and pipelines to deliver the water to Ilovica Reservoir and to Ilovica Water Treatment Works.

- The length of time it will take to solve the problem with water supply with the relationship established between the Municipality of Bosilovo and Euromax:
  - Euromax is currently supporting the Municipality to improve the water distribution network during the construction phase, before the operations start. Euromax is aiming to complete the construction of the new village water supply system in 2017 but this will depend on receipt by Euromax of mining permits from government and on local contractors.

- Details on the diversion of Shtuka River:
  - A description of the diversion channel is provided in the project description (Section 4.4.3) the Shtuka River will be diverted in a channel to be constructed along the eastern side of the proposed TMF. Construction of the diversion channel will take place in the mine construction phase. A River Diversion Dam will be constructed at the northern end of the proposed TMF to capture the flow in the river and divert it into the diversion channel. The diversion channel will carry the flow in the Shtuka River past the TMF and will re-enter the Shtuka River downstream of the TMF. The diversion will operate throughout mine life.

- Details on what will happen to the Mala Shtuka River which flows through the proposed TMF:
  - Mala Shtuka is a tributary of the Shtuka River. The Mala Shtuka flows into the Shtuka River between the proposed River Diversion Dam and the TMF embankment. During construction of the TMF embankment, the Shtuka River and the Mala Shtuka will be impounded by the embankment. From that time onwards and during mine operations the Mala Shtuka will flow into the TMF pond which will form on the surface of the TMF. The water in the TMF pond (which includes water from the Mala Shtuka and other small tributaries flowing onto the TMF from the west) will be pumped to the process plant as part of the process water supply system. Towards the end of mine life, a TMF spillway channel will be constructed at the eastern end of the TMF embankment. The spillway will be able to convey water from the surface of the TMF to the Shtuka River downstream of the TMF. When mining and processing of ore is complete, pumping to the process plant will cease. Flows onto the TMF from the Mala Shtuka and other tributaries will be directed through the spillway to flow to the Shtuka River downstream.

- How the groundwater under the TMF will be protected:

A description of the TMF design is provided in the project description (Section 4.4.3). A description of the seepage collection facility (SCF) which will collect groundwater and seepage from the TMF and allow it to be recycled during operations and treated following closure is presented in Section 4.4.9. The impacts on water quality are assessed in Section 5.3.

### 7.3 Water Quality

Using the decision matrix presented in Annex 1, Table 9-4 in Annex 5B presents the route to the classification of the residual impacts. Table 7-3 presents a summary of the classification of residual impacts.

The residual impacts presented here will be passed on to the biodiversity Section, (Section 5.8) where effects and impacts on aquatic biodiversity will be evaluated.
### Table 7-3: Assessment of residual impacts for water quality

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
</table>
| Jazga River at Ilovica water supply intake (JZGS01) | Post pit lake (Yr 110) | Change in water quality due to pit lake spilling affecting water supply security and other receptors | Major | Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, comprising:  
  - New potable water distribution network to all households in Ilovica and Shtuka;  
  - Permanent connection between Ilovica WTW and the new distribution networks;  
  - Extension of existing agricultural water distribution network to unserved households from Ilovica Reservoir;  
  - Decommissioning of Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. | Negligible |
| Ilovica reservoir (ILWT01) | Post pit lake (Yr 110) | Change in water quality due to pit lake spilling affecting water supply security and other receptors | Major | Negligible | Negligible |
| Jazga River at Radovo (JZGS03) | Post pit lake (Yr 110) | Change in water quality due to pit lake spilling. | Moderate | Euromax will collect the pit lake overflow and pipe to a passive or active treatment system where the pH will be neutralised and metal concentrations will be reduced (as described in Table 6-1). | Negligible |
| Shtuka River at Shtuka water supply intakes (STGS01) | Operations (Yr 20) | Change in water quality affecting water supply security and other receptors due to:  
  (i) poor quality seepage from the TMF and embankment during operations.  
  (ii) poor quality seepage from the TMF and embankment and poor quality overflow from the SCF following closure | Major (all phases) | Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, comprising:  
  - New potable water distribution network to all households in Ilovica and Shtuka;  
  - Permanent connection between Ilovica WTW and the new distribution networks;  
  - Extension of existing agricultural water distribution network to unserved households from Ilovica Reservoir;  
  - Decommission of Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. | Negligible (water supply security) |
| | Closure (Yr 21) | | | | |
| | Closure (Yr 220) | | | | |
| | | Euromax will:  
  i. Maintain the negligible impact on flow in the Shtuka River at STGS01  
  ii. Construct a grout or gel curtain at the SCF to capture 95% of the flow of contaminated groundwater under the SCF. | | | Low (Other receptors) |
### Receptor

<table>
<thead>
<tr>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>iii.</td>
<td></td>
<td>Re-assess at the detailed design stage potential seepage rates and pathways and modeling the reduction in seepage post-closure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td></td>
<td>Assess the feasibility of encapsulating ARD producing material in the TMF embankment and the efficiency of hydroseeding for stabilizing and reducing infiltration into and runoff on the TMF surface.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td></td>
<td>Monitoring of the water quality of seepage collected in the SCF during operations and closure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi.</td>
<td></td>
<td>If monitoring results during operations and closure indicate that water quality is as predicted in this ESIA, then Euromax will treat seepage captured in the SCF that is not suitable for discharge in a treatment plant. Preliminary assessment suggests a high density sludge (HDS) process or activated iron solids process (neutralisation and precipitation of metals), followed by a clarifier. Treated water should be discharged back into the Shtuka River channel, ideally between the SCF and STGS01.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vii.</td>
<td></td>
<td>Long term monitoring of the quality of SCF water will be used to identify when treatment of SCF water may cease.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>viii.</td>
<td></td>
<td>The SCF will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted and comply with project water quality standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td></td>
<td>To ensure the appropriate mitigation and treatment system can be implemented the following steps will be outlined in more detail as part of the environmental management plans:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td>Conceptual design of an appropriate mitigation measure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td>Bench scale and pilot studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td>A plan and schedule to complete pilot within early years of mine life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td>A high level schedule towards detailed design.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
<td>A conceptual plan to maintain intellectual capital into the future</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shtuka River at Sekirnik road bridge (STGS02)</td>
<td>Operations (Yr 20)</td>
<td>Change in water quality during operations due to poor quality seepage from the TMF and embankment</td>
<td>Moderate</td>
<td>As above for Shtuka River at Shtuka water supply intakes (STGS01)</td>
<td>Low</td>
</tr>
<tr>
<td>Closure (Yr 21)</td>
<td>Change in water quality in post-closure due to poor quality seepage from the TMF and embankment and poor quality overflow from the SCF following closure</td>
<td>Moderate</td>
<td></td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Closure (Yr 220)</td>
<td>Change in water quality in post closure due to poor quality seepage from the TMF and embankment and poor quality overflow from the SCF following closure</td>
<td>Moderate</td>
<td></td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>
In consideration of the issues raised during the stakeholder engagement (Section 5.3.4 and 5.3.7.3):

Stakeholders asked a number of questions about the project during the ‘open house’ events held in Ilovica and Novo Selo on 16 and 17 September 2015 (regarding the baseline studies) and on 18 and 19 May 2016 (regarding the impact assessment) respectively. The questions and the respective responses relevant to water quality impact assessments are listed in Section 5.3.4. The following addresses the questions asked in respect of the mitigation measures proposed and residual impact assessment for water quality:

- The current water quality in Ilovica and Shtuka and the suitability of current water supplies (village wells and springs, Ilovica reservoir and river intakes) for potable use in terms of water quality:
  - The current water quality at village wells and springs, Ilovica reservoir and river intakes at Ilovica and Shtuka, and their suitability for potable use, are described and data are presented in the baseline (Annex 3).

- The current water quality in wells that provide drinking water for residents of Sushica and potential contamination of groundwater in the Sushica valley and the planned Sushica reservoir:
  - The current water quality at village wells that provide drinking water for residents of Sushica is described and data are presented in the baseline (Annex 3). The risk of cross-contamination of groundwater in the Suchica valley is assessed in Section 5.3 in this report.

- The future use of water from the Shtuka intake as drinking water and the current quality of this water:
  - A description of the commitment to mitigate predicted water quality impacts to the Shtuka River at the Shtuka intake is presented in Section 6.3. The current quality of the the Shtuka River at the Shtuka intake is presented in the baseline (Annex 3).

- The effect of the project on water quality:
  - Effects of the project on water quality of surface water, groundwater, village wells and springs, Ilovica reservoir and river intakes are described in Section 5.3 and throughout this document. Where effects have been identified the ESIA has committed Euromax to ensuring that water users will have no unacceptable impact on water supplies.

- Observations of white-coloured water in the rivers after recent heavy rainfalls and the cause of this:
  - The cause of the observed white-coloured water in the rivers could have been the erosion of soils and transport of the clay fraction in the flow. Clays in suspension typically give water a pale, turbid appearance.

- The continuation of water quality monitoring at the wells and boreholes in Ilovica:
  - Euromax is committed to continuation of monitoring in wells and boreholes (and other receptors) in Ilovica and Shtuka in order to monitor actual environmental conditions against impacts predicted in this report.

- The removal of the originally proposed oxide ore stockpile:
  - Euromax confirms that the originally proposed oxide ore stockpile in the Jazga valley was removed from the project design in 2016 on water quality and economic grounds. The oxide ore stockpile does not feature in the project description and there are no longer plans to process oxide ore (Section 4).

- The potential influence of the Jazga and Shtuka rivers on the Strumica River at Novo Selo in terms of water quality:
  - The potential effects of the Jazga and Shtuka rivers on the Strumica River at Novo Selo are described in Section 5.3 of this report.

- How the groundwater quality under the TMF will be protected:
A description of the TMF design is provided in the project description (Section 4.4.3). A description of the seepage collection facility (SCF) which will collect groundwater and seepage from the TMF and allow it to be recycled during operations and treated following closure is presented in Section 4.4.9. The impacts on water quality are assessed in Section 5.3.

7.4 Sediment

The modelling results during the construction phase, incorporating the mitigation measures in the Shtuka catchment are presented in Table 5-38.

Table 7-4: Construction phase – TSS results, Shtuka

<table>
<thead>
<tr>
<th>River</th>
<th>Location</th>
<th>TSS concentration (mg/l) for 95%ile</th>
<th>Design criteria for discharge to environment</th>
<th>From construction areas only with no dilution from upstream catchment</th>
<th>From construction areas including dilution from upstream catchment</th>
<th>SWD with 50% flocculation efficiency</th>
<th>SWD with 60% flocculation efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shtuka</td>
<td>STGS01</td>
<td>250</td>
<td>4,385</td>
<td>588</td>
<td>294</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Shtuka</td>
<td>STGS02</td>
<td>250</td>
<td>4,339</td>
<td>585</td>
<td>293</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Strumica</td>
<td>SMGS02</td>
<td>250</td>
<td>1,633</td>
<td>262</td>
<td>257</td>
<td>256</td>
<td></td>
</tr>
</tbody>
</table>

Note: 

a) includes discharge from upstream of the diversion channel, i.e. construction of the diversion channel has not yet been completed.
b) combined concentrations for Shtuka and Jazga catchments.

Implementation of a flocculation programme with 60% efficiency in the SWD, the TSS level for the 95%ile is estimated to reduce to 250 mg/l and TSS for the 95%ile is estimated to be 256 mg/l in the Strumica River.

Using the decision matrix presented in Annex 1 and the receptors listed in Section 5.4.3, the residual impacts have been determined. Table 5-40 presents the classification of each residual impact. Table 1 in Annex 5C presents the route to the classification of the impacts, outlining the magnitude, geographic extent, duration and frequency for each impact.

Table 7-5: Assessment of impacts for sediment

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Key source of impact</th>
<th>Impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jazga River - downstream of the open pit, upstream of the reservoir (JZGS01)</td>
<td>Open pit</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Jazga River - downstream of Ilovica Reservoir and Ilovica village (JZGS03)</td>
<td>Open pit</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Shtuka River - downstream of TMF and diversion (STGS01)</td>
<td>Construction</td>
<td>TMF</td>
<td></td>
</tr>
<tr>
<td>Shtuka River - downstream of TMF and diversion (STGS02)</td>
<td></td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>Strumica River – downstream of mine area</td>
<td></td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

In consideration of the issues raised during the stakeholder engagement:

- The concern about changes to water quality, monitoring and initiation of intervention are assessed in Section 5.3.

Whitish water observed after heavy rainfall in August or September 2015, claimed to be associated with drilling: this anecdotal information may be indicative of changes in suspended sediment. The mitigation and
management proposed herein will avoid or minimise any such increases in suspended sediments throughout the life of the mine.

7.5 Noise and Vibration

Using the decision matrix presented in Annex 1, Table 7-6 presents the classification of the residual impact. Table 2 in Annex 5D presents the route to the classification of the residual impacts.

Table 7-6: Assessment of residual impacts for noise and vibration

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact classification before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shtuka</td>
<td>Off-site access road construction</td>
<td>Off-site access road construction, daytime and evening periods</td>
<td>Moderate</td>
<td>Sensitive timing of works, screening of noisy activities</td>
<td>Moderate</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Mine construction</td>
<td>Truck movements on off-site access road, daytime period</td>
<td>Moderate</td>
<td>Acoustic barrier adjacent to access road</td>
<td>Negligible</td>
</tr>
<tr>
<td>Shtuka</td>
<td>Operations</td>
<td>Truck movements on off-site access road during daytime and night-time period</td>
<td>Major</td>
<td>Acoustic barrier adjacent to access road</td>
<td>Negligible</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Off-site access road construction</td>
<td>Permanent off-site access road construction, daytime and evening periods</td>
<td>Moderate</td>
<td>Sensitive timing of works and screening of noisy activities</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sekirnik</td>
<td>Operations</td>
<td>Truck movements on permanent off-site access road during night-time period</td>
<td>Major</td>
<td>Acoustic barrier adjacent to access road</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

Following the specification of mitigation, moderate impacts associated with construction of the permanent off-site access road remain at Shtuka and Sekirnik. Furthermore, it is considered that construction of an acoustic barrier prior to construction of the road itself will not be feasible.

The short duration of the access road construction works will limit the scale of the noise impacts at individual receptor villages and sensitive timing of noisy works will aid in reducing annoyance. Good community relations and the selection of low-noise plant during the construction works will further assist in minimising impacts. During the programming of access road construction works, the proposed schedule will be discussed with the municipalities and local residents. Actions will then be put in place to minimise noise impacts.

Mitigation has been specified to mitigate noise impacts from use of the permanent off-site access road. An acoustic barrier will be required at Shtuka during mine construction and throughout operations and at Sekirnik throughout operations.

In consideration of the issues raised during the stakeholder engagement, this noise and vibration impact assessment has reviewed and addressed the following (refer to Section 5.5.4):

- Concern from Ilovica/Shtuka residents regarding vibration from the blasting at the mine is addressed in Sections 5.5.6.2;
- Concern from Ilovica/Shtuka residents regarding the control of noise from the mine during its lifetime is addressed in Section 5.5.6.2, 6.5 and 7.5;
Concerns that noise from the mine will drive away animals from the hills and reduce hunting opportunities will be addressed in Section 5.8 (i.e., Biodiversity & Ecology), using inputs for the effects analysis described herein;

Regarding the concern from residents of Ilovica about damage to their properties from the increased vibrations; this question is addressed in Sections 5.5.4, 5.5.6.2 and 6.5.4. In addition, Euromax are committed to completing condition surveys of the current status of all properties in Ilovica and Shtuka prior to construction; and

The question asking what kind of mitigation measures will be taken in order to reduce the noise caused by the access road traffic is addressed in Section 6.5.

The question asking what kind of noise mitigation measures related to the HGV movements on the M6 transport route in the area of Novo Selo and Novo Konjarevo will be applied is addressed in Section 6.5.3

7.6 Air Quality
All qualitatively assessed (pre-mitigation) impacts were classified as negligible or low for Air Quality. Beyond the engineering measures presented in Section 5.6.2 therefore, no further mitigation is required to manage impacts the Project which may have on air quality and consequently there are no residual air quality impacts.

7.7 Greenhouse Gas
The assessment has considered the key related emissions to calculate the greenhouse warming potential of Project activities.

It is assessed that the most significant Project related emissions are the Scope 2 emissions of purchased electricity. The Scope 1 emissions, which addresses direct emissions generated from within the Project, are a much smaller contribution (less than 5%) of the annual total. The assessment has estimated that approximately 400,054 t/yr of CO\textsubscript{2}e has the potential to be emitted annually from the Site (including scope 1 and scope 2 emissions). This is approximately 4% of the 2016 budgeted Republic of Macedonia annual emissions.

Assessed GHG emissions are estimated to be above the IFC reporting threshold in IFC Performance Standard 3 requirement of 25,000 t/yr of CO\textsubscript{2}e. Therefore the Project should commit to annual accounting or auditing using actual operational data. However reporting is not mandatory, so Euromax will keep sufficient auditable records on energy usage, fuel usage, waste generation and disposal, land clearance and blasting to allow actual emissions to be calculated annually.

7.8 Biodiversity & Ecology
Using the decision matrix presented in Annex 1, Table 7-7 presents the classification of the residual impact after the application of the additional mitigations presented above. Table 2 in Annex 5F presents the route to the classification of the residual impacts.

In some cases, outcomes may remain uncertain because the information needed to predict effects is not yet available or confidence in a mitigation strategy is low. Where this is the case, measures such as monitoring or additional local or regional surveys will be proposed to be delivered through the Biodiversity Management Plan (BMP) to reduce uncertainty, provided that risks of irreversible adverse effects can reasonably be concluded to be acceptable. Finally, it must be recognised that most positive effects from ecological restoration will only take place in the future and that the success of reclamation in providing biodiversity benefits are uncertain. Because of this both closure and post closure residual impacts are described.
A biodiversity offsetting feasibility study will take place to develop offsetting options for terrestrial and aquatic habitat to allow for achievement of NNL/NG as applicable. Features such as terrestrial habitats (forest communities), critical habitats supporting endangered species (Ogраžden Prime Butterfly Area) and aquatic habitat, specifically the Shtuka river will form the focus of this study. These features are all assessed as being afforded moderate or major impact consequences in the absence of the development and implementation of such a study. The initial options document will be prepared and shared with stakeholders for input prior to finalisation and implementation in order to mitigate risk and ensure the greatest possibility of biodiversity gain.
# Table 7-7: Assessment of Residual Impacts for impacts moderate or higher prior to additional mitigation

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Phase of the project</th>
<th>Source of impact</th>
<th>Impact consequence before mitigation</th>
<th>Mitigation</th>
<th>Residual Impact Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial habitats – forest communities (excluding the TMF)</td>
<td>Construction and operations.</td>
<td>Site clearance (including OHL) and project footprint; change in soil quality and quantity; increased air emissions and dust deposition.</td>
<td>Moderate</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Adhere to Biomaster WoS design Mitigation on OHL routing. Revegetate project footprint to forest and scrub mosaic which reflects baseline conditions. Undertake revegetation trials throughout operations. Implement invasive flora monitoring and mitigation. Mandatory environmental training for all workers and contractors. Prior to construction activities commencing, potential bat roosting locations will be surveyed using appropriate techniques.</td>
<td>Minor</td>
</tr>
<tr>
<td>Terrestrial habitats – forest communities (TMF)</td>
<td>Construction, operations, closure, post closure</td>
<td>Site clearance and project footprint; change in soil quality and quantity; increased air emissions and dust deposition.</td>
<td>Major</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Revegetate TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates. Deliver BMP and biodiversity offset feasibility study (excluding implementation) in consultation with local and regional experts. Undertake revegetation trials throughout operations. Implement invasive flora monitoring and mitigation. Mandatory environmental training for all workers and contractors. Prior to construction activities commencing, potential bat roosting locations will be surveyed using appropriate techniques.</td>
<td>Major</td>
</tr>
<tr>
<td>Critical Habitat - Habitats supporting endangered species</td>
<td>Construction, operations, closure, post closure</td>
<td>Site clearance and project footprint; change in soil quality and quantity; increased air</td>
<td>Major</td>
<td>Deliver BMP and biodiversity offset feasibility study in consultation with local and regional experts.</td>
<td>Moderate (potentially moderate positive post-closure)</td>
</tr>
<tr>
<td>Flora SoCC</td>
<td>Construction, operations, closure, post closure</td>
<td>Site clearance and project footprint; change in soil quality and quantity; increased air emissions and dust deposition.</td>
<td>Revegetate project footprint (except TMF) to forest and scrub mosaic. Revegetate TMF to pasture and scrub mosaic at closure. Avoid disturbance to high quality pasture at higher elevations. Fences to be installed to prevent traffic access. As feasible, salvage flora SoCC during site clearance, for use in progressive ecological restoration. Undertake revegetation flora trials throughout operations. Implement invasive flora monitoring and mitigation. Mandatory environmental training for all workers and contractors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terrestrial fauna SoCC (non-butterfly)</td>
<td>Construction, operations, closure, post closure</td>
<td>Site clearance and project footprint, OHL vegetation clearance, noise from traffic, blasting, and crusher; increased air emissions and dust deposition</td>
<td>Pre-clearing rapid surveys plus selective SoCC salvage and relocation. Where possible clearing will be in a direction that would push mobile species away from the Project area. Undertake progressive ecological restoration to minimise impacts to wildlife. Develop and apply species action plans for SoCC. Placement of artificial bat roosting habitat. Implement invasive fauna mitigations. Seasonal constraints applied to earth works (where practicable) and hibernacula active searches during spring, summer and autumn.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aquatic habitat and species – Upstream of Ilovica Reservoir</td>
<td>Operations, closure</td>
<td>Reduction of baseflow in Jazga leading to loss of aquatic habitat</td>
<td>Moderate</td>
<td>Undertake fish and decapod rescue prior to operations.</td>
<td>Minor</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------</td>
<td>------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Aquatic habitat and species – Shtuka River upstream of SWD</td>
<td>Construction, operations, closure, post-closure</td>
<td>Permanent diversion of the Shtuka River into the diversion channel.</td>
<td>Major</td>
<td>Undertake fish and decapod rescue prior to diversion of the Shtuka River.</td>
<td>Major</td>
</tr>
<tr>
<td>Aquatic habitat and species – Shtuka River downstream of TMF</td>
<td>Post-closure</td>
<td>Changes to water quality including mitigation described in Section 6.3</td>
<td>Moderate</td>
<td>Define design criteria for grout curtain and SCF design to ensure protection of aquatic habitats and species.</td>
<td>Minor</td>
</tr>
</tbody>
</table>

* Due to uncertainty of success, this mitigation does not affect the residual impact consequence.
In considerations of the concerns raised by Stakeholders (Section 5.7.4), the biodiversity and ecology impact assessment provides the following responses:

- Concerns over the potential for bioaccumulation of heavy metals by plants including vegetables (Open House 16 September 2015).

Air modelling (section 11) indicates no exceedances of metal deposition within arable (food production) habitat. Baseline results for bioaccumulation in plants and animals (Chapter 10 Baseline) has been undertaken to enable continued monitoring of effects during construction and operation of the Project:

- Concerns over ‘turtle’ (likely tortoise) conservation and possible Project effects to this group (Open House 16 September 2015).

Extensive mitigation, compensation strategies have been committed to ensure that residual effects to flora and fauna are minimised. Wherever possible net gain for biodiversity features will be sought as defined within 6.7 (Section 13):

- Concerns over water quality and suspended sediments even when there is no rain (Open House 16 September 2015).

Sediment report (Section 6.4) provides mitigation including SWD constructed prior to TMF stripping and construction and flocculation in SWD. In addition, all drinking water will be sourced from the Turija reservoir and piped to supply the villagers with clean water (Sections 6.2 and 6.3):

- Concerns regarding what will happen to fauna in the Project area (Open House 16 September 2015).

Extensive mitigation or compensation strategies have been committed to ensure that residual effects to flora and fauna are minimised. Wherever possible net gain for biodiversity features will be sought as defined within Section 6.8:

- Concerns regarding what is considered to be ‘acceptable’ impacts to biodiversity (Open House 16 September 2015).

The impact assessment has been undertaken in accordance with good practice adhering to principals defined by the IFC and EBRD in their respective Performance Standards and Requirements. Extensive mitigation and compensation strategies have been committed to ensure that residual effects to flora and fauna are minimised. Wherever possible net gain for biodiversity features will be sought as defined within Section 6.8:

- Concerns regarding water quality with regard to tailings and effects to air quality (Municipality of Novo Selo, 16:00hrs, 25 March 2015).

Sections 6.8 and 6.11 address these concerns:

- Will there be a tree planting program? (Municipality of Novo Selo, 16:00hrs, 25 March 2015).

Restoration proposals include the provision of approximately 200 ha of tree planting (restoration Drawing 5-25)
7.9 Ecosystem Services

A large number of ecosystem services are supplied and used in the Project Affected Area. Fundamentally, the Project will affect beneficiaries of priority ecosystem services as a result of the physical presence of the Project and associated infrastructure. Priority services that have been identified through the Ecosystem Services review and assessment are needed for the operational performance of the Project as well as for the well-being or livelihood of local people.

The presence of the Project infrastructure will cause land cover changes and associated loss of supply of ecosystem services; it will also change the physical landscape of the area associated with intangible ecosystem value to people in a spiritual and cultural context. Sites such as Shtuchki Vodopad are natural features which offer belief in fertility, spiritual fulfilment, wellbeing and also biodiversity for biodiversity's sake (Landsberg et al, 2011).

Using the decision matrix presented in Annex 1, Table 10 presents the classification of the residual major and moderate impacts after the application of the additional mitigations presented above. Table 1 in Annex 5H presents the route to the classification of the residual impacts.

Measures such as the delivery of community engagement action planning and associated to management plans including delivery of livelihood restoration assistance (LRP) within the context of the Land Acquisition and Resettlement Framework (LARF) will be proposed to be delivered successfully according to the commitments in the ESIA and the ESMS.
## Table 7-8: Assessment of Residual Impacts

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Source of impact</th>
<th>Impact consequence before additional mitigation</th>
<th>Additional Mitigation</th>
<th>Residual Impact Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Type 1</td>
<td>Impacts on quantity and quality of water supply where Project infrastructure intercepts available aquatic resources (ground and surface water features).</td>
<td>Major</td>
<td>Euromax to work with SPWMC and others to ensure a water pipeline will be constructed between Turija reservoir and Ilovica WTW, enabling the supply of water to the WTW to be switched from Ilovica reservoir to Turija reservoir. This will preserve the reliability and quality of water entering the WTW for treatment and supply to villages. Measures to reduce make up water requirements of Project activities through treatment and re-use of process water and waste water are already in place.</td>
<td>Minor</td>
</tr>
<tr>
<td>Freshwater Type 2</td>
<td>Quantity of fresh water supply to the Project may be affected by change in supply from Turija Reservoir; Security of supply affected due to other developments/projects or irrigation also abstracting water from the Turija reservoir;</td>
<td>Major</td>
<td>Euromax will decommission water intakes on both Jazga and Shtuka Rivers and work with the municipalities to ensure alternative treated supplies. Euromax to agree with SPWMC to operate abstraction from the proposed Turija pipeline to ensure a prescribed flow (to be agreed) remains in the Turija pipeline downstream of Euromax's abstraction point to maintain supply for irrigation downstream of the project. Active and or passive treatment of water discharge from the TMF following closure, plus active treatment of discharge form the pit lake once formed following closure. The project will continue to examine resource efficiencies during the life of the project to reduce make up water demand.</td>
<td>Minor</td>
</tr>
<tr>
<td>Ecosystem Service</td>
<td>Source of impact</td>
<td>Impact consequence before additional mitigation</td>
<td>Additional Mitigation</td>
<td>Residual Impact Consequence</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------</td>
<td>--------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Water quality deterioration may necessitate treatment of water being used in Project activities, increasing Project operation costs and affecting operational performance</td>
<td></td>
<td>Development of stable embankment slopes, mechanical stabilisation and installation of erosion control features, and prompt revegetation of appropriate areas.</td>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>Site clearance and project footprint (vegetation loss); Change in soil quality and quantity; and Increased exposure to natural weathering and dust mobilisation and deposition.</td>
<td>Moderate</td>
<td>Installation of physical erosion control features such as silt fences, ditches and berms, rock check dams, sediment ponds/sumps/traps, mulches, mats or netting to control erosion (prior to the establishment of a protective vegetative cover). Temporarily disturbed areas will be graded, revegetated and reclaimed so that surface water run-off from these areas will, where feasible, be similar to natural or pre-mining conditions. Roads, stockpiles and other features will be designed and constructed so that natural drainage patterns and catchments are changed as little as possible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site clearance and project footprint (Placing Project infrastructure within and intercepting streams, springs and natural drainage lines will both reduce the surface area of these land cover types, reducing their ability to regulate water flows;</td>
<td>Moderate</td>
<td>Construction of SWD. Zero surface water discharge from the site during construction and operations phases. Temporary water management and sediment control structures will be designed to control discharge to the environment through storm events with a 25-year return period. Permanent water management and sediment control structures (permanent through construction and operations phases) will be designed to control discharge to the environment through storm events with a 100-year return period.</td>
<td></td>
<td>Minor</td>
</tr>
</tbody>
</table>
### Ecosystem Service

<table>
<thead>
<tr>
<th>Source of impact</th>
<th>Impact consequence before additional mitigation</th>
<th>Additional Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in soil quality and quantity; Increase in surface water drainage facilities within the LSA.</td>
<td></td>
<td>Passive and active treatment and closure and post closure.</td>
</tr>
</tbody>
</table>

### Ethical and Spiritual Value

| Site clearance and project footprint permanently affecting sites, including the Shtuchki Vodopad waterfall. | Moderate | Relocation of receptors and photographic logging and preservation of sites. It is proposed that a photographic record is created for Shtuchki Vodopad and its surroundings prior to its loss. The cultural value of this site is derived in part from the plant gathered there around Easter by the local community which is widely available elsewhere in the landscape. The CHMP will provide a method for identifying alternative accessible locations for this plant and methods of enhancing access to ensure it can be collected, thereby reducing the impact consequence. Although it will not prevent the loss of this receptor as a locally significant point of interest, preservation through photographic recording is considered a meaningful and appropriate mitigation for its loss. | Minor |

<table>
<thead>
<tr>
<th>Residual Impact Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
</tr>
</tbody>
</table>
The following provides a response to each of the stakeholder issues raised in section 5.9.3:

- In response to concerns over the potential for bioaccumulation of heavy metals by plants including vegetables (Open House 16 September 2015).

Air modelling (section 5.6) indicates no exceedances of metal deposition within arable (food production) habitat. Baseline sampling for bioaccumulation in plants and animals (Chapter 10 Baseline) has been undertaken to enable continued monitoring of effects during construction and operation of the Project:

- In response to concerns over water quality and suspended sediments even when there is no rain (Open House 16 September 2015).

Sediment report (section 5.4) provides mitigation including SWD constructed prior to TMF stripping and construction and flocculation in SWD. In addition, all drinking water will be sourced from the Turija reservoir and piped to supply the villagers with clean water (Sections 5.2 and 5.3):

- In response to concerns regarding what will happen to fauna in the Project area (Open House 16 September 2015).

Extensive mitigation and compensation strategies have been committed to ensure that residual effects to flora and fauna are minimised. Wherever possible net gain for biodiversity features will be sought as defined within section 6.8):

- In response to concerns regarding water quality with regard to tailings and effects to air quality (Municipality of Novo Selo, 16:00hrs, 25 March 2015).

Sections 5.3 and 5.6 address these concerns:

- In response to concerns about tree planting program? (Municipality of Novo Selo, 16:00hrs, 25 March 2015).

Restoration proposals include the ongoing management of forest within the concession but not within the project footprint, and provision of approximately 200 ha of tree planting (restoration Drawing 5-25):

- In response to concerns that the Project may contaminate groundwater and produce.

Section 5.3 - Water Quality:

- In response to concerns that the tailings dam will influence water used for agriculture and livestock.

Section 5.3 - Water Quality:

- In response to concerns that livestock grazing may be disturbed by mining facilities and loss of access to concession.

There will be a reduction in the available grazing for Villagers. This will be addressed and compensation/alternative grazing will be sought through the Project livelihood restoration plan (LRP) and via community engagement action planning:

- In response to concerns that the Project will cause vibrations and changes in air quality affecting beekeeping.

Some hives will need to be moved. Alternative sites/compensation for apiculture will be sought through the Project LRP and via community engagement action planning. Air quality will not alter floral composition outside of the Project footprint which would have the potential to affect honey production (section 5.12):

- In response to concerns that the mine may inhibit access to hunting and affect wildlife populations.

There will be a reduction in available habitat for hunting:

- Medium and large mammals are likely to become displaced by the Project during construction and operation.
In response to concerns that fuel wood removed during construction should go to residents of Ilovica and Shtuka. EOX is committed to making timber felled from the site available to the local communities of Ilovica and Shtuka. Progressive clearing and the seasoning and storage of harvested timber should mean that there is no demand for 'new' timber from these communities for at least 5 years, probably longer:

- In response to concerns that tree removal will affect the air quality in the area adversely.

Tree loss to the Project will account for just 7.5% of the total available forest within the LSA and only 0.8% at the RSA scale (Section 5.12). Any losses will be offset by the planting of approximately 200 ha of forest within the LSA:

- In response to concerns that there will be changes in drinking water quality due to mining activity.

Sections 5.2 and 5.3 describe how clean water will be sourced and maintained for users benefit:

- In response to concerns that the Project will change the availability of drinking water, particularly in the Ilovica Reservoir.

Sections 5.2 and 5.3 describe how clean water will be sourced and maintained for users benefit:

- In response to concerns about the Project’s effect on water quality in communities.

Sections 5.2 and 5.3 describe how clean water will be sourced and maintained for users benefit.

### 7.10 Cultural Heritage

Using the decision matrices presented in Annex 1, Table 7-9 presents the classification of the residual impact. Table 2 in Annex 5I presents the route to the classification of the residual impacts.
### Table 7-9: Assessment of residual impacts for cultural heritage

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Project phase</th>
<th>Impact</th>
<th>Impact consequence before mitigation</th>
<th>Mitigation</th>
<th>Residual impact consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preslop Spring Memorial Stone (SP-01)</td>
<td>Construction</td>
<td>Ground disturbance - construction of plant site</td>
<td>Moderate</td>
<td>Relocation of receptor</td>
<td>Minor</td>
</tr>
<tr>
<td>Shtuchki Vodopad (NF-01)</td>
<td>Construction</td>
<td>Ground disturbance - construction of TMF</td>
<td>Moderate</td>
<td>Photographic recording and enhanced access</td>
<td>Minor</td>
</tr>
<tr>
<td>Religious beliefs and practices</td>
<td>Construction</td>
<td>Noise – construction</td>
<td>Moderate</td>
<td>Sympathetic construction schedule</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Construction and Operations</td>
<td>Noise – blasting</td>
<td>Major</td>
<td>Sympathetic blasting regime</td>
<td>Minor</td>
</tr>
<tr>
<td>Adit/Tunnel Site (AR-03)</td>
<td>Construction</td>
<td>Ground disturbance – construction of mine workshop area</td>
<td>Moderate</td>
<td>Photographic recording</td>
<td>Minor</td>
</tr>
<tr>
<td>Domus Gaber (AR-05)</td>
<td>Construction and Operations</td>
<td>Ground disturbance – construction of TMF</td>
<td>Moderate</td>
<td>Archaeological watching brief</td>
<td>Minor</td>
</tr>
<tr>
<td>Anovi (AR-06)</td>
<td>Construction and Operations</td>
<td>Ground disturbance – construction and ore extraction in open pit area (creation of mine pit)</td>
<td>Major</td>
<td>Archaeological evaluation and excavation</td>
<td>Moderate</td>
</tr>
<tr>
<td>Preslop (AR-07)</td>
<td>Construction</td>
<td>Ground disturbance - construction of upper plant site and TMF</td>
<td>Major</td>
<td>Archaeological evaluation and excavation</td>
<td>Moderate</td>
</tr>
<tr>
<td>Kravivchevo and Golemata Niva (AR-08)</td>
<td>Construction</td>
<td>Ground disturbance - construction of upper plant site</td>
<td>Major</td>
<td>Archaeological evaluation and excavation</td>
<td>Moderate</td>
</tr>
<tr>
<td>Gradishte (AR-10)</td>
<td>Construction and Operations</td>
<td>Ground disturbance – construction of TMF</td>
<td>Major</td>
<td>Archaeological evaluation and excavation</td>
<td>Moderate</td>
</tr>
<tr>
<td>Old Mill (AR-11)</td>
<td>Construction and Operations</td>
<td>Ground disturbance - construction of TMF</td>
<td>Moderate</td>
<td>Sympathetic blasting regime and visual inspection and vibration monitoring</td>
<td>Negligible</td>
</tr>
<tr>
<td>Crkvistite (AR-04)</td>
<td>Construction and Operations</td>
<td>Ground vibrations - blasting</td>
<td>Moderate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In consideration of the issue raised during the stakeholder engagement, this cultural heritage assessment concludes that:

- Regarding the concern raised about potential flooding at the archaeological site of Crkvishte: This issue is not assessed within this Impact Assessment, however the elevation of Crkvishte is 566 mASL and the bed of the adjacent river Jazga is 495 mASL, therefore flood risk from the watercourse at this location is highly improbable.

### 7.11 Landscape and Visual

In terms of visual effects, the objective of the cumulative assessment is to identify receptors or viewpoints from which the Ilovica mine and other major developments (particularly other mine projects) would be visible, in order to identify receptors that may experience cumulative effects (landscape impacts are unlikely to be an issue).

No large infrastructure projects are planned for the next three to five years. However, the following small-scale projects are proposed and may be visible in conjunction with the Ilovica Project:

- Construction of a road from Koleshino to Koleshino waterfalls;
- Construction of a road from Radovo to Ilovica;
- Upgrading of the road from Turnovo to Ilovica and Shtuka;
- Construction of a road from Ilovica to Drvosh;
- Construction of a road from Borievo to Koleshino; and
- Technological industrial development zone near the village of Bosilovo.

Due to the relatively small scale and duration of these projects, it is unlikely that the cumulative visual impact would be significant. There are currently no other large scale operational mines within the 25 km landscape and visual study area and no other large mineral extractions are currently within the planning system awaiting determination.

The Buchim Mine is a large open pit copper, gold and silver mine located near Radovish, approximately 45 km west-northwest of Ilovica. Buchim produces 4 million tonnes of ore per year. ZTV analysis indicates that there would be no inter-visibility between the two mines.

There a number of small-scale mineral extraction sites within the Strumica Valley, including a feldspar mine located on the lower slopes of the Ograzden Mountain (which currently produces around 10,000 tonnes per annum, with no plans for expansion).

Overall, no significant cumulative landscape or visual effects are predicted.

### 7.12 Socioeconomics

Using the decision matrices presented in Annex 1, Table 7-10 presents the classification of residual socio-economic impacts in consideration of the mitigation identified in Section 6.12. Table 2 in Annex 5K presents the route to the classification of the residual impacts.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Effect</th>
<th>Project phase</th>
<th>Pre-mitigation impact classification</th>
<th>Mitigation or benefit enhancement measure</th>
<th>Residual impact classification</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>The Project will contribute to the GDP of the Republic of Macedonia</td>
<td>Construction, operation</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute to the importance of the national mining industry in international trade</td>
<td>Operation</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute annual revenue to the national government</td>
<td>Construction, operation</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute annual revenue to the municipal governments of Bosilovo and Novo Selo</td>
<td>Operation</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will contribute to local business development and economic growth</td>
<td>Construction, operation</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will result in an induced effect on economic activity as employees spend their incomes locally</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>None practical</td>
<td>Moderate</td>
<td>Positive</td>
</tr>
<tr>
<td>Employment</td>
<td>The Project will create new direct employment outside the local area in construction and mining</td>
<td>Construction, operation</td>
<td>Low</td>
<td>None required</td>
<td>Low</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will create new direct local employment opportunities in construction and mining</td>
<td>Construction, operation</td>
<td>High</td>
<td>Please refer to the mitigation identified in Section 6.12.2</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will indirectly result in employment outside the local area in industries servicing the mining industry</td>
<td>Construction, operation</td>
<td>Low</td>
<td>None required</td>
<td>Low</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will indirectly result in employment at the local level in industries servicing the mining industry</td>
<td>Construction, operation</td>
<td>High</td>
<td>Please refer to the mitigation identified in Section 6.12.2</td>
<td>High</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will induce employment as direct and indirect workers spend their incomes outside the local area</td>
<td>Construction, operation</td>
<td>Low</td>
<td>None practical</td>
<td>Low</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>The Project will induce employment as direct and indirect workers spend their incomes locally</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>None practical</td>
<td>Moderate</td>
<td>Positive</td>
</tr>
<tr>
<td>Incomes</td>
<td>Project employment will generate incomes outside the local area that are high in comparison to average annual incomes</td>
<td>Construction, operation</td>
<td>Low</td>
<td>None required</td>
<td>Low</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Project employment will generate incomes in the local area that are high in comparison to average annual incomes</td>
<td>Construction, operation</td>
<td>High</td>
<td>Please refer to the mitigation identified in Section 6.12.2</td>
<td>High</td>
<td>Positive</td>
</tr>
</tbody>
</table>
## ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Topic</th>
<th>Effect</th>
<th>Project phase</th>
<th>Pre-mitigation impact classification</th>
<th>Mitigation or benefit enhancement measure</th>
<th>Residual impact classification</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project-related indirect employment will generate incomes outside the local area in line with industry standards</td>
<td>Construction, operation</td>
<td>Low</td>
<td>• None practical</td>
<td>Low</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project-related indirect local employment will generate incomes in line with industry standards</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>• None practical</td>
<td>Moderate</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project-related induced employment outside the local area will generate incomes in line with industry standards</td>
<td>Construction, operation</td>
<td>Low</td>
<td>• None practical</td>
<td>Low</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project-related induced local employment will generate incomes in line with industry standards</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>• None practical</td>
<td>Moderate</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>The Project will result in in-migration to Strumica and an incremental increase in population in 2019</td>
<td>Operation</td>
<td>Negligible</td>
<td>• None practical</td>
<td>Negligible</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project on-site medical clinic will provide services to workers, removing some pressure on existing healthcare services</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>• Assist in improving the Ilovica clinic</td>
<td>Moderate</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project community investment can support community development initiatives</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>• Please refer to the benefit enhancements identified in Section 6.12.5</td>
<td>High</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project incomes can enhance access to housing, education, consumer goods and services, and savings</td>
<td>Construction, operation</td>
<td>High</td>
<td>• None required</td>
<td>High</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Project noise will exceed baseline and guideline values in some communities</td>
<td>Construction</td>
<td>Moderate</td>
<td>• None practical</td>
<td>Moderate</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>Project components will alter the visual character of forest and agricultural plains</td>
<td>All phases</td>
<td>Moderate to high</td>
<td>• None practical</td>
<td>Moderate to High</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>Perception of harm may change day-to-day life for those concerned about water, soil and air pollution</td>
<td>Construction, operation</td>
<td>High</td>
<td>• Public education of environmental effects</td>
<td>Low</td>
<td>Negative</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Topic</th>
<th>Effect</th>
<th>Project phase</th>
<th>Pre-mitigation impact classification</th>
<th>Mitigation or benefit enhancement measure</th>
<th>Residual impact Classification</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical infrastructure</td>
<td>Project construction of the OHL will add to existing regional utility infrastructure</td>
<td>Operation, Post-Closure</td>
<td>Moderate</td>
<td>None required</td>
<td>Moderate</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Project support for replacement of the water reticulation system in Ilovica and Shtuka will improve water distribution infrastructure</td>
<td>All phases</td>
<td>Moderate</td>
<td>None required</td>
<td>Moderate</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Project support for replacement of the water reticulation system in Ilovica and Shtuka will improve access to treated water</td>
<td>All phases</td>
<td>Moderate</td>
<td>None required</td>
<td>Moderate</td>
<td>Positive</td>
</tr>
<tr>
<td>Land use</td>
<td>Project land acquisition will remove arable land suitable for agricultural production and under cultivation</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>Compensation via LRP</td>
<td>Negligible</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Project land acquisition will remove grazing land</td>
<td>Construction, operation</td>
<td>High</td>
<td>Compensation via LRP</td>
<td>Negligible</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Project land acquisition will temporarily remove productive forestry land</td>
<td>Construction, operation</td>
<td>Moderate</td>
<td>Payment of compensation Reclamation</td>
<td>Low</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>The Project will result in the permanent loss of productive forestry land-base over the reclaimed TMF</td>
<td>All phases, post-closure</td>
<td>High</td>
<td>None practical</td>
<td>High</td>
<td>Negative</td>
</tr>
</tbody>
</table>
In response to the stakeholder concerns presented in Section 5.12.4; the following provides a guide to how the concerns have been addressed in this section of the ESIA.

Comments Related to the Economy

- Concern that there will be a detrimental effect on the sale of agricultural products as a result of potential buyers’ perception that produce has been contaminated by the mine (Sections 5.12.6.2.5; 5.12.6.2.7; 6.12.5; and 6.12.7);

- Desire to have the mine procure goods and services locally where possible, with emphasis on agricultural produce and food products (Sections 5.12.6.1 and 6.12.1);

- Local employment should be maximised, and should be spread out throughout the community (Sections 5.12.6.2.2 and 6.12.2);

- Job postings should be accessible to local people and be posted in a timely manner (Section 6.12.2);

- Concern that local employment will not be high quality, instead focused on manual labour (Sections 5.12.6.2.2 and 6.12.2);

- There should be an employment policy that targets women with families (Sections 6.12.2);

- Desire to have training and scholarships to help maximise employment (Section 6.12.2); and

- Desire to have community contributions that improve culture, arts and education (Section 6.12.5).

Comments Related to Human Health and Quality of Life

- Concern that blasting, truck movement and dust deposition will affect human health (Sections 5.12.6.2.4; 5.12.6.2.5; 5.12.6.2.6; and 6.12.7);

- Concern about greenhouse gas emissions from trucks idling at the Bulgarian border (Section 5.6);

- Concern that tree removal will affect the air quality in the area adversely (Section 5.6);

- Concern that there will be changes in drinking water quality due to mining activity (Sections 5.12.6.2.4; 5.12.6.2.6; and 6.12.6);

- Concern that the Project will change the availability of drinking water, particularly in the Ilovica Reservoir (Sections 5.12.6.2.4; 5.12.6.2.6; and 6.12.6);

- Concern about the Project’s effect on water quality in communities (Sections 5.12.6.2.4; 5.12.6.2.6; and 6.12.6);

- Concern over increased risk of cancer due to exposure to chemicals or dust (Sections 5.12.6.2.4 and 5.12.6.2.7);

- Concern that vibrations as a result of blasting may be felt in communities (Section 5.12.6.2.5);

- Concern that blasting, mining activities, and Project traffic will create noise disturbance (Section 5.12.6.2.5); and

- Request for support to reconstruct the health clinic in Ilovica (Section 6.12.5).

Comments Related to Physical Infrastructure

- Statement that local irrigation water is currently taken from the Turija Canal and the Ilovica Reservoir and concern that supply could be affected by the Project (Sections 5.12.6.2.6 and 6.12.7);
Statement that a new water supply and sewage system needs to be constructed (Sections 5.12.6.2.6 and 6.12.7);  
Concern that the Project will affect water supply, sewage and electricity (Sections 5.12.6.2.6; and 6.12.6);  
Concern that the Project will influence the water supply network, increasing costs for people (Sections 5.12.6.2.6 and 6.12.7);  
Concern that vibrations from Project traffic and blasting may structurally damage nearby houses (Section 5.12.6.2.5);  
Questions have been raised about where workers will be housed (Sections 5.12.2; 5.12.6.2.3; 5.12.6.2.5);  
Concern that existing roads are too narrow for mine traffic (Sections 4; 5.12.2; 5.12.6.2.6 and 5.12.6.2.7); and  
Concern that the Project will worsen traffic congestion at the Novo Konjarevo Bridge (Sections 4 and 5.12.2).

Comments Related to Land Use

Concern that the Project may contaminate groundwater and produce (Sections 5.12.6.2.7 and 6.12.7);  
Concern that the tailings dam will influence water used for agriculture and livestock (Sections 5.12.6.2.6 and 6.12.6);  
Concern that livestock grazing may be disturbed by mining facilities and loss of access to concession (Sections 5.12.6.2.7 and 6.12.7);  
Concern that the Project will cause vibrations and changes in air quality affecting beekkeeping (Sections 5.12.6.2.5; 5.12.6.2.7; and 6.12.7);  
Concern that the mine inhibit access to hunting and affect wildlife populations (Sections 5.12.6.2.7 and 6.12.7);  
Concern that fuel wood removed during construction should go to residents of Ilovica and Shhtuka (Sections 5.12.6.2.7 and 6.12.7); and  
Concern that compensation be paid for timber cut on private land (Sections 5.12.6.2.7 and 6.12.7).

7.12.1 Summary of Residual Socio-economic Impacts

The Project is expected to have substantial economic benefits to the republic of Macedonia, representing a major contributor to national economic activity and government revenues. It will also benefit the local economy through procurement of goods and services, payment of municipal royalties, employment, and associated incomes. The Project is not expected to result in large population or demographic change in local communities, or the associated changes in demand for and pressure on public infrastructure and community services. Project-related impacts on community health, safety and security, and on the quality of life for residents of nearby communities (primarily in Ilovica, Shhtuka, and Strumica), have the potential to be both positive (e.g. community development, increased incomes, medical services on site) and negative (e.g. noise along roads, changes to the visual environment, increased traffic). Positive effects will be supported by benefit enhancement measures, while negative effects will be minimised to the greatest extent possible through mitigation. The Project’s effects on land use are in part associated with land acquisition requirements for infrastructure and roads and will be mitigated through the implementation of a Land Acquisition and Resettlement Framework and a Livelihood Restoration Plan.
8.0 CUMULATIVE IMPACTS

8.1 Introduction

Cumulative impacts for the Ilovica-Shtuka Project are those that result from the effects of the development when added to effects of other existing, planned, and/or reasonably predictable future projects, plus taking into account any concerns raised by the local community during ESIA consultation. The EBRD Environmental and Social Policy provides guidance on this definition of cumulative impacts:

“…the assessment process will consider cumulative impacts of the project in combination with impacts from other relevant past, present and reasonably foreseeable developments as well as unplanned but predictable activities enabled by the project that may occur later or at a different location” (Performance Requirement 1, Paragraph 9; EBRD, 2014).

In the absence of specific EBRD guidelines on cumulative impact analysis, IFC guidance (2013) has been used to frame the assessment of cumulative impacts. Cumulative impacts have been assessed to consider both the interaction of potential Project effects and potential impacts associated with developments that are existing or planned to occur within the lifetime of the Project.

The assessment of cumulative impacts has incorporated the following steps:

- Defining spatial and temporal boundaries;
- Identifying groups of receptors\(^\text{48}\) which include environmental and social attributes that may be important to assessing risks);
- Identifying the potential Project-generated (residual) effects that may combine to act incrementally (i.e. as ‘combined effects’) upon receptor(s);
- Identify how new activities and developments may generate impacts that could act cumulatively, together with potential project combined effects; and
- As necessary, outlining management strategies to address any potential cumulative impacts.

As the Ilovica-Shtuka Project is located on a greenfield site in an agricultural and forested setting, there are no historical industrial projects or activities which might interact with the Project to result in cumulative impacts. This study considers existing, planned and proposed developments and projects in the Municipalities of Bosilovo, Novo Selo and Strumica and identifies their potential to contribute to cumulative environmental and social impacts.

Existing impacts on the biophysical and social environment from small-scale agriculture which occurs throughout the area affected by the access road and power lines, and the licenced and unlicensed forestry management which occurs within the direct footprint on the mine infrastructure, have been characterised as part of the ESIA baseline. These small scale activities and the way they interact with the existing environment are not considered under cumulative impact assessment.

8.2 Spatial and Temporal Boundaries

The study of cumulative impacts includes the regional study area as defined in Section 1.4.5 (Introduction), which includes the local study area, Project footprint and the concession area.

The RSA provides a regional context for the environmental conditions within the LSA. While the majority of potential cumulative effects would be felt greatest locally, some effects (e.g. socio-economic) may extend beyond the LSA. This is particularly true of positive economic and employment effects. Where appropriate therefore, the Republic of Macedonia has been considered as an appropriate study area for the analysis of cumulative impacts.

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\(^{48}\) Termed “Value Added Components” (VECs) by the IFC (IFC 2013). The term “groups of receptors” is used throughout this Chapter, in place of VECs, in order to maintain consistency throughout the ESIA.
The four Project phases as defined in the Project Description (Section 4.0) are the temporal boundaries of the Project. This includes the Project lifetime and beyond into the ‘post-closure’ phase:

- **Construction**: a two year period during which mine facilities are constructed and the pit area is stripped in preparation for mining;
- **Operations**: a 20 year period of open pit mining, processing of the ore, production and export of copper concentrate and gold doré, and deposition of the tailings;
- **Closure**: a two year period during which mining infrastructure is decommissioned and removed (where possible) and land is rehabilitated and revegetated; and
- **Post-closure**: the period after closure of the mine. Considered where effects of the Project extend beyond the closure period (e.g. management of discharges, formation of pit lake post closure).

### 8.3 Identification of receptors

The receptors identified in the ESIA remain relevant to the cumulative assessment. Receptors are identified within each technical chapter in Section 5 of the ESIA. They may be physical, biological or social (e.g. villages, dwellings, areas of cultural importance, watercourses, land use) depending on the technical area. However, receptors defined by each technical study were identified prior to completing effects analysis or impact analysis and shared across technical studies, so that common receptors could be identified and results of effects analysis could be shared between technical disciplines.

### 8.4 Combined Effects

The ESIA is an integrated process that has considered not only the effects of the Project directly on individual or groups of physical, biological or social receptors, but also the combined direct and indirect effects from numerous sources of effects on each receptor.

Combined effects were characterised by passing residual impact analysis results (including mitigation) from upstream technical disciplines (e.g. air quality, noise, water, visual and soil), to inform combined effects analysis and impact assessment of downstream disciplines (e.g. biodiversity, cultural and socio-economics). This means that mitigation is not considered more than once and the assessment of impacts considers indirect, direct and combined effects.

For example:

- Residual results from air quality (dust deposition) has been used in the soils effects analysis and impact assessment;
- Residual results from air quality (dust deposition), noise and soils have been used in the terrestrial ecology effects analysis and impact assessment;
- Residual results from water and sediment have been used in the aquatic ecology effects analysis and impact assessment;
- Residual results from land use, visual, noise, air quality have been used in the cultural heritage effects analysis and impact assessment; and
- Residual results from water, ecology, visual, noise, air quality and soils have been used in the socio economic effects analysis and impact assessment.

### 8.5 Existing Activities in the Region

A desktop review was completed of publicly available data for the Macedonia EIA in August 2015 and direct interviews with officials from the relevant national, regional and local institutions. This included information from the following institutions:

- Ministry of Transportation and Communications (MTC);
- Public Enterprise for State Roads (PESR);
- Ministry of Economy (MOE);
- Energy Agency of Republic of Macedonia (EARM);
- Ministry of Environment and Physical Planning (MOEPP);
- General Secretariat of the Government of Republic of Macedonia;
- Interviews with officials from the Municipalities of Bosilovo and Novo Selo; and
- Centre for Development of South East Region (Strumica).

Analysis has been updated with local intelligence in February 2017. Based on the available information the following analysis covers all developments which could be considered ‘reasonably foreseeable’.

The following sections provide details of existing developments and Section 8.6 presents new or proposed developments, which could contribute to cumulative effects. Table 8-1 presents a summary of all existing and proposed developments.

8.5.1 Ograzhden Feldspar Mine

Ograzhden Feldspar Mine is located on the slope of Ograzhden Mountain. It is a small mine, with a design capacity of 30,000 tonnes. Currently, the mine operates with minimum capacity (on an as needed basis) and there are no plans for capacity expansions. The majority of production is exported to Bulgaria, Serbia and Greece, with smaller volumes exported to other European markets (such as Slovenia and Romania).

8.5.2 Dalvina Winery

Dalvina Winery was established in 2007 and produces bulk wine and bottled wine. Dalvina distributes the products to domestic and international markets (such as Germany, Croatia and Serbia). Dalvina employs 40 people working in one or two shifts, depending on the season. The vineyards and winery are located near Hamzali in the Strumica-Radovish wine region, approximately 4 km northwest of Ilovica. Designed capacity is around 4.2 million litres per year and includes red wine (900,000 litres), white wine (250,000 litres) and rosé wine (120,000 litres), with plans to increase production capacity to 9 million litres.

8.5.3 Zdravje Radovo Dairy

The dairy is owned by a leading Macedonian producer of dairy products with headquarters in Skopje. Established in 2002 and with a staff of 360 employees across four sites, products are exported to Serbia, Montenegro, Bosnia and Herzegovina, Kosovo and Albania (http://en.mlekarazdravje.com.mk/).

The Radovo dairy is sited approximately 7 km southwest of the concession, covering an area of 0.15 ha and employing 42 people. Milk is collected from across the Strumica region, including the municipalities of Strumica, Bosilovo, Novo Selo and Vasilevo. The site was expanded, through EBRD investment, in 2009 (http://www.ebrd.com/news/2009/ebrd-supports-leading-cheese-producer-in-fyr-macedonia.html).

8.6 New or Proposed Developments in the Region

8.6.1 Planned Construction of National Gas Distribution Pipeline

A national gas distribution pipeline is under construction in Macedonia, with the aim of distributing natural gas for industrial and commercial purposes. Future expansion of this network could make natural gas available for household and heating purposes. Based upon data from MTC, the national gas distribution pipeline will be routed from Shtip to Hamzali (Section 3 – see Figure 8-1 and Figure 8-2) and then will continue on to Stojakovo near the Greek border (Section 4 – see Figure 8-3).
Figure 8-1: Construction of Macedonian national gas distribution pipeline – Section 3

Figure 8-2: Macedonian national gas distribution pipeline – Section 3 (Shtip to Hamzali)

Figure 8-3: Macedonian national gas distribution pipeline – Section 4 (Hamzali to Stojakovo)
8.6.2 **Industrial and Technological Development Zones**

A 25 hectare technological industrial development east of Strumica, (the Strumica Free Zone) is set aside for the development of export-oriented, high-tech clean industry production (http://www.dtirz.com/about-us/zones-at-a-glance/).

The following industrial development zones have also been established in the region to provide locations for the development of future industrial activities if needed:

- 5 hectare technological industrial development zone located near the village of Bosilovo;
- 30 hectare technological industrial development zone between the villages of Novo Selo and Samuilovo (along the regional highway M6); and
- Technological industrial development zone with winery, cold storage, and ethno-restaurant near the village of Hamzali.

These development zones are dedicated for light and non-polluting industry and food processing/packing. The zoning of these areas enables industrial development to occur within these areas, but no activities are planned at this stage. No EIAs have been undertaken for these development zones at this time. EIA procedure would apply to any proposed development within these zones by future investors.

8.6.3 **Road Construction and Reconstruction Projects**

Plans for road construction/reconstruction at the national and regional level are detailed and executed through PESR. Detailed medium term (5 year) plans are publicly available. Based upon review of these plans, there are proposals for the construction of new local roads and a proposed reconstruction project (renewal of asphalt surface). These include:

- Reconstruction of the local road from Turnovo to Ilovica and Shtuka (status: proposed);
- Construction of new local road from Borievo to Koleshino (7.5 km with a bridge over the River Vodochinica) (status: permitted/in construction);
- Construction of new local road from Koleshino to Koleshino waterfalls (status: included in development plan);
- Construction of new local road from Radovo to Ilovica (5 km) (status: proposed);
- Construction of new local road from Ilovica to Drvosh (4.5 km) (status: proposed);
- Construction of new local road from Bosilovo to Radovo (3 km) (status: currently under construction); and
- Repairs to the worst sections of the Strumica – Novo Selo – Bulgarian road (M6) (status: proposed)\(^49\).

8.6.4 **Water Supply, Irrigation and Sewer System Projects**

Regional and local authorities from the program for government-funded projects published by the General Secretariat of the Government of Republic of Macedonia were consulted on potential water supply, irrigation and sewer projects. Many planned projects are small, local systems and will not trigger EIA, therefore no data are available.

Komunalec Strumica Public Utilities Enterprise is however building a wastewater treatment plant to the west of Strumica, scheduled for completion in 2017. The plant is designed to treat 10,000-15,000 m\(^3\)/day (3.6 - 5.4 Mm\(^3\)/year) of sewage. Treated effluent from the sewage works will discharge into the River Trkajna, a tributary of the water course that flows into the Monospitovo wetland. An EIA was prepared and approved for the project.

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\(^49\) Information from Public Enterprise for State Roads, March 2017
One project with potential overlap with the Ilovica Project is the reconstruction of the drinking and irrigation water supply system in Ilovica and Shtuka. This is a project which was commenced in 2016 with the installation of some pipework and which will be completed by the Municipality of Bosilovo and Strumichko Pole Water Management Company with full financial assistance from Euromax. The goal of the project is to reconstruct the thirty year old water supply system by replacing the existing pipes which are in poor condition, in specific sectors of the villages, with new polyethylene pipes and extend the irrigation water supply network to the areas in Ilovica and Shtuka in need of irrigation.

Other water and sewer projects which are under discussion include the construction of a water supply system in Sushica (status: planning application in development) and the reconstruction of the sewer system in Novo Selo (status: permitted, due for construction in 2016).

### 8.6.5 Overhead Line (OHL) between Ilovica and Berovo

The proposed OHL will comprise two 110 kV overhead line (OHL) power connections: one will connect to an existing sub-station in Sushica, approximately 7 km south of the Ilovica Shtuka site; the second will run from Ilovica to Berovo, 30 km north of the mine site. The route passes through private land parcels that consist of orchards, abandoned meadows and pastures. Construction of the Ilovica-Berovo OHL requires a specialized workforce. Local employment will involve a small number of positions likely for land clearing and will be short term, during construction.

This development is associated with the Ilovica-Shtuka Project and has been assessed on a high level in the ESIA, it will however require separate permitting, with the Ilovica – Berovo line requiring a full EIA and the Ilovica – Sushica line subject to an environmental elaborate, both may be subject to an Addendum to this ESIA.

### 8.7 Summary of Existing, Planned and Proposed Activities

**Table 8-11: Summary of Existing and Proposed Activities**

<table>
<thead>
<tr>
<th>Name of Project/Activity</th>
<th>Status</th>
<th>Description</th>
<th>Potential Impacts Considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ograzhden Feldspar Mine</td>
<td>Operating</td>
<td>Located on the slope of Ograzhden Mountain. A small mine, with a designed capacity of 30,000 tonnes. Operates with minimum capacity (on an as needed basis) and there are no plans for capacity expansions. Given the mine’s low level of production and distance from the Project, no cumulative impacts are anticipated.</td>
<td></td>
</tr>
<tr>
<td>Dalvina Winery</td>
<td>Operating</td>
<td>Producing 4.2 million litres of bulk and bottled wine per year. Exporting, with plans for expansion. Approx.3.5 km north west of Ilovica. The current operation is small scale, with a relatively low rate of production. Local impacts are considered low (and seasonal) with no cumulative impacts anticipated.</td>
<td></td>
</tr>
<tr>
<td>Zdravje Radovo Dairy</td>
<td>Operating</td>
<td>Factory site at Radovo, approximately 7 km southwest of the Project concession area. Large scale operation, with potential cumulative impacts related to production. From for example, the processing and discharge of waste water products, and air emissions/noise impacts from vehicular transport on local roads (discussed in Section 8.9)</td>
<td></td>
</tr>
<tr>
<td>National gas distribution pipeline is under construction in Macedonia</td>
<td>Proposed</td>
<td>To distribute gas for commercial and industrial purposes with potential for further expansion for household supply. Routed from Shtip to Hamzali. The EIA study scoping report indicates that only local impacts are expected during the construction phase and minimal or no impacts during the operational lifetime of the pipeline. Considering the small footprint of the project, the localised nature of</td>
<td></td>
</tr>
</tbody>
</table>

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### Potential Impacts Considered

- **Ilovica-Berovo OHL**
  - The proposed OHL will comprise two 110kV overhead line (OHL) power connections: one will connect to an existing sub-station in Sushica, approximately 7 km south of the Ilovica Shtuka site; the second will run from Ilovica to Berovo, 30 km north of the mine site.
  - Potential impacts from the OHL, relevant to the study of cumulative effects includes residual noise from trucks during construction of the OHL Ilovica–Berovo and Sushica area and temporary land loss. It is anticipated that land uses are broadly compatible with the OHL’s and will not be disrupted permanently by the presence of the lines, instead only experiencing temporary construction effects.
  - Permitting for the Ilovica – Berovo section of the OHL is subject to a Macedonian EIA while an Environmental Elaborate will be prepared for the Ilovica – Sushica line.

### 8.8 Assessment of Potential for Cumulative Impacts – Existing, Planned and Proposed Developments

As described in Table 8-11, limited cumulative impacts are expected to occur as a result of interaction between the Project and existing developments with the region.

Based upon the information available, there is potential for cumulative impacts to occur between the Ilovica Project and the following partially implemented, planned and proposed developments:

- 5 hectare technological industrial development zone located near the village of Bosilovo;
- The Strumica Free Zone technological industrial area;
- Reconstruction of the local road from Turnovo to Ilovica and Shtuka;
- Construction of new local road from Radovo to Ilovica (5 km);
- Construction of new local road from Ilovica to Drvosh (4.5 km);
- Repairs to Strumica – Novo Selo – Bulgarian road (M6) road;
- Reconstruction of the water supply system in Ilovica and Shtuka; and
Development of wastewater treatment plant west of Strumica.

Although the current status of these projects is “proposed”, rather than in development or permitted for development, they are ‘reasonably foreseeable’ and as such are included for further analysis in this cumulative impact assessment.

A potential adverse impact would be the cumulative addition of heavy vehicles on the M6 regional highway, with effects including air emissions (Section 8.10.3), noise disturbance (Section 8.10.2), and increased public safety hazard on the highway which runs through a number of villages.

8.8.1 External Stressors

The potential incremental effects of urbanisation and climate change have also been considered in this assessment of cumulative effects (i.e. in addition to Project driven effects). Project-related in-migration is discussed in detail within the Socio-Economic section, 5.12.6. Estimates suggest an increase of 354 people, accounting for the fact that the majority of workforce will be sourced from the local area. Furthermore, the population moving into the LSA will be employed in high quality jobs, with in-migration considered broadly positive with the Project expected to have an overall neutral, perceptible effect on, for example, medical services (Section 5.12.6). The Project’s effect of slowing out-migration through the provision of employment opportunities is expected to have a negligible impact on population (Section 5.12.6). Considering the proposed projects in the region listed above (Table 8-11), their scale, and their potential to draw workers, the cumulative effect is anticipated to remain neutral.

Future climate change, specifically changes to annual precipitation and temperatures have the potential to affect water availability, habitats, agriculture and land use. Potential climate change effects are discussed in detail in Section 5.2.5 (Water Quantity). Project effects, and mitigation plans for water quantity and particularly flood risk, have been considered including an allowance for climate change. The Greenhouse Gas Assessment (Section 5.7) assesses the incremental impacts of predicted Project GHG emissions during Operation together with those ‘budgeted’ for the Republic of Macedonia.

8.9 Summary of Cumulative Impacts

8.9.1 Water Environment

It is anticipated that the Project may have a positive cumulative impact on the regional water supply network by facilitating the construction by Bosilovo Municipality and Strumichko Pole Water Management Company of the drinking and irrigation water supply network in Ilovica and Shtuka already under discussion (Section 6.2), as well as the improvement of conveyance for water supplies from Turija Reservoir to the Project area.

Operation and production activities at the Zdravje Radovo Dairy have the potential to act cumulatively with the Project through the abstraction and discharge of waste water products to and from the Turija River. However, the magnitude of the pre-mitigated effect from the Project on water quality in the Turija (Section 5.3.6.2.8) at post closure is low due to the buffering capacity in the Turija River (the Jazga only contribute 6% of flow – Section 5.2.6.4.11). Once mitigation is put in place, the effect will be negligible, therefore there would be no cumulative effect.

The mitigation presented in Section 6.2 considers impacts on irrigation users upstream and downstream of the Project. The proposed irrigation projects presented in Section 8.6.4, will therefore be unaffected by the residual impacts presented in Section 7.2 and the cumulative impacts will be negligible.

8.9.2 Noise and Vibration

The noise and vibration impact assessment (Section 5.5) identified that (moderate) residual impacts occur at Sekirnik and Shtuka only during the construction of the off-site access road. During construction, operation and closure of the Project all other residual impacts are no more than negligible, including at other settlements located close to the M6 transport route e.g. Novo Selo, Samuilovo and Novo Konjarevo.

50 The six key Greenhouse Gases (GHGs) produced by human activities and covered by the Kyoto Protocol Agreement are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).
Additional traffic along the highway could cause an increase in the overall noise environment, however is unlikely to cause a substantial change or increase. A change in public safety hazard associated with increased traffic on the highway is unlikely given that traffic volumes on the highway are already relatively high. Appropriate traffic management and controls of Project related traffic will limit the risk to members of the public.

Off site access road construction at Sekirnik has the potential to have temporary cumulative impacts if it occurs within the same period as other changes to traffic through Sekirnik, likely related to the three construction or reconstruction projects bullets in Section 8.8. Noise disturbance is likely to be one of the primary concerns for nearby residents. This can be managed through appropriate consultation with local residents, awareness of potential effects on traffic from other proposed Projects and mitigation, such as the selection of appropriate machinery and sympathetic works schedules. Such actions would reduce any cumulative impacts to low or negligible.

If road construction/repair/reconstruction activities take place before or after the Ilovica-Shtuka Project construction period, then no cumulative impacts are anticipated.

8.9.3 Air Quality

The proposed development of technological and industrial zones, the Dairy traffic, and the construction of new roads in the region (Section 8.6) may act cumulatively to generate adverse impacts on air quality, through increased traffic emissions. The air quality impact assessment (Section 5.6) states that Project traffic emissions would be negligible and therefore, any traffic-related emissions increase (as a result of planned developments listed in Section 8.6) are expected to be of minor cumulative consequence, which should be addressed with the permitting process of these other developments.

8.9.4 Biodiversity

No other developments have been identified within the study area which have the potential to generate cumulative biodiversity impacts.

The proposed development of technological and industrial zones, together with the construction of new roads in the region (Section 8.6) may act cumulatively to generate adverse impacts on biodiversity indirectly, through noise/traffic disturbance and air quality impacts. The air quality impact assessment (Section 5.6) states that Project traffic emissions would be negligible and that any traffic-related emissions increase (as a result of planned developments listed in Section 8.6) are expected to be of minor cumulative consequence, which should be addressed with the permitting process of these other developments.

The proposed OHL between Ilovica and Berovo will be subject to a Macedonian EIA which will identify potential adverse impacts on biodiversity and propose appropriate mitigation or management measures to reduce any direct impacts.

8.9.5 Ecosystem Services

No other developments have been identified within the study area which have the potential to generate cumulative ecosystem services impacts.

Any temporary or permanent land access restrictions that may limit ES beneficiaries’ access to specific services within the RSA as a result of the Ilovica – Berovo OHL are predicted to be limited in scale and will be subject to appropriate assessment and mitigation and will be subject to a Macedonian EIA or permitting process.

8.9.6 Cultural Heritage

There are no other proposed or recent developments in the vicinity which impact directly, or are predicted to, upon the same cultural heritage receptors. As such, there will be no cumulative cultural heritage impacts.

8.9.7 Landscape and Visual Impacts

No large infrastructure projects are planned. However, small scale projects are proposed and may be visible in conjunction with the Ilovica-Shtuka Project. These include the road construction and reconstruction and the Technological industrial development zones presented in Section 8.6.
Due to the relatively small scale and duration of these projects the cumulative visual effect would be negligible. No other large mineral extractions are currently within the planning system awaiting determination.

8.9.8  Socio-Economic

No other developments have been identified within the study area which have the potential to generate negative, cumulative socio-economic impacts.

The presence of a technological industrial development zone near Bosilovo has the potential to combine in a positive way with the Ilovica-Shtuka Project. The Project will source a range of goods and services from the local community, which will encourage economic development and may prompt development within the technological industrial development zone. This would have positive socioeconomic benefits for the local area through the creation of jobs and new industry.

8.10 Conclusion

In summary, no large infrastructure projects are planned and, as such, no significant adverse cumulative impacts are anticipated with relation to the development of the Ilovica Project. The Project has the potential to achieve benefits to community infrastructure and economic development through direct and indirect contributions to proposed reconstruction of the drinking and irrigation water supply system in Ilovica and Shtuka and the development of the technological industrial zone at Bosilovo.

Provisions for regular environmental monitoring are outlined within the ESMS (Annex 6). As the Ilovica-Shtuka project will be the primary driver of change in the local area the discipline-specific mitigation measures identified within this ESIA are the long term measures to manage any minor cumulative impacts identified herein.
9.0 SUMMARY OF MITIGATION MEASURES AND RESIDUAL IMPACTS

The following summarises the mitigation measures identified in Section 6 and outlines the commitments that Euromax are making to minimise any adverse impacts and maximise benefits that the Project may have on the biophysical and social environment.

9.1 Geomorphology, Terrain and Soils

The following provides a summary of mitigation relating to Geomorphology, Terrain and Soils across the Project affected area during construction, operations and closure:

- Progressive revegetation of disturbed areas throughout the life of the Project;
- Revegetation of the site at closure before removal of the drainage system and sediment ponds;
- Soils removed during construction will be stockpiled at or above the elevation from which it was removed;
- Stockpiles will be seeded with native vegetation to establish vegetation cover and minimise erosion;
- Erosion control measures (e.g. silt fences, ditches, rock check dams, temporary surface water diversions, soakaways and small sediment ponds) will be installed at all appropriate locations;
- Operating the site on a zero discharge basis during operations;
- Establishing a temporary sediment pond/sump within the pit area to manage runoff from the pre-strip area; and
- Waste rock to be used for reclamation of the surface of the tailings management facility (TMF) will be stockpiled in suitable locations to minimise double handling and transportation at closure.

Mitigation directly relating to the closure of the TMF includes:

- Capping the TMF with a layer of material that will enable vegetation growth likely to be a layer of growth medium at least 50 cm thick, composed of reclaimed waste rock, fertilisers and alternative substrates, which may include soil salvaged during construction and dredged sediment (meeting EDC values) from the Ilovica Reservoir;
- Conducting soil enhancement and vegetation trials to investigate requirements for soil improvement;
- Seeding with pasture grasses and undertaking irrigation if necessary;
- Establishing suitable grass and shrub species;
- Preventing tree species from establishing; and
- Establishing long-term soil and ecological health and risk assessment plots and monitoring for changes in the surface soil quality.

9.2 Water Quantity

The following provides a summary of mitigation relating to Water Quantity during construction, operations and closure:

- Financing, design, planning and implementation support to the Municipality of Bosilovo (including the Ograzhdhen Public Utility Enterprise (PUE) and Strumichko Pole Water Management Company (SPWMC)) to connect all households in Ilovica and Shtuka to the Ilovica Water Treatment Works (WTW);
- Assist the municipality in the decommissioning of the existing water supply intakes on both the Jazga and Shtuka rivers;
Extension of the existing irrigation supply pipe network, owned and operated by SPWMC, to supply all those in Ilovica and Shtuka who are currently ‘unserved’ with untreated irrigation water from Ilovica reservoir;

Managing Ilovica reservoir during construction and operations. This includes minimising abstraction from the reservoir and developing alternative sources of water supply during construction;

Committing to provision of sufficient funds to design, construct and commission a water supply pipeline from Turija reservoir to Ilovica WTW, including a storage tank nearby, to allow SPWMC and PUE to switch the supply of water to the Ilovica WTW from the Ilovica reservoir to the Turija reservoir before the mine opens. This water supply arrangement would be maintained by SPWMC and PUE after closure of the mine;

Committing to provision of sufficient funds to ensure an energy supply is in place at closure to provide power for the augmentation of Ilovica Reservoir from the Turija pipeline following mine closure, as well as during operations;

Committing to establish a fund that will provide financial resources for maintenance of infrastructure to augment Ilovica Reservoir from the Turija pipeline during closure and post-closure;

During operations and following closure, until the lake pit discharge reaches Ilovica Reservoir, a limited number of releases from Ilovica Reservoir via its low level outlet will be agreed between EOX and SPWMC to increase the median flows downstream of the Ilovica Reservoir.

Protecting against the enhanced flood risk in Ilovica village from the Jazga River following formation of a pit lake post closure, by designing the pit for provision of storage and attenuation of flood waters up to the 100-year flood;

The engineering design of the water management on the TMF will ensure one of the following solutions:

- Diversion channel will be maintained and convey the Shtuka River in perpetuity (or until such time that water quality improves so it can be released to the environment without treatment); or
- Shtuka River will be routed across the surface of the tailings in an engineered channel to the TMF spillway and median flows and lower flows will be able to drain freely via a culvert into the TMF spillway without ponding or attenuation on the TMF; or
- Shallow groundwater in the TMF cap, recharged from direct rainfall, the upper Shtuka and diversion channel in disrepair, will be discharged under control via a culvert.

During operations, Euromax will work with PUE and SPWMC to ensure that abstraction from the Turija pipeline at Ilovica will be operated to a prescribed flow to maintain water supply for irrigation downstream; and

Provision in the detailed design of the Storm Water Dam (SWD) downstream of the TMF to manage flood risk downstream and to maintain low flows downstream.

9.3 Water Quality

The following provides a summary of mitigation relating to Water Quantity during construction, operations and closure:

- Installation of a newly designed water supply system for Ilovica and Shtuka villages and decommissioning of existing intakes, as described in Section 9.2;
- Ilovica reservoir levels will be managed as described in Section 9.2;
- Construction of a pipeline from Turija reservoir to Ilovica WTW as described in Section 9.2;
- Treatment of pit lake discharge to neutralise pH and reduce metals and sulphate concentrations to acceptable discharge limits. Preferably a passive system will be employed, which will be defined during
the detailed design and pilot testing. If a passive system is not possible, active treatment systems will be assessed as alternative options, or a combination of passive and active systems;

- Engineering design of water management on the TMF as described in Section 9.2;
- The Seepage Collection Facility (SCF) will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted to comply with project water quality standards;
- A grout or gel curtain will be constructed at the SCF to capture 95% of the groundwater flow throughout operations and following closure;
- An active treatment system following closure (flow rate is too high for a passive system) to receive water collected in the SCF following closure (following conceptual design and bench scale and pilot studies);
- Monitoring of the water quality of seepage collected in the SCF during operations and closure;
- Encapsulation of Acid Rock Drainage (ARD) generating material in the TMF embankment (following a feasibility assessment on volumes and timing of waste rock arisings);
- Hydroseeding or planting of the final surface of the TMF embankment (following a feasibility study and trials) for stabilizing and reducing infiltration and runoff;
- The SWD will be constructed downstream of the TMF embankment prior to stripping of the TMF area and placement of any waste rock for the TMF embankment;
- Management of ammonia arising from blasting; and
- Management of the TMF pond towards end of mine life.

9.4 Sediment

The following provides a summary of mitigations relating to Sediment during construction, operations and closure:

- The SWD will be constructed downstream of the TMF embankment prior to stripping of the TMF area and placement of any waste rock for the TMF embankment;
- Sediment dams, surface water drainage and surface water storage will be in place prior to stripping and construction;
- Erosion control measures including silt fences, ditches, rock check dams, temporary surface water diversions, soakaways and small sediment ponds will be constructed as required;
- Phased tree removal and vegetation stripping;
- Maintenance or establishment of vegetated buffer zones around watercourses, including a vegetated buffer zone between the pit and Jazga River;
- Operating the site on a zero discharge basis during operations;
- Revegetation of the site at closure before removal of the drainage system and sediment ponds;
- Management of the potential increase in erosion attributed primarily to stripping and construction of the pit and TMF;
- Temporary sediment management within and downstream of the pit to manage the finer sediment that would otherwise require flocculation;
- Silt fences installed on contours within the cleared area of the TMF starter dam and also around the downslope boundaries; and
- To minimise the discharge from the SWD of clays and any fine silts remaining in the water, the storage will be flocculated following larger storm events (and as required based on sampling).
9.5 Noise and Vibration

The following provides a summary of mitigation relating to Noise and Vibration during construction, operations and closure:

- Sensitive timing of the highest intensity works;
- Residents will be consulted prior to construction of access roads;
- Euromax will consider the use of additional noise protection for properties within 50 m of the access road if the impacts of the road construction are deemed unacceptable by residents;
- Acoustic barrier to be constructed alongside the access road at Shtuka and maintained for the life of the project;
- Cut-fill profile of road will be used to maximise screening;
- Construction activities with unacceptable noise impacts will be confined to the daytime and evening;
- HGV movements on the access road during operations will be confined to daytime and evening periods with departures to be staggered throughout the day (i.e. a maximum of up to 5 per hour and not travelling in convoys);
- Noise barrier constructed alongside the access road at Sekirnik during operations;
- Blasts during construction and operations will occur during the daytime period only;
- The proposed blasting schedule will be clearly communicated to neighbouring communities in advance and vibration monitoring will be undertaken. In the event that complaints arise, additional vibration monitoring will be undertaken; and
- Euromax will undertake a condition survey of all properties in Ilovica and Shtuka prior to commencement of any blasting and continue to monitor them throughout operations.

9.6 Air Quality

Beyond the engineering measures presented in Section 5.6.2, no further mitigation is required to manage impacts the Project may have on air quality.

9.7 Greenhouse Gas Emissions

Greenhouse gas emissions over the lifetime of the mine are predominantly from the purchase of electricity. Therefore the largest impact on GHG emissions from the project could be from managing electricity usage. The following mitigation measures will be expanded upon in the Traffic and Transport management plan and the Resource Efficiency plan:

- Training will be provided to all employees to make them aware of their responsibilities relating to power consumption;
- All energy usage will be metered and audited annually. Energy use reduction measures will be investigated and implemented where possible;
- Reduction of fuel consumption by minimising haulage distances, idle time and distances travelled;
- Purchase of vehicles and equipment selected to be as fuel-efficient as possible, and regular maintenance will occur to keep emissions within the required range;
- Back-up generators will only be tested for as long as necessary and not left running for extended periods;
- Euromax are committed to using the minimum quantity of ANFO needed for the required blasting; and
- Carbon offsetting options could be quantified and should be considered in future resource efficiency planning.
9.8 Biodiversity & Ecology

The mitigation strategy for biodiversity is based on the objective of achieving “no net loss” (NNL) for biodiversity and net gain (NG) for effects to critical habitat. Biodiversity mitigation beyond those identified for other technical areas, which have already been considered in the Biodiversity assessment, include the following:

- Rescue and translocation of fish and decapods from the Jazga River upstream of the Ilovica Reservoir, where flow will be reduced during construction, operation and following closure;
- Rescue and translocation of fish and decapods from the Shtuka River in the footprint directly affected by the TMF, where there will be permanent loss of aquatic habitat;
- Regular flushing of the River Jazga downstream of the Ilovica Reservoir to maintain environmental flows and to meet (or improve upon) baseline water quality in this stretch of river;
- The detailed design of the grout curtain proposed at the SCF on the Shtuka River will include consideration to minimise ecological impact;
- Fauna (such as small mammals and herpetofauna) will be removed from the Shtuka River valley during construction by a suitably qualified environmental technician. Earthworks will be scheduled to avoid mortality. Where this is not possible, hibernacula will be carefully dismantled in order to safely disperse species (April to October inclusive);
- The site will be revegetated in accordance with the conceptual revegetation strategy (creation of a grassland and scrub mosaic suitable for grazing on the surface of the TMF and planting native forest species to achieve a scrub and forest mosaic on restored footprint of all other project infrastructure). A focus on pasture re-vegetation will allow for the creation of habitat suitable for the Large Blue butterfly, as well as numerous other invertebrates which naturally occur on the site.
- A Biodiversity Management Plan (BMP) will be developed prior to construction and implemented throughout the life of the Project, including adaptive management based upon monitoring results and additional consultation with stakeholders and local specialists who have already assisted with the ESIA. This will include, but not be limited to the following actions:
  - Salvage of samples of flora of conservation concern;
  - Protective fencing and signage will be used to ensure that the Project footprint and traffic does not encroach into identified ecologically sensitive areas;
  - Management of invasive species;
  - Placement of artificial bat roosting habitat;
  - Site lighting should make use of low pressure sodium lights;
  - Maintenance of access and existing grazing regimes on grasslands within the concession area, or replication of grazing regime;
  - Habitat creation through progressive restoration and re-naturalisation; and
  - Mandatory environmental training for all workers and contractors.
- Implementation of the BMP will be overseen by a suitable nominated person.

9.9 Ecosystem Services

Mitigation measures listed below include those from specialist studies that are specific to potential impacts on the supply of ecosystem services. Additional mitigation measures based on the commitments provided within the Project Land Acquisition and Resettlement Framework (LARF) and Livelihood Restoration Plans (LRP) and in line with IFC Performance Standard 5 are also included:
Livelihood restoration assistance and plans will be developed to specifically formulate mitigation strategies for the loss of grazing land.

The Project could also support the local economy by sourcing food locally, where feasible. Economic displacement experienced by farming communities will be addressed through delivery of the LRP.

Local communities will be supported through the LRP and informed of areas that remain accessible for wild foods and hunting.

The Project will endeavour to work with the Forestry company and local community groups to investigate other fuel sources. EOX is committed to making timber felled from the site available to local communities.

A water pipeline will be constructed between Turija reservoir and Ilovica Water Treatment Works as described in Section 9.2.

Water intakes on Jazga and Shtuka Rivers will be decommissioned as described in Section 9.2.

Active and/or passive treatment of water discharge from the TMF following closure, plus, active treatment of discharge from the pit lake, once formed following closure.

Economic effects experienced by foraging communities will be addressed for project-affected communities through delivery of the LRP.

Installation of physical erosion control features as described in Section 9.4.

Temporarily disturbed areas will revegetated and reclaimed as described in Sections 9.1 and 9.7; and

The Cultural Heritage Management Plan (CHMP) will include an outline method for identifying alternative accessible locations for the plant gathered from Shtuchki Vodopad to ensure it can be collected (Section 9.10).

**9.10 Cultural Heritage**

Mitigation relating to cultural heritage includes the following:

- Archaeological excavation and recording of five archaeological receptors that are located within the project footprint;
- The memorial stone at Preslop spring will be relocated within the concession area where it will not be disturbed or damaged, and will remain accessible to interested parties, such as relatives and friends;
- Euromax will provide a method for identifying alternative accessible locations for the plant Bigroot Cranesbill, which is currently collected at Shtuchki Vodopad, and methods of enhancing access. This plant has ritualistic significance, specifically in relation to Easter celebrations;
- A photographic record of Shtuchki Vodopad and the adit/tunnel site will be created, prior to construction, and deposited for long term storage with Strumica Museum;
- A precautionary watching brief will be undertaken at Domus Gaber during construction. In the event that significant archaeological remains are discovered during construction, an evaluation will be made by the supervising archaeologist as to whether further detailed excavation is required;
- Demarcation and avoidance of seven archaeological sites will help protect archaeological remains from inadvertent damage as a result of unforeseen vehicle movements, stockpiling and the lay-down of construction equipment. This is a general good practice measure;
- Construction activities will be modified on 21 September (Nativity of Theotokos) to lessen the effects of noise and dust disturbance at the Monastery of St. George;
- The transport and blasting schedules will be managed as described in Section 9.5;
Euromax will liaise with the Rusali festival organisers to minimise any disturbance to the festival associated with Project traffic noise;

A visual inspection (including building fabric survey) of three cultural heritage receptors will be undertaken before blasting commences, which will inform a Monument Management Plan for each receptor which will be used to monitor the potential impact of ground-borne vibrations. In the event that vibrations are observed to be affecting any of the receptors, alternative mitigation measures (such as evaluation and excavation) may be required; and

Existing vegetation will be retained around the Shrine at the Monastery of St. George to provide visual screening.

9.11 Landscape and Visual
Mitigation relating to visual impacts includes the following:

- Trees (locally occurring indigenous species) will be planted around the periphery of the mine workshop area;
- Project lighting should be located away from the prominent summit and southern faces of Čukar;
- Post-extraction selective blasting of the horizontal mine pit benches/rises; and
- The downstream face of the TMF embankment will be revegetated at closure.

9.12 Socio-economics
The following are mitigation measures related to specific land uses affected by the Project's land take:

- Effects on agricultural land use and loss of forestry resources, including fuel wood, will be mitigated through the Livelihood Restoration Plan and through a compensation agreement with the Forestry Company regarding salvageable timber;
- Graziers and holders of private forestry licences in the concession area will be provided with suitable alternative land and associated improvements (e.g. watering location for graziers) on which to conduct their activities during Project construction and operation;
- Close collaboration with beehive owners who currently use the slopes of Ograzhden Mountain, will lead to the beehives being relocated to alternative agreed upon areas;
- Harvesters of special crops, including mushrooms and plants used in religious ceremonies, will be consulted and should they be without alternative areas for harvesting, alternatives will be considered and negotiated;
- Euromax will consult with hunters to determine the extent of the impact of land take and noise impacts on the ability of local people to engage in hunting and will work with the hunting authorities, to identify alternative/accessible areas to mitigate these impacts;
- Monitor environmental conditions (e.g. air and water quality) and keep local authorities updated regarding any potential environmental incidences or exceedances of air and water quality guidelines that have the potential to adversely influence physical health;
- Develop a Training and Recruitment Plan;
- Prioritise a local labour force with low levels of education for entry-level positions and local trades people for apprenticeship positions;
- Establish achievable targets for growing the representation of women in the Project workforce over time;
- Monitor and enforce subcontractor performance for compliance with Euromax commitments and use monitoring results in decisions on contract administration and management;
- Tailor contracting and procurement strategies to maximise economic development within local municipalities;
- Establish and enforce a code of conduct guiding the behaviour of non-resident workers while working in or travelling through local communities;
- Establish a workforce discipline which encourages health, safety, learning, retention and advancement of employees;
- Include in the evaluation criteria for subcontractors the extent to which they commit to manage their workforces through similar measures;
- Establish an Emergency and Preparedness Response Plan and a Traffic and Transport Management Plan;
- Prepare a Community Investment Plan;
- Fence and/or install signage at the Project site to prevent public access and provide public education programs on risks present within the Project site boundary;
- Provide recrimination free opportunities for workers to express concerns, including those related to health and safety, and bring to light conflicts such that grievances are addressed promptly; and
- Provide assistance to improve the existing Illovica health clinic facilities (in addition to the on-site health clinic for workers provided during construction and operation, to minimise potential increases in demand for local health services).
10.0 ENVIRONMENTAL RISKS AND ACCIDENTS

The Environmental Risk and Accidents section of the ESIA includes an evaluation of the risk of natural and industrial hazards which could cause environmental or social impacts by adversely affecting the environment or public safety. Risk is calculated as a hazard multiplied by the probability of that hazard occurring.

The study area for the Environmental Risk and Accidents assessment is the biophysical local study area (Section 1) as it contains all activities and infrastructure relating to the Project.

10.1 Hazards to be Considered

This section considers the following natural and industrial hazards, which have the potential to cause risks to environmental and social receptors.

Natural Hazards:
- Extreme rainfall exceeding the engineering design criteria, extreme snow or rapid snow melt;
- Extreme wind speeds;
- Lightning strike;
- Avalanche;
- Landslips and landslides; and
- Seismic events.

Industrial Hazards
- Spills from project infrastructure;
- Damage to project infrastructure;
- Loss of containment from storage areas;
- Road traffic accidents;
- Seepage from waste rock or other stockpiled materials;
- Tailings dam failure;
- Storm water dam (SWD) failure;
- Seepage Collection Facility (SCF) failure;
- SCF Spill;
- Failure of Shtuka River diversion channel;
- Use of combustible or explosive materials;
- Poor blast design; and
- Use of hazardous materials including cyanide.

10.2 Summary of Information Used in the Assessment

10.2.1 Meteorological

10.2.1.1 Flood risk

The risk of flooding in Ilovica and Shtuka villages and at the Turnovo-Sekirnik road crossing was assessed by simulating flood events on each river and during a 1 in 100-year peak flow resulting from a 1 in 100-year 24-hour rainfall event. Details of the analysis are presented in Section 2.2.
Baseline flood risk in Ilovica was assessed to be very low. The circumstances under which actual flooding of Ilovica can be conceived include:

- Flood events with extreme return periods (possibly >500 years under present baseline conditions);
- A major dam failure at Ilovica Reservoir; and
- A significant flood flow coinciding with a major channel blockage, for example at bridges by vegetation debris.

Baseline flood risk in Shtuka was assessed to be moderate with minor scale flooding of the village square occurring at return periods down to a few years. The circumstances under which significant flooding of Shtuka can be conceived include:

- Flood events with return periods in excess of 50 years; and
- Flood flow coinciding with a major channel blockage, for example at bridges due to vegetation debris.

Baseline flood risk at the Turnovo-Sekirnik road was assessed to be moderate with the 25-year flood flow just being accommodated by the road culvert. The circumstances under which significant flooding of the road is likely to arise include:

- Flood events with return period in excess of 25 years; and
- Flood flow coinciding with a major culvert blockage, for example by vegetation debris.

Snow melt did not play a significant role in causing flooding in the Jazga catchment in the period 2000 to 2014.

The TMF construction phasing has been carried out to provide storage at all times to allow the facility to accommodate a 24 hour Probable Maximum Flood (PMF) event, as well as to accommodate wall settlements should a seismic event occur.

### 10.2.1.2 Wind speed

Wind speed and direction data was collected at the Euromax Resources meteorological station from 14 May 2013 to 8 April 2015. The dominant wind direction at the Euromax Resources meteorological station is bimodal, although predominantly south-easterly in direction. The location of the monitoring station within the mountain range is likely to influence this bimodal pattern due to channelling of the wind. The same effect is potentially also observed in the wind speed data where the average monthly wind speeds are greater than those recorded at the Strumica station.

Wind speed averages 1.79 m/s overall. The highest recorded maximum wind speed between 2013 and 2015 was 17.5 m/s in July 2014. Ilovica appears to experience consistent low to moderate wind speeds throughout the data period with some fluctuation between the winter and summer seasons.

### 10.2.1.3 Lightning

Data for thunder and lightning were obtained for Strumica (232 masl) from the Hydrometeorological Service, Skopje. Table 10-1 summarises the number of days per month of thunder and lightning at Strumica. It is assumed that the incidence of thunder and lightning will be similar at the project site (Annex 1).

<p>| Table 10-1: Number of days with thunder and lightning at Strumica (2008/9 to 2013/14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|</p>
<table>
<thead>
<tr>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Mean</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Max</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>6</td>
<td>5</td>
<td>52</td>
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<tr>
<td>Min</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>18</td>
</tr>
</tbody>
</table>

Data source: Hydrometeorological Service, Skopje
10.2.2 Landslides

The most common soil map units in the biophysical LSA are those derived from colluvial deposits. These soils are located in the highland zone (mountainous regions) and are characterised by moderately well to rapidly drained soils of variable texture and coarse fragment contents (primarily angular to sub-angular).

The majority of the LSA is characterised by steep (>30%) to very steep slope gradients (>60%). During intense or extreme rainfall events, the potential for soil erosion is a function of increases in slope gradient and slope length. The LSA is prone to geohazards due to a mountainous landscape (steep slopes), climatic variability (including intense rainfalls and aridity), old, deeply, weathered bedrock, and highly erodible soils (coarse-textured). Geohazards such as landslides do occur in the LSA. Although landslides are likely to be natural, anthropogenic activity such as deforestation, unsustainable agriculture, access road construction and alteration of water flow patterns (e.g. surface flow, irrigation, and reservoir drawdown) can increase the risk.

10.2.3 Seismic

The eastern Mediterranean region is one of the world’s most seismically active areas (Section 2.1). Earthquakes in this area are related to large scale tectonic movements resulting from the Arabian plate moving northward with respect to the Eurasian plate. Earthquakes are the leading and most devastating geohazard in the regional study area (RSA). The most recent notable earthquake (with a magnitude of 4.5 on the Richter scale) in the RSA occurred 26 years ago (31 January 1990) in the area of Strumica. The main fault is the North Anatolian fault and the closest fault is the VFZ strike slip fault, approximately 50 km west of the proposed Ilovica mine running in a north-south direction. The locations of earthquakes of M>3.0 in Macedonia and the surrounding area are shown in Figure 10-1, overlain upon a map showing young and active faults.

Figure 10-1: Location of earthquakes of M>3.0 in Macedonia and surrounding region for period 1976–2004 superimposed on the map of young and active faults (Dumurdzanov, et al., 2015)
Seismic data for the area was obtained from the United States Geological Survey (USGS) and Geoscience Australia (GA) (ICOLD, 1986). This catalogue only includes earthquakes in the search area, an approximate 600 km radius around the proposed Illovica mine. Based on the USGS and GA data, the extrapolated magnitudes for various event return frequencies are tabulated below in Table 10-2.

<table>
<thead>
<tr>
<th>Distance from the proposed Illovica mine (km)</th>
<th>1:100 Year event extrapolated M</th>
<th>1:500 Year event extrapolated M</th>
<th>1:1,000 Year event extrapolated M</th>
<th>1:10,000 Year event extrapolated M</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 20</td>
<td>3.8</td>
<td>4.0</td>
<td>4.8</td>
<td>5.8</td>
</tr>
<tr>
<td>20 – 50</td>
<td>5.8</td>
<td>6.2</td>
<td>7.5</td>
<td>9.2</td>
</tr>
<tr>
<td>50 - 100</td>
<td>6.1</td>
<td>6.4</td>
<td>7.6</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Source: Golder, 2015

The nearest large fault zone is approximately 40 km to 60 km from the site and is identified as the VFZ strike slip fault. There are minor fault zones closer to the site, but these have not recorded significant magnitude values and are unlikely to produce significant motions. It is however noted that many large scale fault structures in the region show evidence of active or recent movement. The proposed Project is in an area of increased seismic hazard and this has been taken into account in the design of structures and facilities.

The seismic design criteria for the Illovica mine site have been evaluated using seismic data of the region to derive the operating base earthquake (OBE) also known as the design base earthquake (DBE) and the maximum design earthquake (MDE).

**10.2.4 Hazardous Materials**

**10.2.4.1 Storage of hazardous materials**

Hazardous materials used for the Project will be stored as follows:

- Fuel and chemical storage and usage areas will be demarcated, sealed and bunded, with storm water directed around these areas;
- Fuel storage will occur at the mining infrastructure. Fuel suppliers will supply and maintain the equipment. The design of this area will allow for secondary containment (bunded area) and concrete hard standing and will be guided by the fuel supplier’s recommendations. The bundled area will allow for containment of 110% by volume of the largest expected spillage event. This procedure will be provided for the storage of oils, grease, fuels, chemicals and any other hazardous materials throughout all stages of the Project;
- Fire water storage tanks will be installed at the processing plant and at the mining infrastructure;
- Oil and grease traps or sumps at refuelling facilities, workshops and fuel storage depots will be installed and maintained. Drip trays will be used in the plant and workshops; and
- Transportation of hazardous substances will be subject to the commitments stated in the Transport Management plan (Section 11) and will be in line with Macedonia and International guidelines and best international practice.

Further information is provided in the Environmental and Social Engineering Considerations Report (Annex 1).

**10.2.4.2 Hazardous equipment**

The storage location for all equipment which may be a source of ignition will be determined after the hazardous areas have been classified in the detailed design phase. Where possible, such equipment will be located outside of the classified area or in the zone of least hazard.
All equipment which must be installed in a hazardous area will be selected in accordance with all the applicable statutory codes, standards and procedures. For field-mounted instruments, Intrinsic Safety Ex ‘ib’ using electronic isolators will be the preferred protection technique.

10.2.4.3 Hazardous waste disposal

A waste management procedure will be implemented on-site to ensure safe removal and control of all waste generated on-site during the construction and operation phase. An on-site hazardous waste management facility will be provided to manage site-generated waste. Hazardous waste will be contained within designated containers, such as drums, bags and pallets for containment of batteries, greases, oil filters, contaminated soils, fluorescent tubes and ink cartridges.

During the construction phase, this will be managed by individual contractors, co-ordinated by Euromax Resources or the Main Contractor, depending on the construction philosophy. During the operations phase, this will be managed by Euromax Resources.

Hazardous waste management infrastructure and equipment available on site will include a waste transition yard for handling hazardous waste, non-hazardous waste and waste for recycling, prior to disposal off-site.

The types and volumes of hazardous waste expected to arise from the Project are presented in Section 4.

10.2.4.4 Cyanide management

Prior to any use of cyanide, Euromax will sign up to the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold for the Project (http://www.cyanidecode.org). This code was developed by a multi-stakeholder steering committee under the guidance of the United Nations Environmental Program (UNEP) and the then-International Council on Metals and the Environment (ICME).

The Code is a voluntary industry program for gold mining companies focussing on the safe management of cyanide and cyanidation mill tailings and leach solutions. In adopting the Code, companies agree to have their mining operations which use cyanide to recover gold audited by an independent third party to determine the status of Code implementation. Certification will be given to those operations that meet the Code requirements. A unique trademark symbol can then be utilised by the certified operation. Audit results are made public to inform stakeholders of the status of cyanide management practices at the certified operation. Transporters of cyanide for the Project will also be registered under the Code.

10.2.5 Transport

10.2.5.1 Road speed

The speed limit within the mining perimeter will be no more than 50 km/h. Haulage vehicle speeds will vary depending on the segment of the route. A minimum speed of 15 km/h and a maximum speed of 30 km/h have been used for haul roads (Euromax, 2015b).

The design for the off-site access road is at the permissible limits for low volume rural highways. It will allow maximum speeds of 50 km/h, with further speed reductions at hairpin bends and, where necessary, lane widening to accommodate larger vehicles (Euromax, 2015b).

10.2.5.2 Drivers

Traffic management requirements include ensuring that drivers are trained and experienced (Euromax, 2015b). When driving or operating any self-propelled vehicle or equipment on site, the driver/operator of such equipment will be appointed by the contractor’s Construction Manager and be at least 18 years of age. The appointed driver/operator will have completed a satisfactory course of training and be either competent or in the possession of a driver’s license issued by the Ministry of Interior for which authorisation is granted. Workers in specialised work categories will be required to be certified by an approved organisation as defined in the relevant acts (e.g. crane drivers, forklift drivers). Access tracks will be used by competent drivers operating suitable off-road vehicles.
10.2.5.3 Restrictions on access

10.2.5.3.1 Off-site Access Road

A new off-site access road will connect the Project to the existing M6 highway which runs between Strumica and the Bulgarian border. The new off-site access road will be developed in two stages to serve mine construction and mine operations.

- The temporary off-site access road, to be used during construction, is located along the eastern bank of the Shtuka River and through agricultural land. During construction, passing places will be constructed to allow two way traffic when necessary. Access for agricultural workers will not be affected. Once the permanent off-site access road is constructed, the temporary off-site access road will be cleared and returned to local use.

- The permanent off-site access road will run between the concession and the M6 to a new junction between Serkirmik and Turnovo. This new road will allow project traffic access and local farm access only during operations. Service roads for local farmers will be included on both sides of the project access road to give access to fields without the need for crossing points on the project access road.

- During operations the permanent off-site access road will be in use 24 hours per day with mixed mine traffic usage, from personal vehicles to trucks making deliveries or exporting copper concentrate and/or gold. There will be no public access to this new road during operations. Access will be controlled during operations at the junction between the temporary and permanent off-site access road. Speed limits will be set according to the requirements of the Macedonian road authorities.

10.2.5.3.2 On-site Access Road

The permanent on-site access road will be maintained by Euromax (or an appointed contractor) during operations. Speed limit within the mining concession will be no more than 50 km/h. There will be security at the concession boundary to restrict entry to authorised vehicles only.

10.2.6 Tailings Management Facility

The TMF will use a downstream constructed earthen and waste rock dam to provide containment for the tailings. Waste rock from the mining operations will be buttressed against the TMF embankment (Euromax, 2015b). The TMF construction phasing has been carried out to provide adequate freeboard at all times to allow the facility to accommodate a PMF event, as well as to accommodate wall settlements should a seismic event occur.

The Shtuka River diversion channel has been designed to divert flow from the upstream section of the Shtuka River around the TMF. The diversion channel will be designed to convey a 1 in 100 year return period 24 hour event. The diversion dam and diversion channel will be designed to safely spill a PMF event into the TMF. A spillway will be installed on the TMF prior to closure. This spillway has been designed to cope with peak flow during a PMP event.

10.2.7 Water management infrastructure

10.2.7.1 Storm Water Dam

A Storm Water Dam (SWD) will be constructed on the Shtuka River downstream of the TMF. The SWD will attenuate high flows up to a 25 year return period storm and allow settlement of sediment-heavy runoff from the stripped dam site and from the entire Shtuka catchment, which will be partially stripped in the TMF footprint during the construction phase.

The SWD will be sized according to the 1 in 25 year return period storm in the entire catchment (i.e. construction scenario), which will more than accommodate a 100 year return period storm for the reduced catchment reporting to the SWD during operations. During operations the SWD will store sediment-heavy runoff from the reduced catchment comprising the TMF embankment and infrastructure within its catchment on the right bank of the Shtuka River.
There will be limited attenuation of normal flows reporting to the SWD, which will be allowed to discharge through the porous dam of the SWD to maintain ecological flows downstream, whilst high flows will be attenuated to ensure that flood risk is not increased downstream.

Stored water meeting the project TSS discharge standard will be released to the Shtuka River. The SWD is provided to mitigate a potential impact of the TMF on water quality in the Shtuka River. It may be necessary to flocculate water reporting to the SWD to remove clay particles.

10.2.7.2 Seepage Collection Facility

A Seepage Control Facility (SCF) will be constructed on the Shtuka River between the TMF and the SWD. The SCF is designed to contain seepage and mitigate a potential impact of poor quality seepage from the TMF on water quality in the Shtuka River.

During operations the SCF will collect seepage from the TMF and runoff from the TMF embankment. Seepage and runoff collected will be pumped back for supply to the process plant. During high return period storm events some runoff may overflow the seepage control dam and flow into the SWD. The seepage collection facility will be sized to retain seepage and contact water and only allow spilling should dilution mean that spilled water is of an acceptable quality.

Following closure, assuming mitigation proposed in Section 6.3 is adopted, the SCF will collect contaminated runoff and seepage for treatment before discharge of treated water into the environment.

10.2.7.3 Pit Lake management

Following closure a pit lake will form (likely to fill approximately 90 years after closure). Assuming mitigation proposed in Section 6.3 is adopted, the spilling pit lake water will be piped to treatment before discharge of treated water into the environment.

10.2.8 Use of Combustible Materials and Blast Design

Blasting during construction and mining operations will be conducted by a blasting contractor who will be responsible for the infrastructure required to store ammonium nitrate fuel oil (ANFO) and detonators. A nominal distance of 400 m for the blast radius has been applied in the development of the site layout (Euromax, 2015b). Blast radius limitations will not apply to the primary crusher, since the crusher only operates when ore is being hauled from the pit. This stops during blasting in the pit. The crusher will require fly rock protection. Dust plumes from waste rock blasting will be reduced through design of the blast to prevent fly rock and dust.

10.2.8.1 Blasting in the Pit

During construction of the pit, stripping will involve blasting and earth moving to excavate the overburden/waste rock (which will be used in construction of the TMF wall). Around 2 to 3 blasts per week are anticipated during the construction phase; blasting activities are only to be undertaken during daylight hours.

During operations, the pit will operate 24 hours per day. Blasting will occur in the daytime only but will be on a daily basis (assuming on average 1 blast per day). Prior notification of blasting will be provided to police and local authorities.

Roughly 90% of the material in bulk excavations will require blasting.

10.2.8.2 Blasting for Road construction

Blasting will be used in key sections of the haul road and onsite access road. The blasting regime will be defined by the construction contractor. However, prior notification of blasting will be provided to police and local authorities and all blasting will be blanketed, as needed and as identified in the ESIA, to prevent flyrock. This will also have the effect of damping the noise generated by blasting.

10.3 Environmental Risks and Accidents Assessment

For each of the hazards listed in Section 10.1, a consequence rating and its probability of occurring have been assigned according to the definitions given in Figure 10-2. Hazard consequence and probability are then
combined to give the risk level of each hazard (Table 10-3). All hazards and risk levels take into account the mitigation presented in Section 6 of this ESIA. Based upon the risk level, mitigation and management measures are specified in accordance with Figure 10-2.
<table>
<thead>
<tr>
<th>ILOVICA ENVIRONMENTAL AND INDUSTRIAL RISKS AND ASSOCIATED CONSEQUENCES</th>
<th>CONSEQUENCE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>INSIGNIFICANT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MINOR</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MODERATE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MAJOR</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Lasting days or less; limited to very small area; no environmentally sensitive receptors</td>
<td></td>
</tr>
<tr>
<td>Lasting weeks; limited to small area; no environmentally sensitive receptors</td>
<td></td>
</tr>
<tr>
<td>Lasting months; impact on an extended area (kilometres); area with some environmental sensitivity</td>
<td></td>
</tr>
<tr>
<td>Lasting years; impact on an extended area (kilometres); environmentally sensitive habitat</td>
<td></td>
</tr>
<tr>
<td>Permanent impact; affects a whole basin or region; highly sensitive habitats</td>
<td></td>
</tr>
<tr>
<td><strong>Social</strong></td>
<td></td>
</tr>
<tr>
<td>Awareness/ concern from specific individuals; Minor disturbance of local cultures/ social structures</td>
<td></td>
</tr>
<tr>
<td>Concern/ complaints from certain groups/ organizations; Some reversible impacts on local population.</td>
<td></td>
</tr>
<tr>
<td>Isolated complaints from community members/ stakeholders; reversible impacts on local population.</td>
<td></td>
</tr>
<tr>
<td>Local/ regional public concern and reactions; irreversible impacts on local population (health, property)</td>
<td></td>
</tr>
<tr>
<td>National/ international public attention and repercussions; irreversible impacts on local/regional population (fatality)</td>
<td></td>
</tr>
</tbody>
</table>

**PROBABILITY**

- **ALMOST CERTAIN** 5
  The unwanted event has occurred frequently: occurs in order of one or more times per year & is likely to reoccur within 1 year

- **LIKELY** 4
  The unwanted event has occurred infrequently: occurs in order of less than once per year & is likely to reoccur within 5 years

- **POSSIBLE** 3
  The unwanted event has happened in the business at some time: or could happen within 10 years

- **UNLIKELY** 2
  The unwanted event has happened in the business at some time: or could happen within 25 years

- **RARE** 1
  The unwanted event has never been known to occur in the business: or it is highly unlikely that it will occur within 25 years

**RISK RATING**

<table>
<thead>
<tr>
<th>Risk Rating</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 to 25</td>
<td>H - High</td>
</tr>
<tr>
<td>13 to 20</td>
<td>S - Significant</td>
</tr>
<tr>
<td>6 to 12</td>
<td>M - Medium</td>
</tr>
<tr>
<td>1 to 5</td>
<td>L - Low</td>
</tr>
</tbody>
</table>

**GUIDELINES FOR RISK MATRIX**

- A high risk exists, appropriate mitigation strategy to be devised immediately.
- A significant risk, appropriate mitigation strategy to be devised as soon as possible.
- A moderate risk, appropriate mitigation strategy to be devised as part of the normal management process.
- A low risk, monitor risk, no further mitigation required.

Figure 10-2: Risk matrix for the assessment of environmental risks and accidents
Table 10-3: Environmental risk assessment

<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
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<tr>
<td></td>
<td>Natural hazards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Extreme rainfall, exceeding design criteria or extreme rapid snow melt</td>
<td>Increased flooding risk due to impacted catchments</td>
<td>Ilovica and Shtuka</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>● Emergency Preparedness and Response Plan</td>
</tr>
</tbody>
</table>
|     |                                                                        | Increased seepage from tailings dam                                          | Aquatic resources in the Shtuka River and surface and groundwater resources for Shtuka community village water supplies | Moderate           | Possible     | Significant | ● Closure Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Water Management Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Environmental Monitoring Plan                                                  |
|     |                                                                        | Pit lake spills to environment following closure                             | Jazga River (aquatic environment) and Ilovica Reservoir (irrigation water source) | High               | Unlikely     | Significant | ● Closure Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Water Management Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Environmental Monitoring Plan                                                  |
|     |                                                                        | Overtopping of the TMF flood attenuation capacity                            | Shtuka village                                                          | High               | Rare        | Medium   | ● Emergency Preparedness and Response Plan                                        |
|     |                                                                        | Overtopping of the SWD                                                       | Property and effects in Shtuka                                             | High               | Rare        | Medium   | ● Closure Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Water Management Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Emergency Preparedness and Response Plan                                        |
|     |                                                                        | Overtopping of the SCF                                                       | Aquatic resources in the Shtuka River and surface water resources for Shtuka community village water supplies | Moderate           | Possible     | Significant | ● Detailed design and sizing  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Closure Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Water Management Plan  
|     |                                                                        |                                                                             |                                                                          |                    |             |          | ● Emergency Preparedness and Response Plan                                        |
|     |                                                                        | Tailings dam failure                                                        | See hazard no.12                                                           |                    |             |          |                                                                                  |
| 2   | Extreme wind speeds                                                    | Damage to project infrastructure                                            | See hazard no.8                                                          |                    |             |          |                                                                                  |

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<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Lightning strike</td>
<td>Vegetation fire</td>
<td>Ilovica, Shtuka, project infrastructure and terrestrial flora and fauna</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>□ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air quality due to smoke from fire</td>
<td>Ilovica, Shtuka, project infrastructure and workforce and terrestrial flora and fauna</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>□ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td>4</td>
<td>Avalanche</td>
<td>Increased hazard from impacted catchment</td>
<td>Property in local communities</td>
<td>Minor</td>
<td>Rare</td>
<td>Low</td>
<td>□ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to site infrastructure - subsequent contamination of land and water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>See hazard no. 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Landslides</td>
<td>Shtuka diversion channel damaged, resulting in increased flows to TMF and subsequent tailings dam failure</td>
<td>See hazard no. 13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|     |                 | Shtuka diversion channel damaged, resulting in increased flows to TMF and subsequent contamination from seepage | Shtuka community water supplies and aquatic resources                        | Moderate           | Rare        | Medium | □ Closure Plan  
 □ Water Management Plan  
 □ Environmental Monitoring Plan  |
|     |                 | On site access road damaged                      | Project infrastructure                                                      | Moderate           | Rare        | Medium | □ Emergency Preparedness and Response Plan                                       |
|     |                 | Haul road damaged                                | Project infrastructure                                                      | Minor              | Rare        | Low    | □ Emergency Preparedness and Response Plan                                       |
|     |                 | Watercourse contaminated with sediment           | Ilovica and Shtuka community water supplies and aquatic resources          | Moderate           | Rare        | Medium | □ Water Management Plan  
 □ Closure Plan  
 □ Environmental Monitoring Plan  |
<p>|     |                 | Damage to site infrastructure                    | See hazard no. 8                                                            |                    |             |        |                                                                                  |
| 6   | Seismic events  | Tailings dam failure                            | See hazard no. 12                                                          |                    |             |        |                                                                                  |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ilovica Reservoir dam failure, causing flooding</td>
<td>Ilovica Reservoir dam failure, causing flooding</td>
<td>Ilovica</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>■ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td>SWD failure</td>
<td>SWD failure</td>
<td>Property and effects in Shtuka</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>■ Closure Plan ■ Water Management Plan ■ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td>SCF failure</td>
<td>SCF failure</td>
<td>Aquatic resources in the Shtuka River and surface and groundwater resources for Shtuka community village water supplies</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>■ Closure Plan ■ Water Management Plan ■ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td>Landslide</td>
<td>Landslide</td>
<td>See hazard no. 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damage to site infrastructure</td>
<td>Damage to site infrastructure</td>
<td>See hazard no. 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased seepage from waste rock and TMF</td>
<td>Increased seepage from waste rock and TMF</td>
<td>Local community water supplies and aquatic resources</td>
<td>Moderate</td>
<td>Rare</td>
<td>Medium</td>
<td>■ Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td>Damage to pit lake pipe to treatment plant – contaminated discharge to environment</td>
<td>Damage to pit lake pipe to treatment plant – contaminated discharge to environment</td>
<td>Ilovica water supplies and aquatic resources</td>
<td>High</td>
<td>Possible</td>
<td>Significant</td>
<td>■ Closure Plan ■ Water Management Plan ■ Environmental Monitoring Plan</td>
</tr>
</tbody>
</table>

**Industrial hazards**

<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Spills from project infrastructure</td>
<td>Spills from project infrastructure</td>
<td>Soil, aquatic resources and community water supplies</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
<tr>
<td>8</td>
<td>Damage to project infrastructure</td>
<td>Damage to buildings or storage tanks from road traffic accidents resulting in contamination of land or water</td>
<td>Soil, aquatic resources and community water supply</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
<tr>
<td>No.</td>
<td>Hazard</td>
<td>Consequence</td>
<td>Receptor</td>
<td>Consequence rating</td>
<td>Probability</td>
<td>Risk</td>
<td>Management Plan</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Damage to buildings and powerlines from road traffic accidents</td>
<td>Project infrastructure, worker health and safety</td>
<td>High</td>
<td>Unlikely</td>
<td>Significant</td>
<td>Traffic Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to pit stability or buildings due to poor blast design</td>
<td>Project infrastructure, worker health and safety</td>
<td>High</td>
<td>Rare</td>
<td>Medium</td>
<td>Operational Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to project infrastructure from extreme wind speeds</td>
<td>Project infrastructure</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to site infrastructure due to avalanche</td>
<td>Project infrastructure</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to site infrastructure due to landslide/seismic event</td>
<td>Project infrastructure, worker health and safety</td>
<td>High</td>
<td>Unlikely</td>
<td>Significant</td>
<td>Emergency Preparedness and Response Plan</td>
</tr>
<tr>
<td>9</td>
<td>Loss of containment of hazardous materials including cyanide</td>
<td>Spills from project infrastructure and contamination of land or water</td>
<td>Soil, aquatic resources and community water supply</td>
<td>Moderate</td>
<td>Unlikely</td>
<td>Medium</td>
<td>Construction Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inhalation or absorption of hazardous substances by site workers</td>
<td>Worker health and safety</td>
<td>High</td>
<td>Unlikely</td>
<td>Significant</td>
<td>Hazardous Materials Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spills from transportation</td>
<td>Soil, aquatic resources and community water supply</td>
<td>Moderate</td>
<td>Unlikely</td>
<td>Medium</td>
<td>Hazardous Materials Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Traffic Management Plan</td>
</tr>
<tr>
<td>No.</td>
<td>Hazard</td>
<td>Consequence</td>
<td>Receptor</td>
<td>Consequence rating</td>
<td>Probability</td>
<td>Risk</td>
<td>Management Plan</td>
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</tr>
<tr>
<td>10</td>
<td>Road traffic accidents</td>
<td>Damage to project infrastructure                                            See hazard no. 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hazardous material spills                                                   See hazard no. 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-hazardous material spills                                               Soil, aquatic resources and community water supply.                 Minor               Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Vehicle collision causing injury or death                                   Other road users (including pedestrians)                               Major               Possible</td>
<td>High</td>
<td>Traffic Management Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Damage to public infrastructure                                             Roadside infrastructure such as bridges and powerlines.            Moderate            Possible</td>
<td>Significant</td>
<td>Traffic Management Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Injury to workers                                                           Workers on site                                                            High               Possible</td>
<td>Significant</td>
<td>Operational Management Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Seepage from waste rock</td>
<td>Contamination of water and aquatic environment                             Aquatic resources and community water supply.                       Minor               Likely</td>
<td>Medium</td>
<td>Construction Management Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water Management Plan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Environmental Monitoring Plan</td>
</tr>
<tr>
<td>No.</td>
<td>Hazard</td>
<td>Consequence</td>
<td>Receptor</td>
<td>Consequence rating</td>
<td>Probability</td>
<td>Risk</td>
<td>Management Plan</td>
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</tr>
<tr>
<td>12</td>
<td>Tailings dam failure</td>
<td>Contamination of water, aquatic environment and land affected by tailings and or waste rock material, loss of life</td>
<td>Local communities (Shtuka, Ilovica, Turnovo, Sekirnik), aquatic environment (Shtuka River, Strumica River) and terrestrial environment. Potential for transboundary impacts to the aquatic environment.</td>
<td>High</td>
<td>Rare</td>
<td>Significant</td>
<td>■ Emergency Preparedness and Response Plan</td>
</tr>
</tbody>
</table>
| 13  | Failure of Shtuka River diversion channel       | Increased seepage from tailings dam                                          | Aquatic resources and Shtuka community water supply                      | Moderate           | Unlikely    | Medium    | ■ Water Management Plan  
■ Environmental Monitoring Plan  
■ Closure Plan |
|     | Tailings dam failure                            | See hazard no.12                                                             |                                                                          |                    |             |           |                                                     |
|     | Overtopping of the TMF flood attenuation capacity|                                                                              | Property and effects in Shtuka                                           | High               | Rare        | Significant | ■ Construction Management Plan  
■ Emergency Preparedness and Response Plan |
| 14  | Failure of SWD                                  | Flooding in Shtuka village,                                                 | Property and effects in Shtuka                                           | High               | Rare        | Medium    | ■ Closure Plan  
■ Water Management Plan  
■ Emergency Preparedness and Response Plan |
| 15  | Failure of SCF                                  | Effects on local community water supplies and aquatic resources              | Aquatic resources in the Shtuka River and surface and groundwater resources for Shtuka community village water supplies | High               | Rare        | Significant | ■ Closure Plan  
■ Water Management Plan  
■ Emergency Preparedness and Response Plan |
<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
</thead>
</table>
| 16  | Failure of conveyance system from Pit lake to treatment system, post closure | Effects on local community water supplies and aquatic resources          | Jazga River (aquatic environment) and Ilovica Reservoir (irrigation water source)                     | High               | Rare        | Significant | Closure Plan  
Water Management Plan  
Emergency Preparedness and Response Plan |
| 17  | Failure of conveyance system from SCF to treatment system, post closure | Effects on local community water supplies and aquatic resources          | Aquatic resources in the Shtuka River and surface and groundwater resources for Shtuka community village water supplies | High               | Rare        | Significant | Closure Plan  
Water Management Plan  
Emergency Preparedness and Response Plan |
| 18  | Use of combustible or explosive materials                             | Fire during transportation to site                                        | Property in local communities, local infrastructure (e.g. roads)                                    | Moderate           | Rare        | Medium   | Hazardous Materials Management Plan  
Traffic management plan |
|     |                                                                        | Fire at fuel depot                                                        | Terrestrial fauna and flora and local communities                                                   | High               | Rare        | Medium   | Hazardous Materials Management Plan  
Emergency Preparedness and Response Plan |
|     |                                                                        | Fire damage to buildings or storage tanks resulting in contamination of land or water | Soil, aquatic resources and community water supply                                                 | Minor              | Unlikely    | Low      | No further mitigation required |
|     |                                                                        | Explosion during transportation                                           | Property in local communities, local infrastructure (e.g. roads)                                    | High               | Rare        | Medium   | Emergency Preparedness and Response Plan  
Hazardous Materials Management Plan |
|     |                                                                        | Air quality due to smoke from fire                                        | Local communities and terrestrial flora and fauna                                                   | High               | Rare        | Medium   | Environmental Monitoring Plan  
Hazardous Materials Management Plan |
<table>
<thead>
<tr>
<th>No.</th>
<th>Hazard</th>
<th>Consequence</th>
<th>Receptor</th>
<th>Consequence rating</th>
<th>Probability</th>
<th>Risk</th>
<th>Management Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Poor blast design</td>
<td>Fly rock</td>
<td>Health and safety of workers and surrounding land users (grazers, forestry). Damage to project infrastructure or local communities (Ilovica, Shtuka).</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excessive noise</td>
<td>Local communities</td>
<td>Minor</td>
<td>Unlikely</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excessive vibration</td>
<td>Local communities</td>
<td>Minor</td>
<td>Rare</td>
<td>Low</td>
<td>No further mitigation required</td>
</tr>
</tbody>
</table>
10.4 Management of Risk
As part of the ESIA, environmental and social management plans will be developed to provide details for the implementation of mitigation measures, management and monitoring required to avoid or minimise adverse impacts and to optimise beneficial effects of the Project.

These management plans will be live documents which will be updated on a regular basis throughout the life of the Project. Mitigation measures for the risks summarised in this chapter will steer the development on management procedures, policy and training for all workers on the site. The following sections present key issues to be addressed to manage the risks identified above.

10.4.1 Emergency Preparedness and Response Plan
The Emergency Preparedness and Response Plan will detail mitigation measures associated with the consequences of natural and industrial hazards. Emergency preparedness will be a key training for all staff and Euromax will ensure that the local emergency services are well versed in their procedures and agree the responsibilities of all parties prior to construction commencing. The necessary permits will be obtained.

The Emergency Preparedness and Response Plan will put in place early warning systems to alert local people and site workers of threats from natural hazards (e.g. landslides, floods, avalanche).

The Emergency Preparedness and Response Plan will describe procedures, in the event of a natural or industrial hazard, to safely exit/access and respond to any such event. For the risks identified in Table 10-3 these could include, but would not be limited to:

- Safe exit from the site and Ilovica and Shtuka in the event of a flood;
- Protocol in case of fire or explosion on site or en-route, including responsibilities of the Forestry Company;
- Protocol in case of an avalanche or landslide affecting access routes;
- Protocol in the case of an environmental spill or unplanned discharge; and
- Protocol in case of a seismic event.

The plan will follow the principles of raising Awareness and Preparedness for Emergencies at Local Level (APELL for mining) (UNEP, 2001) and will include:

- Disastrous release of reagents from the warehouse of reagents or from facilities for processing or recycling;
- Release during loading and mixing;
- Emissions in case of fire and explosion;
- Transportation accidents;
- Unplanned outflow from the tailings management facility or SCF;
- Breaking of pipelines, cranes and tankers;
- Accidents in the tailings management facility;
- Accidents at the SCF; and
- Power supply failure and break down of pumps.
10.4.2 Water Management Plan, including Sediment Management

The Water Management Plan will give details of construction, maintenance and operation of all water management on site including flow control structures and drainage (in catchment or in watercourses) and protocols on site for environmental protection and management of discharge to the environment.

This plan will also give details of construction maintenance and operation of all sediment control structures (in catchment or in watercourses) and protocols on site.

The plan will describe the procedure should any unplanned discharge occur to the environment and also aim to avoid slope instabilities resulting from deforestation, soil exposure, road construction and other activities associated with the Project which could cause slope failure.

10.4.3 Compliance Monitoring Plan

The Compliance Monitoring Plan will describe all environmental monitoring (type, frequency and procedure) to occur during construction and operations. The plan will provide the control (additional monitoring required) and trigger (emergency procedures or halt to operations required) values for any changes to the baseline environment.

The Compliance Monitoring Plan will also provide details of how the monitoring data will be publicised and how it will be regulated.

10.4.4 Transport Management Plan

The Traffic Management Plan will give details of all training and procedures for all drivers and the protocol should any unplanned events occur on site and off site that could cause harm to local communities or the environment.

The plan will describe the procedure and responsibilities should any road traffic accident occur.

10.4.5 Hazardous Materials Management Plan

The Hazardous Materials Management Plan will describe all protocols and regulations required to be adhered to by best practice and by the regulators. The procedures for all transport, handling, storage and disposal of hazardous materials (including cyanide) will be addressed.

The plan will describe the procedure should any unplanned discharge occur to the environment.

10.4.6 Construction Environmental Management Plan

The Construction Environmental Management Plan will guide how the detailed design incorporating the necessary mitigation measures will be implemented in the construction phase. It will refer to all other management plans applicable during the construction phase.

10.4.7 Closure Management Plan

The Closure Management Plan will guide how the detailed design incorporating the necessary mitigation and management measures will be implemented in the closure phase.
11.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM MANUAL

11.1 Introduction

The Project is a proposed open pit gold and copper mine located in the Municipalities of Bosilovo and Novo Selo, in southeastern Macedonia. An ESIA has been developed using data collected during a series of environmental and social studies conducted between 2013 and 2016.

The ESIA identifies and quantifies impacts that the Project will have on the biophysical and socio-economic environments by comparison to the ESIA baseline and Project environmental design criteria. Where identified as necessary, the ESIA proposes potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits to Macedonia, local communities and other stakeholders.

The Environmental and Social Management System (ESMS) provides a framework for the management of mine activities, ensuring standards are upheld throughout construction, the life of the mine and into closure, in accordance with the terms of the Macedonian regulator, Lenders, Investors and other stakeholders. The ESMS represents a commitment to maintaining the Project’s Environmental and Social licence to operate.

This ESMS manual outlines the contents of the ESMS and links to management plans located in Annex 6 of the ESIA. Management plans (MPs) and subordinate documents such as Standard Operating Procedures and Method Statements will be developed by Euromax and implemented throughout the life of the Project to provide the operational control required to meet the commitments of Euromax Policies and the ESIA. The ESMS will be reviewed and updated on a regular basis. This ESMS manual has been developed in line with the requirements of ISO14001:2015 in order to enable Euromax to attain certification to the environmental management standard for the Project in due course.

For the March 2017 version of the ESIA these management plans are largely undeveloped (with the exception of the Project Stakeholder Engagement Plan (SEP)) and this ESMS manual therefore, remains in draft. The draft management plans will be shared with Lenders and equity partners, and consultation on key plans will take place with stakeholders so that their suggestions and feedback can be incorporated as the ESMS is produced.

11.2 Euromax Policies and Procedures

The MPs will be aligned with relevant international good practice guidelines including the EBRD Environmental and Social Policy (2014) and Performance Requirements; IFC Performance Standards (2012); International Cyanide Management Code; Equator Principles and Sustainable Development Policies of ICMM, as well as meeting the requirements of Macedonian Legislation.

Contractors working on the Project will be required to adhere to the obligations of the environmental and social management plans and their ability to do this will be established during the pre-qualification and bidding phases, with requirements included in relevant contract clauses. Contractors will be required to submit health, safety and environment plans, or demonstrate their understanding of these issues to the HSEC Manager for approval prior to commencing work.

Current Euromax Policies are presented in Table 11-1 while procedures to be developed and implemented as the Project progresses are presented in Table 11-2.

Table 11-1: Euromax Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Policy</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Corporate Procurement Policy</td>
<td>2017</td>
<td></td>
</tr>
</tbody>
</table>

51 ISO14001 is currently in the process of transition from IS14001:2004 to ISO14001:2015. It is assumed that, when certified, the Project will operate under the updated accreditation.
ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Policy</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disclosure, Confidentiality &amp; Insider Trading Policy</td>
<td>2012</td>
<td>Revised 2014</td>
</tr>
<tr>
<td>Environmental Policy</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>EOX Code of Conduct and Ethics</td>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>Health and Safety Policy</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Recruitment Policy/HR Policy</td>
<td>2015</td>
<td>DRAFT only</td>
</tr>
</tbody>
</table>

Source: Euromax, December 2016

Table 11-2: Euromax Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESIA Stakeholder Engagement Plan</td>
<td>2017</td>
<td>Annex 2 of the ESIA</td>
</tr>
<tr>
<td>Grievance Mechanism</td>
<td>2015</td>
<td></td>
</tr>
<tr>
<td>Terms of Reference for Public Liaison Committee</td>
<td>2016</td>
<td>Draft only</td>
</tr>
<tr>
<td>Project Stakeholder Engagement Plan</td>
<td>2016</td>
<td>EOX is developing the SEP in conjunction with the public liaison committee</td>
</tr>
<tr>
<td>Land Access Resettlement Framework (LRF)</td>
<td>2016</td>
<td>Updates will be implemented through the LRP</td>
</tr>
<tr>
<td>Livelihood and Restoration Plan (LRP)</td>
<td>In development</td>
<td>To be developed as the Project progress</td>
</tr>
<tr>
<td>Risk Management</td>
<td>2016</td>
<td>Euromax have developed a Risk Register which will be updated as the Project programme progresses</td>
</tr>
<tr>
<td>Social Investment</td>
<td>2017</td>
<td>Draft only</td>
</tr>
</tbody>
</table>

11.3 Organisation

An organogram of the Euromax roles relating to the implementation and execution of the ESMS will be developed prior to commencement of construction.

11.4 Impact Analysis

An Aspects Register for the Project will be presented with the management plans located in Annex 6. This will identify the environmental and social commitments necessary to manage the effects associated with the Project’s activities. Included in this register will be any compliance obligations and any other commitments made by the project. This Register will serve as a tool to ensure that all commitments are addressed in an MP or elsewhere in project documentation and that the necessary control measures are put in place, and to track progress in meeting commitments. The Register will be reviewed and updated regularly.

11.5 Legal Register

The detailed requirements of the legal register will presented with the management plans in Annex 6. Euromax’s ESMS manager in conjunction with the in house Legal Counsel will be responsible for identifying, and regularly reviewing, all relevant legislation for the Project. Consequently, the Legal Register will be updated on an annual basis and after any change in pertinent legislation.

The Project’s legal register will be retained in a non-editable format and circulated to all staff on an annual basis reminding them of the need to comply with legislative requirements and alerting them to the location of the Legal Register. All employees, contractors and sub-contractors working on the Project will be responsible for carrying out their actions within the applicable legal requirements listed.
11.6 Objectives and Targets

Annex 6 will also include documented environmental and social objectives for the Project, and a plan setting out how these objectives will be met, with details of implementation responsibilities and, where possible measurable targets. Objectives will be managed by the Euromax’s ESMS Manager.

11.7 Operational Control

Operational control measures apply to all phases of the Project, including pre-construction, construction, operation, closure and post-closure. The following management plans will present management and monitoring practices to be adopted and developed by Euromax’s ESMS Manager in line with European Bank for Reconstruction and Development (EBRD) Performance Requirements (PRs). The following will be included in Annex 6 of the ESIA:

- Environmental Compliance Plan;
- Water Management Plan;
- Construction Environmental Management Plan;
- Biodiversity Management Plan;
- Cultural Heritage Management Plan;
- Soils, Rehabilitation and Reclamation Plan;
- Social Management Plans, including:
  - Workers Health and Safety Plan;
  - Community Health, Safety and Security Management Plan;
  - Land Acquisition and Resettlement Framework (LARF) and a Livelihood Restoration Plan (LRP);
  - Human Resources Plan;
  - Local Content and Procurement Plan; and
  - Community Investment Plan.
- Traffic and Transport Management Plan;
- Hazardous and Non Hazardous Waste Management Plan;
- Hazardous Materials Management Plan;
- Mine Waste Management Plan;
- Emergency Preparedness and Response Plan;
- Resources Efficiency Plan;
- Conceptual Closure Plan; and
- Project Stakeholder Engagement Plan52.

The following provides a brief description of the objectives of each of the aforementioned plans.

11.7.1 Environmental Compliance Plan

The Environmental Compliance Plan will describe the practices and policies required to demonstrate environmental compliance in line with the environmental permitting of the Project and the commitments to meet national and international regulation presented in the ESIA, and in line with EBRD PRs 1 and 3.

This plan will include triggers, controls relating to compliance to national and international standards, the approaches to demonstrating environmental monitoring and reporting.

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52 The Project Stakeholder Engagement Plan (SEP) differs from the ESIA SEP presented in Annex 2 of the ESIA, which describes the engagement processes and outcomes from the ESIA process. The Project SEP will describe processes and practices to be put in place throughout the life of the Mining Project.
It will be a Golder Associates generated document, approved by Euromax.

11.7.2 Water Management Plan
The Water Management Plan will give details of construction, maintenance and operation of all water management on site including flow control structures, active or passive treatment and drainage and complement the Environmental Compliance Plan with protocols for environmental protection and management of discharge to the environment.

The Water Management Plan will also present details of construction maintenance and operation of all sediment control structures (in catchment or in watercourses) and protocols to be adopted on site and will complement the Mine Waste Management Plan when relating to management of geochemistry and related water quality.

It will be a WSP Parsons Brinkerhoff and Golder Associates generated document, approved by Euromax.

11.7.3 Construction Environmental Management Plan
The Construction Environmental Management Plan guides how the detailed design incorporating the necessary mitigation measures will be implemented in the construction phase. It refers to all other management plans and outlines policies, procedures and training required to be in place prior to and during the construction period.

It will be a Golder Associates generated document, approved by Euromax.

11.7.4 Biodiversity Management Plan
The Biodiversity Management Plan (BMP) supports conservation through the implementation of practical operational methods and conservation program management and the development of the off-set feasibility study. Protocols and training will be identified to conserve the biodiversity of the Project area in line with mitigation or management practices identified in the ESIA, all in line with national and international standards such as EBRD PR 6.

The BMP will present protocols for monitoring protection of biodiversity assets, improvements and tracking rehabilitation of the site for all workers, including contractors and sub-contractors.

It will be a Golder Associates generated document, approved by Euromax.

11.7.5 Cultural Heritage Management Plan
The Cultural Heritage Management Plan will describe the practices and procedures required to meet commitments of national and international regulation (such as EBRD PR 8) and all management and mitigation presented in the ESIA.

This plan will include Chance Find Procedures and other cultural heritage management practices relating to national and international compliance practices to ensure the safeguarding of any culturally sensitive or archeologically significant finds and heritage assets.

It will be a Golder Associates generated document, approved by Euromax.

11.7.6 Soils, Rehabilitation and Reclamation Plan
The Rehabilitation and Reclamation Plan will describe the strategy for stockpiling, storage and maintenance of material for rehabilitation, reclamation and revegetation. It will also complement the BMP in describing the development of a revegetation nursery for slope stabilisation and biodiversity purposes.

The plan will also include generic methods and strategies of progressive and closure reclamation and rehabilitation, including sources and types of soil forming materials (such as sediment from sediment control structures and compost), revegetation methods including trial plots, pit planting, small scale seeding and hydoseeding.

It will be a Golder Associates generated document, approved by Euromax.
11.7.7 Social Management Plans

Social management plans describe the immediate and future commitments to manage and mitigate impacts identified in the ESIA with a view to minimizing impacts and maximizing benefits for project affected stakeholders. Some stakeholders will be more affected than others, depending on their proximity to and interactions with the Project.

11.7.7.1 Workers Health and Safety Plan

The Workers Health and Safety Plan will describe the code of conduct, practices and procedures required to meet commitments to national and international regulation (including EBRD PRs 2 and 4), including, but not limited to, policies for zero tolerance on the abuse of controlled substances and alcohol, zero-tolerance on workplace harassment and discrimination, recrimination free opportunities for workers to express concerns and grievances, prohibitions against illegal activity, harassment, verbal and physical abuse, prohibition of negligence in driving company vehicles, and other behaviours that may be identified by people in communities as offensive or problematic.

The plan must ensure Euromax achieves high standards of health and safety in all activities in which Euromax is engaged with all workers, including contractors and sub-contractors. This includes including first aid training and stations, appropriate equipment for all activities.

It will be a Euromax generated document, reviewed by Golder Associates.

11.7.7.2 Community Health, Safety and Security Plan

The Community Health, Safety and Security Plan will describe the guidance and operational procedures relevant to meet commitments to national and international regulation (including EBRD PR 4), and to meet commitments presented in the ESIA.

The plan will describe the roles and responsibilities associated with a continued social licence to operate and describe any training required. It will describe partnership with local authorities and stakeholders, including, but not limited to, local government, health authorities and community liaison groups. The plan will describe the required monitoring and measuring of any impacts to local livelihoods, health and safety and security throughout the project and the reporting procedures, including Key Performance Indicators.

It will be a Golder Associates generated document, approved by Euromax.

11.7.7.3 Land Acquisition and Resettlement Framework and Livelihood Restoration Plan

The Land Acquisition and Resettlement Framework for the project has already been developed and disclosed, and the Livelihood Restoration Plan is in development. Both documents conform to both national and international regulations in particular EBRD’s PR5 and will guide the implementation of mitigation for land use effects of the Project.

The LARF contains sections on legal and policy framework, objectives, principles and approach, eligibility and entitlements, land acquisition and compensation processes, public consultation and disclosure, a grievance procedure, an outline timetable for land acquisition, monitoring and reporting. Land acquisition is both temporary (for the temporary access road) and permanent (for the permanent access road and OHL). Land users as well as land owners will be appropriately compensated (for example graziers and fungi collectors who use the concession) and cultural heritage aspects are also respected.

A series of Livelihood Restoration Plans will be developed, each focussing on an area and type of land to be acquired. Initially, these will focus on the temporary access road and the concession, then the permanent access road, the OHL to Berovo and the water pipeline which will bring water to the project from Turija reservoir. The LRPs will have a similar structure to the LARF but will contain more detail about eligibility and entitlements, identification of affected parties, land and assets, compensation, livelihood and assistance packages being offered.

They will be developed in close co-operation with Euromax by Van Zyl Consulting.
11.7.4 Human Resources Plan

The Human Resources Plan will cover issues relating to human resources throughout the life of the Project. It will inform Euromax policy and will be developed to meet commitments presented in the ESIA and in line with EBRD PR 2.

It will include a description of approaches to develop mining-related educational and training programs for semi-skilled and skilled positions and offers of internships and scholarships to students interested in mining employment. It will outline how to communicate Project-related opportunities and provide guidance on the recruitment process, how to create career development plans for employees whilst developing continuous education and training initiatives, guidelines on mentoring staff developing recruitment policy, including equal opportunities.

It will be a Euromax generated document, reviewed by Golder Associates.

11.7.5 Local Content and Procurement Plan

The Local Content and Procurement Plan will cover issues relating to the purchase of goods and services from local businesses throughout the life of the Project. It will inform the further development of Euromax’s Local Content and Procurement Policy and will be developed to meet the commitments presented in the ESIA and in line with national and international regulations.

The focus of this plan is to ensure that Euromax and their subcontractors maintain a Social Licence to Operate through good community and local stakeholder relationships, adherence to Macedonian governmental expectations and provide benefits to the local community by creating sustainable business opportunities with local enterprises.

It will be a Euromax generated document, reviewed by Golder Associates.

11.7.6 Community Investment Plan

The Community Investment Plan will be developed in support of community development initiatives and will identify and prioritise community needs. It will identify investment in community development schemes throughout the life of the project, including post closure, which reflect core business activities. It will describe how Euromax can work in partnership with the community using clear and equitable selection criteria and a transparent project funding process.

It will be a Euromax generated document, reviewed by Golder Associates.

11.7.8 Traffic and Transport Management Plan

The Traffic and Transport Management Plan will outline the roles and responsibilities for the transport of people or materials associated with the Project in line with mitigation or management practices identified in the ESIA, and in line with national and international standards and best practice.

It will give details of training and operational procedures for all drivers, guidelines for monitoring and reporting procedures, including Key Performance Indicators, and the protocol should any unplanned events occur on- or off-site that could cause harm to workers, local communities or the environment.

It will be a Golder Associates generated document, approved by Euromax.

11.7.9 Hazardous and Non Hazardous Waste Management Plan

The Waste Management Plan will describe roles and responsibilities and methods for managing all types of non-mining waste generated by the Project, including construction waste, hazardous and medical waste, domestic waste, emergency response waste and sewage. It will outline plans for the minimisation of waste through re-use and recycling. It will be written with reference to national and international regulations, and with reference to best available technology (BAT).

The plan will present procedures and guidelines for the training of workers, including contractors and subcontractors, on waste reduction, re-use, recycling and reclaiming. It will define waste management
infrastructure and equipment and an approach to implementing a monitoring regime to ensure successful management is in place, while outlining guidelines on remedial or corrective actions to improve performance if required. The Plan will complement procedures outlined in other management plans including the BMP, the Rehabilitation and Reclamation plan and the Environmental Compliance Plan.

It will be a Golder Associates generated document, approved by Euromax.

11.7.10 Hazardous Materials Management Plan

The Hazardous and Non-Hazardous Materials Management Plan will describe all protocols, roles, responsibilities and regulations to be adhered to, in line with national and international regulations, including the International Cyanide Management Code, and with reference to best practice.

It will give details of all training and operational procedures for all workers, including contractors and subcontractors, for transport, handling, storage and disposal of hazardous materials (including cyanide), guidelines for monitoring and reporting procedures, including Key Performance Indicators and the protocol should any unplanned events occur on site and off site that could cause harm to workers or local communities or the environment.

It will be a Golder Associates generated document, including key input from an International Cyanide Management Code (ICMC) auditor and approved by Euromax and Ausenco.

11.7.11 Mine Waste Management Plan

The Mine Waste Management Plan will refer heavily to the Tailings operational manual. This plan will present roles and responsibilities, training and operational procedures for the mine waste management of materials including, but not limited to, tailings, waste rock and acid rock drainage generating material, complementing the Water Management Plan when relating to management of geochemistry and related water quality. It will be developed in line with mitigation or management practices identified in the ESIA, and national and international standards and best practice.

It will give details of all training and operational procedures for the transport, handling, storage and disposal of mine waste, including provisions for the monitoring and reporting against Key Performance Indicators and outline the protocol should any unplanned events occur on site that could cause harm to workers, local communities or the environment.

It will be a Golder Associates and WSP Parsons Brinkerhoff generated document, approved by Euromax.

11.7.12 Emergency Preparedness and Response Plan

The Emergency Preparedness and Response Plan will address the consequences of natural and industrial hazards and describe procedures, in the event of a natural or industrial hazard, to safely exit/access and respond to any such event. Emergency preparedness will be a key training for all workers, including contractors and sub-contractors. There will be two elements to the EPRP; procedures to manage those accidents that occur within the mine site and which do not have the potential to migrate off site through air, water or solids material (such as a landslide) and those accidents which occur outside of the mine property (including associated infrastructure, such as the access roads), or the effects of which could be felt beyond the project boundary, for example through air quality or water quality.

Euromax will work with the local emergency services to get the appropriate plans developed and approved. This will also ensure that local emergency services are well versed in their procedures and agree the roles and responsibilities of all parties prior to construction commencing.

The Emergency Preparedness and Response Plan will put in place early warning systems to alert local people and site workers of threats from natural hazards (e.g. landslides, floods, avalanches) and inform them how to respond in case of such an accident. The plan will also contain the necessary elements of the ICMC covering transport of cyanide, although it is anticipated that these will be implemented by the contractor who brings the cyanide to site, who will be an ICMC registered carrier.

It will be a Euromax generated document, reviewed by Golder Associates.
11.7.13 Resource Efficiency Plan
The Resource Efficiency Plan will be a strategic document presenting guidelines on the use of natural resources and defining efficiency targets to be met including, but not limited to, water use and recycling, waste management and recycling and energy and fuel use.

Protocols and training will be identified in line with mitigation or management practices identified in the ESIA and with adherence to national and international standards such as EBRD PR 3.

It will be a Golder Associates generated document, approved by Euromax.

11.7.14 Conceptual Closure Plan
The Conceptual Closure Plan will describe the operational procedures, training and design criteria for closure of the Project. The plan will define all roles and responsibilities for closure and post closure activities relating to the Project legacy. It will include, but not be limited to:

- Guidelines on the decommissioning of all facilities;
- The closure water management strategy, including details of water treatment and geochemistry post closure and mine waste at closure (to complement the Water Management Plan and Mine Waste Management Plan);
- Demobilisation of workforce;
- The mitigation of social impacts and development of social investment strategies post closure;
- Disposal or management of all waste materials generated from decommissioning facilities;
- Details of any technical studies and funding required for the closure commitments presented in the ESIA;
- Rehabilitation, reclamation and revegetation of all land used by the Project (in line with the rehabilitation and reclamation plan), legacy agreements for infrastructure which will remain post closure (e.g. roads); and
- Post closure monitoring and remedial measures post closure.

The Conceptual Closure Plan will lay down the framework for closure plans to be developed throughout the Project life and include reference to required closure funding as set out in the Project’s Definitive Feasibility Study budget (AFW 2016)

It will be a Golder Associates and WSP Parsons Brinkerhoff generated document, approved by Euromax.

11.7.15 Project Stakeholder Engagement Plan
The Project Stakeholder Engagement Plan (SEP) builds on the ESIA SEP and maps out all stakeholder relationships and engagements for the life of the mine through to post closure, to ensure Euromax maintain their Social Licence to Operate. Protocols, roles and responsibilities and training for workers, including subcontractors, and stakeholders will be identified in line with requirements identified in the ESIA and the ESIA SEP.

The Project SEP includes details of community liaison, the Project Grievance mechanism, nuisance management and monitoring (e.g. noise, artificial light, odours), community interaction (e.g. prior notification of noisy activities, road congestion). The SEP will describe the required monitoring and reporting of stakeholder engagement throughout the Project and following closure while providing guidelines on reporting, including Key Performance Indicators, in line with national and international standards such as EBRD PR 10.

It is a Euromax generated document, which will be regularly reviewed and updated.
11.8 Document Control
Each management plan will be a live document and as such each plan will have an owner in Euromax, who will be responsible for updating the management plans as and when required and ensuring each version of the document is provided with a unique number and date and that all are logged in a document database, which will be available to regulators and auditors at any time.

Euromax will be responsible for developing a document control protocol and policy. All workers, and subcontractors, will be provided with training in document control.

11.9 Competency Training and Awareness
Euromax will be responsible for developing a Competency Training and Awareness programme. All workers, and subcontractors, will be provided training. All training associated with management plans should be recorded and kept up to date throughout the life of the mine.

11.10 Communication
Prior to commencement of the Project, Euromax will develop a policy and procedure to guarantee that those communications received or sent in relation to the Project are documented and appropriately controlled.

Incoming and outgoing emails that have a technical or contractual content will be printed and filed in the appropriate file and/or saved in the relevant project electronic file.

A document register will be maintained. Procedures are put in place so that outgoing communications with contractual or technical content may be attached to email in an unalterable format.

11.11 Auditing and Compliance Assessment
Prior to commencement of the Project, Euromax will develop an auditing procedure, with a designated responsible person in Euromax, which applies to all internal audits carried out in relation to the Project.

As part of this procedure, environmental compliance assessments will be established to evaluate fulfilment of compliance obligations.

The procedure details the system for the planning, execution and recording of auditing sessions and outlines methodologies to enable the recognition of, and the need for, improvement and implementation of any resultant preventative, or corrective, actions.

11.12 Monitoring and Measurement
Each management plan will be a live document and as such each plan will have a designated responsible person in Euromax, whom will be responsible for the monitoring, measurement and recording of all activities associated of the plan.

11.13 Non-conformance Reporting
At deviation from expected procedure, ‘high-risk’ items will be identified, which might put the company at risk if the procedures are not followed. A Non-conformance Report (NCR) will be completed by the issue owner/responsible person when non-conformance or improvement opportunity has been identified. As part of the NCR, time constrained measures will be identified for remedial action.

11.14 Management Review
Euromax Management will be responsible for ensuring monitoring, measurement and recording of all commitments in the ESIA and in the ESMS. A protocol should be in place prior to commencement of the Project to review progress against the commitments register, review learnings, audits, NCRs and grievances on a regular basis.
12.0 CONCLUSIONS AND RECOMMENDATIONS

12.1 Summary of Conformance

Euromax Resources is committed to adhering to the national laws and regulations of the Republic of Macedonia. In addition to meeting the relevant national legislative and regulatory requirements, this ESIA has been compiled in order to meet with the requirements for international investors, including the European Bank for Reconstruction and Development (EBRD) and has taken into account various other international standards and guidelines for good international industry practice.

A compliance analysis to EBRD Performance Requirements will be included in Annex 6, once the ESMS is completed.

12.2 Conclusion of the EIA

The ESIA presents how positive effects of the Project will be supported by benefit enhancement measures, while negative effects will be minimised to the greatest extent possible through management and mitigation measures.

The ESIA presents that, with the successful implementation of the mitigation measures and management plans presented herein, any adverse environmental and social impacts identified are considered acceptable throughout the life of the Project (construction, operations and closure).

All residual impacts identified for geomorphology, terrain and soils, water quality and quantity (following additional mitigation identified under aquatic biodiversity), sediment, ecosystem services and vibration, are low, minor or negligible. A summary of residual impacts for the Project is included in Table 12-1 below.
### Table 12-1 Summary of Residual Impacts

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geomorphology, terrain and soils</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Control of erosion/ sediment loading</td>
<td>Moderate</td>
<td>Erosion control measures incorporated into the Project design.</td>
<td>Low</td>
</tr>
<tr>
<td>Construction, operations, closure, Post-closure</td>
<td>Agricultural land use</td>
<td>Moderate</td>
<td>Road will be routed to minimise loss of productive agricultural land.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Grazing land use</td>
<td>Moderate</td>
<td>Reclamation, monitoring of soil quality.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Forestry land use (fuel, timber)</td>
<td>Major</td>
<td>Capping of TMF with soil or waste rock. Long-term monitoring.</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Water Quantity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations (Yr 20) and Closure (Yr 27)</td>
<td>Jazga River at Ilovica water supply intake</td>
<td>Major</td>
<td>Facilitating new village water supply systems for Ilovica and Shtuka and decommissioning Ilovica and Shtuka intakes on the Jazga and Shtuka rivers.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Year 20) and Closure (Yr 27)</td>
<td>Jazga River upstream, of Ilovica Reservoir</td>
<td>Major</td>
<td>None</td>
<td>Major (see aquatic biodiversity)</td>
</tr>
<tr>
<td>Construction (Yr -1)</td>
<td>Ilovica reservoir</td>
<td>Moderate</td>
<td>Euromax to minimise abstraction of water from Ilovica Reservoir for construction purposes. Develop alternative sources of water supply for mine construction.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Yr 20) and Closure (Yr 27 onwards)</td>
<td>Jazga River downstream of Ilovica reservoir</td>
<td>Major</td>
<td>Euromax to work with SPWMC and others to design, construct and operate supply from Turija Reservoir. At closure, the water supply infrastructure, power supply and pumps will be maintained, linking the Turija pipeline with Ilovica Reservoir and Ilovica WTW. Euromax to work with SPWMC and others to pump water into Ilovica Reservoir from Turija Reservoir to augment river inflows prior to the pit lake spilling.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Operations (Yr 20)</td>
<td>Jazga River downstream of Ilovica reservoir</td>
<td>Major</td>
<td>Euromax to agree with SPWMC that they will make a limited number of releases of water from Ilovica Reservoir of agreed magnitude (flow) and duration (a few days).</td>
<td>Negligible</td>
</tr>
<tr>
<td>Post Closure (Yr 110+)</td>
<td>Jazga River through Ilovica</td>
<td>Moderate</td>
<td>Euromax to design provision of storage and attenuation for flood waters.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Post Closure (Yr 27+)</td>
<td>Shtuka River at the intake</td>
<td>Major</td>
<td>Euromax will develop engineering designs for water management on the TMF to maintain low flow downstream.</td>
<td>Minor</td>
</tr>
<tr>
<td>Project Phase/s</td>
<td>Receptor</td>
<td>Impact before mitigation</td>
<td>Mitigation</td>
<td>Residual impact classification</td>
</tr>
<tr>
<td>------------------------</td>
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<td>-------------------------------</td>
</tr>
<tr>
<td>Operations Years 1 and 2-20</td>
<td>Turija irrigation area</td>
<td>Moderate</td>
<td>Euromax to agree with SPWMC to operate abstraction from the proposed refurbished Turija pipeline to ensure flow remains in the Turija pipeline downstream of Euromax’s abstraction point.</td>
<td>Minor</td>
</tr>
<tr>
<td>Post pit lake (Yr 110)</td>
<td>Jazga River at Ilovica water supply intake</td>
<td>Major</td>
<td>Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, plus decommission Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. Euromax will collect the pit lake overflow and pipe to a passive or active treatment system where the pH will be neutralised and metal concentrations will be reduced (as described in Table 6-1).</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>Ilovica reservoir</td>
<td>Major</td>
<td>Euromax will collect the pit lake overflow and pipe to a passive or active treatment system where the pH will be neutralised and metal concentrations will be reduced (as described in Table 6-1).</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>Jazga River at Radovo</td>
<td>Moderate</td>
<td>Euromax will collect the pit lake overflow and pipe to a passive or active treatment system where the pH will be neutralised and metal concentrations will be reduced (as described in Table 6-1).</td>
<td>Negligible</td>
</tr>
<tr>
<td>Water Quality</td>
<td></td>
<td></td>
<td>Euromax will co-fund with Bosilovo Municipality and SPWMC new village water supply systems for Ilovica and Shtuka, to be commissioned before mine construction stage starts, and decommission Ilovica and Shtuka intakes on the Jazga and Shtuka rivers. Euromax will construct a grout or gel curtain at the SCF to capture 95% of the flow of contaminated groundwater under the SCF, encapsulate acid generating material in the TMF embankment and develop methods for stabilizing and reducing infiltration into and runoff from the TMF embankment surface using vegetation. Euromax will treat seepage captured in the SCF that is not suitable for discharge in a treatment plant. The SCF will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted and comply with project water quality standards.</td>
<td>Negligible (water supply security) Low (other receptors)</td>
</tr>
<tr>
<td>Operations (Yr 20)</td>
<td>Shtuka River at Shtuka water supply intakes</td>
<td>Major (all phases)</td>
<td>Euromax will construct a grout or gel curtain at the SCF to capture 95% of the flow of contaminated groundwater under the SCF, encapsulate acid generating material in the TMF embankment and develop methods for stabilizing and reducing infiltration into and runoff from the TMF embankment surface using vegetation. Euromax will treat seepage captured in the SCF that is not suitable for discharge in a treatment plant. The SCF will be sized to ensure that, following closure, overflows due to storm events will be adequately diluted and comply with project water quality standards.</td>
<td>Negligible (water supply security) Low (other receptors)</td>
</tr>
<tr>
<td>Closure (Yr 21)</td>
<td>Shtuka River at Sekirnik road bridge</td>
<td>Moderate</td>
<td>As above for Shtuka River at Shtuka water supply intakes.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Closure (Yr 220)</td>
<td>Shtuka River - downstream of TMF and diversion</td>
<td>Moderate</td>
<td>SWD will be constructed prior to TMF stripping and construction, flocculation in SWD.</td>
<td>Low</td>
</tr>
</tbody>
</table>

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## ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise &amp; Vibration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Shtuka</td>
<td>Moderate</td>
<td>Sensitive timing of works, screening of noisy activities.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Sekirnik</td>
<td>Moderate</td>
<td>Sensitive timing of works and screening of noisy activities.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Operations</td>
<td>Shtuka</td>
<td>Major</td>
<td>Acoustic barrier adjacent to access road.</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>Sekirnik</td>
<td>Major</td>
<td>Acoustic barrier adjacent to access road.</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction and operations</td>
<td>Terrestrial habitats – forest communities (excluding the TMF)</td>
<td>Moderate</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Revegetate project footprint to forest and scrub mosaic which reflects baseline conditions.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Terrestrial habitats – forest communities (TMF)</td>
<td>Major</td>
<td>Salvage flora SoCC during site clearance, for use in progressive ecological restoration. Revegetate TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates.</td>
<td>Major</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Critical Habitat - Habitats supporting endangered species – Ogražden Prime Butterfly Area</td>
<td>Major</td>
<td>Deliver BMP and biodiversity offset feasibility study in consultation with local and regional experts. Avoid disturbance to high quality pasture at higher elevations. Fences to be installed to prevent access. Maintain the existing access and grazing regime (or replicate through artificial means) for the higher elevation grasslands. Compensatory habitat creation will be undertaken by revegetating the TMF to pasture and scrub mosaic at closure plus offsetting feasibility study delivery.</td>
<td>Moderate ( (potentially \text{ moderate positive post-closure}) )</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Flora SoCC</td>
<td>Moderate</td>
<td>As feasible, salvage flora SoCC during site clearance Revegetate project footprint (except TMF) to forest and scrub mosaic. Revegetate TMF to pasture and scrub mosaic at closure. Avoid disturbance to high quality pasture at higher elevations. Fences to be installed to prevent access.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post closure</td>
<td>Terrestrial fauna SoCC (non-butterfly)</td>
<td>Moderate</td>
<td>Pre-clearing rapid surveys plus selective SoCC salvage and relocation. Undertake progressive ecological restoration to minimise impacts to wildlife. Placement of artificial bat roosting habitat. Implement invasive fauna mitigations.</td>
<td>Minor</td>
</tr>
<tr>
<td>Project Phase/s</td>
<td>Receptor</td>
<td>Impact before mitigation</td>
<td>Mitigation</td>
<td>Residual impact classification</td>
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<tr>
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</tr>
<tr>
<td>Operations, closure</td>
<td>Aquatic habitat and species – Upstream of Ilovica Reservoir</td>
<td>Moderate</td>
<td>Seasonal constraints applied to earth works. Removal of bird nesting habitat outside of the nesting season. Prior to construction activities, carry out an assessment of amphibian and reptile migration corridors.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction, operations, closure, post-closure</td>
<td>Aquatic habitat and species – Shtuka River upstream of SWD</td>
<td>Major</td>
<td>Undertake fish and decapod rescue prior to closure of the Shtuka River.</td>
<td>Major</td>
</tr>
<tr>
<td>Post-closure</td>
<td>Aquatic habitat and species – Shtuka River downstream of TMF</td>
<td>Moderate</td>
<td>Define design criteria for grout curtain and SCF design to ensure protection of aquatic habitats and species.</td>
<td>Minor</td>
</tr>
</tbody>
</table>

**Ecosystem Services**

| Operation, post-closure | Freshwater Type 1 | Major | Euromax to work with SPWMC and others to ensure the supply of water to the WTW will be switched from Ilovica reservoir to Turija reservoir. Water intakes on both Jazga and Shtuka to be decommissioned. Euromax to agree with SPWMC to ensure a prescribed flow remains in the Turija pipeline downstream of Euromax’s abstraction point. Active and or passive treatment of water discharge from the TMF following closure, plus active treatment of discharge from the pit lake once formed following closure. | Minor |
| Operations, post-closure | Freshwater Type 2 | Major | A water pipeline will be constructed between Turija reservoir and Ilovica WTW to preserve the reliability and quality of water entering the WTW. | Minor |
| Construction and operation | Erosion Control type 1 and 2 | Moderate | Development of stable embankment slopes, mechanical stabilisation and installation of erosion control features, and prompt revegetation of appropriate areas. Installation of physical erosion control features. | Minor |
| Construction, operation, closure and post closure | Regulation of Water and Slowing of the water cycle (including Filtering water) | Moderate | Construction of SWD. Zero surface water discharge from the site during construction and operations phases. | Minor |
## ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction, operation, closure and post closure</td>
<td>and slowing of the water cycle)</td>
<td>Moderate</td>
<td>Passive and active treatment and closure and post closure.</td>
<td></td>
</tr>
<tr>
<td>Cultural Heritage</td>
<td>Ethical and Spiritual Values</td>
<td>Moderate</td>
<td>Relocation of receptors and photographic logging and preservation of sites.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction</td>
<td>Preslop Spring Memorial Stone</td>
<td>Moderate</td>
<td>Relocation of receptor.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Shtuchki Vodopad</td>
<td>Moderate</td>
<td>Photographic recording and enhanced access.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Religious beliefs and practices</td>
<td>Moderate</td>
<td>Sympathetic construction schedule.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Adit/Tunnel Site</td>
<td>Moderate</td>
<td>Photographic recording.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Domus Gaber</td>
<td>Moderate</td>
<td>Archaeological watching brief.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Preslop</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Krvavichevo and Golemata Niva</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Gradishte</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Old Mill</td>
<td>Moderate</td>
<td>Archaeological evaluation and excavation.</td>
<td>Minor</td>
</tr>
<tr>
<td>Construction and operation</td>
<td>Anovi (AR-06)</td>
<td>Major</td>
<td>Archaeological evaluation and excavation.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Operation</td>
<td>Religious beliefs and practices</td>
<td>Major</td>
<td>Sympathetic blasting regime.</td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Crkvishte (AR-04)</td>
<td>Moderate</td>
<td>Sympathetic blasting regime and visual inspection and vibration monitoring.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Construction, operation</td>
<td>Economy</td>
<td>High (positive)</td>
<td>None Required.</td>
</tr>
<tr>
<td></td>
<td>Construction, operation</td>
<td>Employment</td>
<td>High (positive)</td>
<td>None Required.</td>
</tr>
<tr>
<td></td>
<td>Construction, operation</td>
<td>Incomes</td>
<td>High (positive)</td>
<td>None Required.</td>
</tr>
</tbody>
</table>
### ILOVICA-SHTUKA ESIA

<table>
<thead>
<tr>
<th>Project Phase/s</th>
<th>Receptor</th>
<th>Impact before mitigation</th>
<th>Mitigation</th>
<th>Residual impact classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction and operation</td>
<td>Population and health</td>
<td>Moderate</td>
<td>Euromax will assist in improving the Ilovica clinic.</td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td>All phases</td>
<td>Noise for local communities</td>
<td>Moderate</td>
<td>Considered above.</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Visual for local communities</td>
<td>Moderate - High</td>
<td>None practical.</td>
<td>Moderate to High</td>
</tr>
<tr>
<td></td>
<td>Perception of harm by local</td>
<td>High</td>
<td>Public education of environmental effects.</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>communities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation, post-closure</td>
<td>Physical infrastructure</td>
<td>Moderate (positive)</td>
<td>None required.</td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td>All phases</td>
<td></td>
<td></td>
<td></td>
<td>Moderate (positive)</td>
</tr>
<tr>
<td>Construction, operation</td>
<td>Land use – grazing and forestry</td>
<td>Moderate - High</td>
<td>Addressed through LRP.</td>
<td>Negligible – Low</td>
</tr>
<tr>
<td>All phases, post-closure</td>
<td>Land use – forestry land over TMF</td>
<td>High</td>
<td>None. TMF will be restored to scrub, there is net positive impact on biodiversity at closure, but forest users remain impacted through all phases.</td>
<td>High</td>
</tr>
</tbody>
</table>
The following residual impacts were identified as moderate or high and warrant reference in this conclusion:

- Noise in Shtuka and Sekirnik during access road construction has potential to present a moderate residual impact. Mitigation has been presented, but may not fully mitigate the impacts. Therefore community consultation and sensitive working (e.g. selection of low-noise plant) will be maintained throughout the construction period;

- Land take of habitats supporting endangered species in the Ograzden Prime Butterfly Area has the potential to have a moderate residual impact. However Euromax has committed to maintain the existing grazing regime (or replicate it through artificial means) and avoid disturbance to high quality pasture at higher elevations and revegetation of the TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates. In line with the suggestions of Butterfly Conservation Europe, Euromax will work with the Macedonian Entomological Society (ENTOMAK) to establish net gain to the biodiversity of an extended range Prime Butterfly Area;

- The placement of the TMF within Shtuka River, with a loss of 4 km of natural aquatic habitat when the Shtuka is diverted into the diversion channel around the TMF, has the potential to have a high residual impact. The decapods will be translocated and at closure the diversion channel will be restored to a natural channel as far as possible while maintaining engineering design criteria and function;

- The Project will result in the permanent loss of productive forestry land-use over the reclaimed TMF, which results in a permanent high residual impact on forest land use and land users. Euromax has committed to revegetation of the TMF to pasture and scrub mosaic at closure, designed for suitability for Large Blue butterfly and other invertebrates, which has the potential to have a net positive impact on biodiversity at closure, even taking into account the loss of aquatic habitat. The permanent loss of productive forestry land-base over the TMF will, however, result in major negative social economic effects for users of Forestry land;

- Despite archaeological evaluation and excavation proposed as mitigation and management at four archaeological sites (Anovi, Preslop, Krvavichevo and Golemata Niva and Gradishte) which are located within the direct footprint of the Project, a moderate residual impact may result. Strumica Museum will be engaged by Euromax to implement mitigation and with successful execution of the Cultural Heritage Management Plan, the residual impact will be reduced through ‘preservation via record’, despite the permanent loss of these sites; and

- Project components altering the visual character of the landscape have potential to present an effect which cannot be fully mitigated. The haul roads, mine workshops and TMF will, from most locations be visible. Revegetation and restoration will partially mitigate this, however a permanent visual effect will remain.

Despite these residual impacts, the Project is expected to have substantial economic benefits to the Republic of Macedonia, representing a major contributor to national economic activity and government revenues and benefits to the local economy. In addition, positive impacts on the quality of life for residents of nearby communities (primarily in the Municipalities of Bosilovo and Novo Selo and more broadly in the Strumica region) will include community development, increased incomes and improved infrastructure and services.

12.3 Limitations and assumptions

The ESIA has assessed the potential environmental and social impacts of the Project as per the project description presented in Section 4. This project description is based upon a range of reports (including the Feasibility Study, which was finalised in January 2016) and information provided by Euromax and project engineers in late 2016. The ESIA is considered to be complete and accurate, while noting the data and knowledge gaps below. These gaps will be addressed in the detailed Environmental and Social Management Plans described in Section 11, which will be prepared prior to construction and included with bid packages to ensure that contractors are aware of the environmental, health and safety and social performance requirements of the Project. In addition, contract clauses relating to environment, health and safety and social requirements will be drawn up and included in all contracts and subcontracts for goods and services.
12.4 Data and Knowledge Gaps

Data gaps in the ESIA relate primarily to the evolving design of the project and potential future changes in the project design, which may alter the environmental and social impacts presented in this report. The table below provides the key project components which are not yet fixed and the work underway or planned to enable a final decision to be made.

Table 12-2 Project issues to be addressed

<table>
<thead>
<tr>
<th>Issue</th>
<th>How issue will be addressed</th>
<th>Stage of project in which design will be considered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water supply source (groundwater)</td>
<td>Groundwater investigations ongoing. Drilling campaign may be extended to identify alternative sources of groundwater. Should any groundwater source with good yield be discovered, the water balance will be revisited. Should any of the impacts addressed in this ESIA worsen, an assessment of impact will be made in appropriate documentation for submission to the Macedonian authorities, lenders and equity partners.</td>
<td>Detailed design. Solution to be developed throughout construction and operations.</td>
</tr>
<tr>
<td>Construction of a power line between Berovo and the Ilovica substation (subject to separate environmental permitting)</td>
<td>EIA, SEA and urbanisation process will be carried out by a local specialist consultancy. Where relevant, baseline data from the mining project will be shared with the team to ensure consistency. A particular emphasis will be placed on biodiversity baseline studies, which will be carried out using the same scope as for the mining ESIA.</td>
<td>Separate EIA. Prior to construction, likely in Q3 2017</td>
</tr>
<tr>
<td>Minor modifications to the layout of project infrastructure within the concession boundary</td>
<td>Unlikely to have environmental or social effects but these aspects will be considered in conjunction with the engineers. Should any of the impacts addressed in this ESIA worsen, an assessment of impact will be made in appropriate documentation for submission to the Macedonian authorities, lenders and equity partners.</td>
<td>Detailed design</td>
</tr>
<tr>
<td>Borrow areas for aggregates used in construction</td>
<td>A materials balance including cut and fill has been completed and off-site aggregate requirements will be drawn up and quantified (e.g. gravel, sand, crushed rock for concrete). Licenced off-site sources providing materials of the correct qualities will be identified. Should any of the impacts addressed in this EIA worsen, an assessment of impact will be made in appropriate documentation for submission to the Macedonian authorities, lenders and equity partners.</td>
<td>Off-site sources of materials (and suitability) being investigated and evaluated. Final decisions to be made during Detailed design.</td>
</tr>
<tr>
<td>Offsetting for no net loss of biodiversity</td>
<td>A biodiversity offsetting feasibility study will take place to develop offsetting options for terrestrial and aquatic habitat to allow for achievement of no net loss/net gain as applicable. Terrestrial habitats (forest communities), critical habitats supporting endangered species (Ogražden Prime Butterfly Area) and aquatic habitat, specifically the Shtuka river will form the focus of this study.</td>
<td>Prior to construction</td>
</tr>
<tr>
<td>Seepage Collection facility, including grout curtain</td>
<td>Detailed design to be completed on the design of the criteria for the SCF and the grout curtain to confirm it is sized according to commitments in the ESIA and that it can meet and maintain 95% efficiency throughout operations and closure and ensure acceptable environmental protection.</td>
<td>Detailed design</td>
</tr>
</tbody>
</table>
| Active/passive treatment for spill from pit lake and from TMF seepage after closure | ■ Conceptual design of the most appropriate treatment option. This design will be reviewed on a regular basis during operations to ensure the best available technologies are still being considered for the water treatment system.  
■ Bench scale and pilot studies of technologies required to confirm the conceptual design will be implemented and completed within the first 10 -15 years of mine life. | Early years of operations |
A plan and schedule to complete the pilot studies within the early years of mine life and how to develop this into a full treatment system by the end mine life.

Conceptual plan for a system to maintain intellectual capital, suggested to be a tripartite planning team comprising the mine, the University of Shtip and the relevant local and national authorities.

Detailed design and implementation.

The ESIA has assessed the worst case scenario in terms of project footprint (land take, habitat loss, ground disturbance) and worst case geochemical analysis.

It is recommended that an updated ESIA be completed if there is a change in project design which could result in significantly larger negative impacts or negative impacts of a different nature to those already assessed.
13.0 REFERENCES


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Date: 20 March 2017

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Stakeholder Engagement
ANNEX 3
ESIA Baseline
ANNEX 4
Geochemistry Study
ANNEX 5
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Annex 5B: Supporting Information to the Water Quantity and Water Quality Impact Assessments
Annex 5C: Supporting Information to the Sediment Impact Assessment
Annex 5D: Supporting Information to the Noise and Vibration Impact Assessment
Annex 5E: Supporting Information to the Air Quality Impact Assessment
Annex 5F: Supporting Information to the Biodiversity and Ecology Impact Assessment
Annex 5G: Critical Habitat Methodology
Annex 5H: Supporting Information to the Ecosystem Services Impact Assessment
Annex 5I: Supporting Information to the Cultural Heritage Impact Assessment
Annex 5J: Supporting Information to the Landscape and Visual Impact Assessment
Annex 5K: Supporting Information to the Socioeconomic Impact Assessment
ANNEX 6
Environmental and Social Management Plans
(To Be Completed)
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