Chapter 5 – Impact Assessment

Vares Polymetallic Mine ESIA
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Adriatic Metals

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5 IMPACT ASSESSMENT

5.1 Overview

The impact assessment chapter identifies potential environmental and social impacts of the Project throughout all stages of its lifetime: construction, operation, and closure. The general methodology undertaken for assessing and determining the impacts and the level of the impacts is described in detail below. It is based on guidelines of the World Bank and other prominent International Finance Institutions (IFIs) such as the EBRD and IFC.

The estimated impacts due to the Project have been assessed and categorised into the following disciplines:

- Greenhouse Gas Emissions and Climate Change Risk;
- Soils and Contaminated Land;
- Biodiversity;
- Air Quality;
- Noise and vibrations;
- Hydrology and hydrogeology;
- Geochemical aspects;
- Socioeconomics, Community Health, Safety and Human Rights;
- Archaeology and cultural heritage;
- Landscape and Visual Impact Assessment;
- Ecosystem Services and Land Use; and
- Cumulative Impacts.

5.1.1 Impact Assessment Approach

The impact on the environment and social conditions was assessed using information and data of the initial baseline conditions and of the potential impacts within the AOI due to Project activities. The following plan illustrates the typical format of each subject area that is discussed within the ESIA:

- Project Activities - Determination of the source of impacts (also referred as impact pathway) based on the Project activities;
- Potential Impacts – Method used to determine the anticipated potential impacts prior to the implementation of mitigation measures. Includes the identification of sensitive receptors anticipated to perceive an effect or change to their baseline conditions by the potential impacts;
- Mitigation Measures – Describes the additional measures and engineering designs implemented beyond standard industry practices and compliance with national regulation to avoid, reduce or mitigate impacts to acceptable levels;
- Residual Impacts – A post-mitigation impact assessment is conducted to re-assess the level of significance once the mitigation measures have been incorporated; and

- Monitoring and Audit – Determining the level of monitoring required, over a defined period, to certify that the mitigation measures implemented maintain the potential impacts within the defined acceptable limits. These limits are detailed in Chapter 2.

The methodology for assessing environmental and social impacts is aligned however, there different criteria definitions for receptor sensitivities. Definitions are presented in section 5.1.5 and 5.1.6. In addition to the general environmental and social impact methodologies outlined in this chapter, any changes to the methodologies are described in detail in the relevant sections.

For both environmental and social disciplines, the mitigation hierarchy has been applied (Figure 5.1.1), aiming to first anticipate and avoid impacts, then to mitigate, and then the least preferred option to compensate or offset. To achieve this the ESIA has been prepared alongside ongoing communication with the Project design team, allowing critical areas and impacts to be avoided and then, where required, mitigation and compensation to be integrated into the design of the Vareš Project.

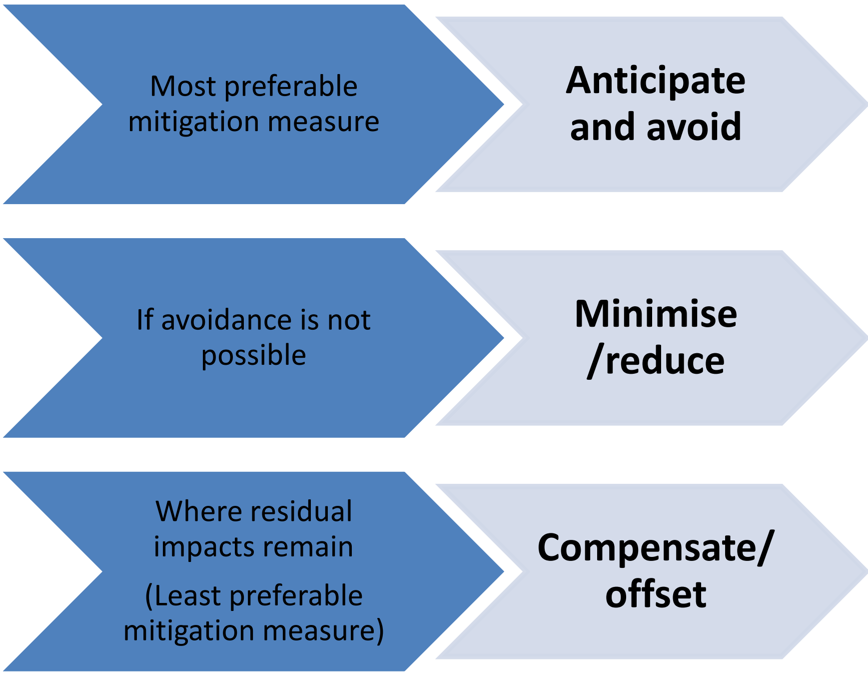


Figure 5.1.1: Mitigation Hierarchy

5.1.2 Project Activities and Identification of Potential Impacts

The nature of the assessment and the methodology adopted to define significance is specified for each environmental aspect; a general framework is set out below.

Where quantitative techniques are suitable, primarily for environmental aspects, the method is to model the natural environment and calculate the magnitude of the potential impact resulting from planned Project activities. Where required with respect to the specific discipline, details of the methodologies for the impact assessment have been considered within the individual section.

The anticipated impacts determined in the impact assessment chapters cannot be given 100% certainty and therefore, the uncertainty is explained within each subject section along with any assumptions on which they are based.

The Project-affected area includes the Project footprint, which covers the surface water courses, ecological survey areas, soil monitoring areas, groundwater resources, air quality monitoring points together with the surrounding areas of social influence and those that would potentially be affected by impacts associated with the construction, operation and closure of the mine.

5.1.3 Environmental Impact Approach

To evaluate the significance of the environmental impacts, impact factors are identified for the different stages of the lifetime of the Project, and are assessed as per the following classification:

- Sensitive receptors – negligible, low, moderate, high;
- Magnitude - negligible, low, moderate, high; assessed through an analysis of the following elements:
  - Type – beneficial or adverse;
  - Extent – spatial extent (area impacted);
  - Duration – short, medium, long or very long-term; and
  - Reversibility – reversible or irreversible.

The receptor sensitivity scale is outlined in Table 5.1.1.

Table 5.1.1: Receptor Sensitivity Scale

Sensitivity of receptor	**Description of receptor**
Negligible	Negligible sensitivity; Abundant; Local importance or scale; Resilient to change; Potential for substitution within the local area.
Low	Low to medium sensitivity; Relatively abundant; Regional important or scale; Reasonably resilient to change; Potential for substitution.
Medium	Medium to high sensitivity; Relatively rare; National importance or scale; Fragile and susceptible to change; Limited potential for substitution.
High	Very high sensitivity; Extremely rare; International importance or scale; Very fragile; Highly susceptible to change; Very limited potential for substitution.

Note: the scale combines the description of the receptor together with its geographic extent. The general descriptions used in this table have been developed for each environmental aspect, taking into account the relevant performance standards that are applicable.

The magnitude of change scale is outlined in Table 5.1.2.

Table 5.1.2: Magnitude of Change Scale

Magnitude of change	Description of change
Negligible	Minimal detectable changes in baseline resource. Changes are either of short duration or infrequent periodicity, such that direct control is not required to manage potential impact.
Low	Detectable change to the baseline conditions or resource. During construction and operations there would be ongoing change in the underlying characteristics or quality of the baseline conditions.
Medium	Degree of change is such that loss of, or adverse alteration to, the baseline conditions of a specific environmental resource would occur. Post development characteristics or quality would be partially changed during construction and operational phases.
High	Degree of change is such that total loss of, or adverse alteration to, the baseline conditions of a specific resource would occur. Post-development characteristics or quality would be fundamentally and irreversibly changed.

The type of impact relates to the positive or negative character of the effect and this can be perceived as below:

- Beneficial Impact – An impact that is considered to provide a net benefit to the receptor; and
- Adverse Impact – An impact that is considered to negatively affect the receptor and may require management activities to mitigate the effects.

The duration of the potential impacts associated with the Project are defined as either short, medium, long or very long-term. In regard to the environmental aspects, short-term has been defined as the construction and/or operational life of the Project and long-term as those which remain and continue post operation and after the post-closure stage of the Project. Very-long term refers to permanent changes.

The significance of impacts is defined via the combination of the magnitude of change and the qualitative descriptions from receptor sensitivity, to create the Impact Significance Matrix as per Table 5.1.3.

Table 5.1.3: Impact Significance Matrix

Receptor Sensitivity	Magnitude of Change			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

5.1.4 Social Impact Approach

5.1.4.1 Overview

The evaluation of social impacts is aligned with the methodology presented above, following a pre- and post-mitigation assessment stage. The pre-mitigation assessment assumes compliance of Project activities with the applicable regulatory framework and standard industry practices. This methodological approach is consistent with international best practice guidelines and standards.

The interaction between the social receptor sensitivity and the impact magnitude determines the pre-mitigation significance, as detailed below.

5.1.4.2 Receptor Sensitivity

In contrast with environmental receptors, the degree of sensitivity of social receptors is based on an individual's abilities and capacity to adapt to changes and maintain their quality of life, livelihood and health conditions. Sensitivity can be understood in terms of resilience to change (e.g. capacity to cope with socioeconomic changes) and the individual's access to resources to adapt to them. Sensitivity can be further determined by several factors such as a receptor's age, gender, ethnicity, access to employment opportunities, livelihood, education, health, level of marginalisation and dependence on natural or common resources. A qualitative definition is presented below.

Table 5.1.4: Receptor Sensitivity Scale

Sensitivity of receptor	Description of receptor
Negligible	A social receptor with no need to adapt to change or has a high capacity to adapt completely and almost immediately. Receptor has no shortage of access to adequate resources (material, financial, social) and will have no difficulty adapting to changes.
Low	A social receptor with capacity and means to adapt to change and maintain/improve current conditions on its own after a certain time. Receptor has a high level of access to resources and has a high capacity to adapt to changes.
Medium	A receptor with limited capacity and means to adapt to change and maintain/improve current conditions. Adaptation may take time and/or may only be partial and can require support from mitigation measures. Receptor has some access to resources and retains capacity to partially adapt to changes.
High	An already vulnerable receptor with very little capacity and means to adapt to change and maintain/improve current conditions. Receptor has very limited access to resources, resulting in multiple levels of vulnerability that limits capacity to adapt to changes.

5.1.4.3 Impact Magnitude

In alignment with the environmental methodology, the magnitude of a potential social impact is a measure of the degree of change from the social baseline conditions and is comprised of different elements which result in different magnitude levels. Each element is described below.

Table 5.1.5: Elements of Impact Magnitude	
Element	**Description**
Type	**Beneficial** (positive): An impact that is considered to represent an improvement to social baseline conditions or the introduction of a new desirable factor. **Adverse** (negative): An impact that is considered to represent an adverse change from social baseline conditions, or the introduction of a new undesirable factor.
Duration	**Short term**: Impacts that are predicted to last for a limited period (construction) or will cease within less than a year. **Medium term**: Impacts that are predicted to last through construction and the beginning part of operations or for a period of one to five years. **Long term**: Impacts that are estimated to occur throughout construction and operations or from six to 14 years. **Very long term**: Impacts that affect a receptor for over 10 years i.e. during will remain during and post-closure.
Reversibility	**Reversible**: Impacts are predicted to be reversed after the end of Project activities or on application of mitigation. **Irreversible**: Impacts that cause a permanent change in the affected receptor or resource that endures substantially beyond the Project lifetime.
Spatial Extent	**Local**: Include the Direct and Indirect Area of Influence. **Regional**: Include various municipalities within BiH. **National**: Encompass all the national territory (FBiH, RS and autonomous District). **International**: Encompass more than one country.

Following this step, a definition of the overall magnitude level considering the combination of elements is presented below.

Table 5.1.6: Magnitude of Change Scale	
Magnitude Level	**Description**
Negligible	Potential impact will not result in any measurable or perceivable changes to baseline conditions.
Low	A potential impact that is unlikely to have a measurable effect on the wellbeing of people so that the baseline conditions will not be considerably affected.
Medium	A potential impact that is likely to be short or medium term (less than one year), spatially localized (likely to affect a small number of social receptors) and reversible.
High	Potential impact will result in measurable change on baseline conditions and is likely to affect a moderate number of social receptors, causing livelihood change on a moderate scale. May or may not be reversible depending on specific conditions.

5.1.4.4 Impact Significance

The pre-mitigation significance is defined through the same Impact Significance Matrix.

Table 5.1.7: Impact Significance Matrix				
Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

5.1.5 Cumulative Impact Approach

The cumulative impact assessment has been undertaken following the same methodology as that described for environmental and social aspects and is described in Chapter 5.13.

Other active, planned or proposed Projects or activities across the region are defined. A comparison is then made to define shared environmental and social receptors between the other Project and the Vares Project. Impacts are identified and their temporal and spatial extent defined.

An assessment has then been made using the same criteria as defined in Sections 5.1.3 and 5.1.4, dependent on the nature of the receptor.

5.1.6 Mitigation Measures and Residual Impacts

Negligible and low significance are considered as ‘insignificant’ impacts and do not require additional mitigation measures. Moderate and major significance are considered ‘significant’ impacts and are subjected to specific mitigation measures to reduce them to acceptable levels. Significant impacts have a post-mitigation evaluation, based on the same methodology and Impact Significance Matrix to determine the residual effects of the Project activities.

Post-mitigation significance is evaluated considering the implementation of mitigation measures for adverse impacts and enhancement measures for beneficial impacts. Mitigation plans and mechanisms are detailed in the Project Environmental and Social Management Plan (ESMP), with the objective to prevent, reduce, mitigate and manage impacts. Residual impacts are to be continuously managed and monitored by the ESMP with the specific plans targeted to audit the effectiveness of the mitigation measures, such as:

- Health and Safety Management Plan;
- Strategic Blueprint (covering human resources and local employment);
- Air Quality and GHG Management Plan;
- Noise and Vibration Management Plan;
- Traffic Management Plan;
- Soils, Contaminated Land and Erosion Control Management Plan;
- Hazardous Materials Management Plan;

- Waste and Hazardous Waste Management Plan;
- Surface Mineral Waste Disposal Plan;
- Cultural Heritage Management Plan with Chance Finds Procedure;
- Community, Health, Safety and Security Management Plan;
- Contractor Environmental Management Plan;
- Land Acquisition, Compensation and Livelihood Restoration Plan;
- Biodiversity Action Plan;
- Water and Waste-water Management Plan;
- Stakeholder Engagement Plan;
- Emergency Preparedness and Response Plan and
- Conceptual Mine Closure Plan.

Details on the mitigation measures can be found in each section.

5.2 Greenhouse Gases and Climate Change

5.2.1 Introduction

Climate Change can be perceived from two environmental perspectives. Consideration must be given to the effect of the Project on the wider climate (i.e. assessing contributions to global warming), but it is also important to consider the effect of the changing climate on the Project (i.e. what needs to be done to improve resilience and any necessary adaptation). This chapter has been produced in two parts to consider both sides of this equation.

The first half of the chapter evaluates and assesses the greenhouse gas ("GHG") emissions attributable to the construction, operation and closure of the Project. The chapter has been prepared in accordance to the International Finance Corporation's (IFC) 2012 Performance Standards[1] (PSs) and EBRD's 2019 Performance Requirements[2] ("PRs"), as well as other relevant best practices, such as the Greenhouse Gas Protocol, which are referenced at the appropriate parts of this chapter (see Table 5.2.1).

The Equator Principles received their latest update (EP4) in July 2020, and this included 'Annex A: Climate Change: Alternatives Analysis, Quantification and Reporting of Greenhouse Gas Emissions'. This Annex, whose implementation requirements are described as "*an integral part of the Equator Principles*", sets out three actions:

- Alternative Analysis: an evaluation of technically and financially feasible and cost-effective options available to reduce Project-related GHG emissions during the design, construction and operation of the Project.
- Quantification and Reporting: GHG emissions should be calculated in line with the GHG Protocol to allow for aggregation and comparability across projects, organisations and jurisdictions, including quantification of Scope 1 and Scope 2 Emissions.
- Climate Change Risk Assessment: this should consider, at a high level, the current and anticipated climate risks of the Project's operations and identify plans, processes, policies and systems put in place to manage these risks i.e. to mitigate, transfer, accept or control.

[1] International Finance Corporation (IFC). 2012. IFC Performance Standards on Environmental and Social Sustainability. January 2012.

[2] European Bank for Reconstruction and Development (EBRD). Environmental and Social Policy, 2019

Table 5.2.1: IFC Performance Standards and EBRD Performance Requirements - Key Relevant Requirements		
	Greenhouse Gases	**Climate Change Mitigation & Adaption**
IFC Performance Standards	**PS1** *"The risks and impacts identification process will consider the emissions of greenhouse gases, the relevant risks associated with a changing climate and the adaptation opportunities, and potential transboundary effects, such as pollution of air, or use or pollution of international waterways."* **PS3** *"Performance Standard 3 recognizes that increased economic activity and urbanization often 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. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. At the same time, more efficient and effective resource use and pollution prevention and GHG emission avoidance and mitigation technologies and practices have become more accessible and achievable in virtually all parts of the world."* *"In addition to the resource efficiency measures described above, the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.* *For projects that are expected to or currently produce more than 25,000 tonnes of CO2-equivalent annually, the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect*	***PS1*** *"The risks and impacts identification process will consider the emissions of greenhouse gases, the relevant risks associated with a changing climate and the adaptation opportunities, and potential transboundary effects, such as pollution of air, or use or pollution of international waterways."* **PS4** *"Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups."* *"The project's direct impacts on priority ecosystem services may result in adverse health and safety risks and impacts to Affected Communities. With respect to this Performance Standard, ecosystem services are limited to provisioning and regulating services as defined in paragraph 2 of Performance Standard 6. For example, land use changes or the loss of natural buffer areas such as wetlands, mangroves, and upland forests that mitigate the effects of natural hazards such as flooding, landslides, and fire, may result in increased vulnerability and community safety-related risks and impacts. The diminution or degradation of natural resources, such as adverse impacts on the quality, quantity, and availability of freshwater, may result in health-related risks and impacts. Where appropriate and feasible, the client will identify those risks and potential impacts on priority ecosystem services that may be exacerbated by climate change. Adverse impacts should be avoided, and if*

Table 5.2.1: IFC Performance Standards and EBRD Performance Requirements - Key Relevant Requirements		
	Greenhouse Gases	**Climate Change Mitigation & Adaption**
	emissions associated with the off-site production of energy used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice."	*these impacts are unavoidable, the client will implement mitigation measures in accordance with paragraphs 24 and 25 of Performance Standard 6.*
EBRD Performance Requirements	**PR3** *"This Performance Requirement (PR) outlines a project-level approach to climate impacts and greenhouse emissions, resource management and pollution prevention and control. It builds on the mitigation hierarchy, the principle that environmental damage should as a priority be rectified at its source, and the "polluter pays" principle. The project related risks and impacts associated with resource use, and the generation of waste and emissions need to be assessed in the context of project location and local environmental conditions. Appropriate mitigation measures, technologies and practices should be adopted for efficient and effective resource use, pollution prevention and control and avoidance, minimisation and reduction of greenhouse gases (GHG) emissions."* *"The client's environmental and social assessment process will consider alternatives and implement technically and financially feasible and cost-effective options to avoid or minimise project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, techniques or processes, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring."* *"For projects that either (1) have, or are expected to have, gross emissions in excess of 100,000 tonnes CO2-equivalent annually, or (2) are expected to result in a net change in emissions, positive or*	**Section III: Scope** *"EBRD recognises the importance of addressing both the causes and the consequences of climate change in its countries of operations. EBRD will engage, whenever appropriate, in innovative investments and technical assistance to support no/low-carbon investments and climate change mitigation and adaptation opportunities, as well as identify opportunities to avoid, minimise or reduce greenhouse gas emissions in projects. EBRD will require its clients to assess risks caused by climate change to the projects. EBRD will also support its clients in developing climate adaptation measures and climate resilient investments as well as in managing risks caused by climate change."* **PR1** *"... risks caused by climate change to the project shall be considered throughout the assessment process."* **PR3** *"The client will, as part of its environmental and social assessment process, consider the potential cumulative impacts of water abstraction upon third party users and local ecosystems. This assessment will also consider the potential effects of climate change. Where adverse risks and impacts are identified, the client will implement appropriate mitigation measures to mitigate such risks and impacts in accordance with the mitigation hierarchy approach and GIP."* **PR4** *"The client will identify and assess the potential risks caused by natural hazards, such as earthquakes, droughts, landslides or floods as these relate to the project. This may require the clients to undertake an*

Table 5.2.1: IFC Performance Standards and EBRD Performance Requirements - Key Relevant Requirements		
	Greenhouse Gases	**Climate Change Mitigation & Adaption**
	negative, of more than 25,000 tonnes of CO2-equivalent annually post-investment, the client will quantify these emissions in accordance with EBRD Protocol for Assessment of Greenhouse Gas Emissions. The scope of GHG assessment shall include all direct emissions from the facilities, activities and operations that are part of the project, as well as indirect emissions associated with the production of energy used by the project. Quantification of GHG emissions will be conducted by the client annually and reported to EBRD."	*assessment of the vulnerability of the project to risks caused by the climate change and identify appropriate climate resilience and adaptation measures to be integrated into the project design."* **PR6** *"The baseline assessment will consider, but will not be limited to relevant risks to biodiversity and ecosystem services, focussing... impacts relevant to climate change and adaptation."* *"In accordance with GIP, the assessment will consider: (i) the project's potential impacts on ecosystem services, including those that could be exacerbated by climate change; (ii) the use of, and dependence on, these ecosystem services by potentially affected communities and/or indigenous peoples; and (iii) the project's dependence on these ecosystem services."*

In addition to the Performance Requirements, EBRD has released specific guidance in the form of a technical note entitled '*Methodology for the economic assessment of EBRD projects with high greenhouse gas emissions*', Jan 2019, and the '*Green Economy Transition*' handbook, which are mainly aimed at addressing the financial implications of the carbon emissions, but which have some relevance for this ESIA too.

The second half of the chapter considers potential effects of Climate Change and how this may directly impact on the mine and require the Project to mitigate and adapt over its life. This part of the assessment is based on climate projections for Bosnia and Herzegovina and discusses the risks in general terms with reference to the recommendations from the Task Force on Climate-related Financial Disclosure (TCFD) and a general climate risk assessment for the mining operations.

5.2.2 Methodology

5.2.2.1 Overview

The GHG emissions for the Vares Project, covering the Rupice Mine (RM) and the Vares Processing Plant (VPP) have been estimated in accordance with the following established guidelines and methodologies:

- World Business Council for Sustainable Development (WBCSD) and the World Resource Institute (WRI) 'Greenhouse Gas Protocol' (2013). A Corporate Accounting and Reporting Standard[3]';
- Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories from 1996 and 2006, as well as Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories from 2000.

5.2.2.2 Scope of Assessment

Greenhouse gas (GHG) emissions have been calculated for the project based on both annual and cumulative basis. The calculations have assessed the net gain in GHG emissions attributable to the Vares Project. The extent of these emissions has been calculated using standard methodologies as defined by the Greenhouse Gas Protocol[4].

The Greenhouse Gas Protocol divides emissions into three categories as follows and illustrated inFigure 5.2.1:

- **Scope 1** – direct emissions: from sources owned or under the operational control of the company or project;
- **Scope 2** – indirect emissions: from the consumption of purchased electricity from the grid; and,
- **Scope 3** – indirect emissions: an optional reporting category allowing for other indirect emissions associated with but not controlled by the company to be included, such as contractor activities.

[3] WBCSD and WRI (2004) *GHG Protocol: Corporate Accounting and Reporting Standard 2004.* Available from the URL: http://www.wri.org/sites/default/files/pdf/measuring-to-manage.pdf *(accessed July 2020)*

[4] World Business Council for Sustainable Development (WBCSD), World Resource Institute (WRI). 2004. GHG Protocol: Corporate Accounting and Reporting Standard. 2004

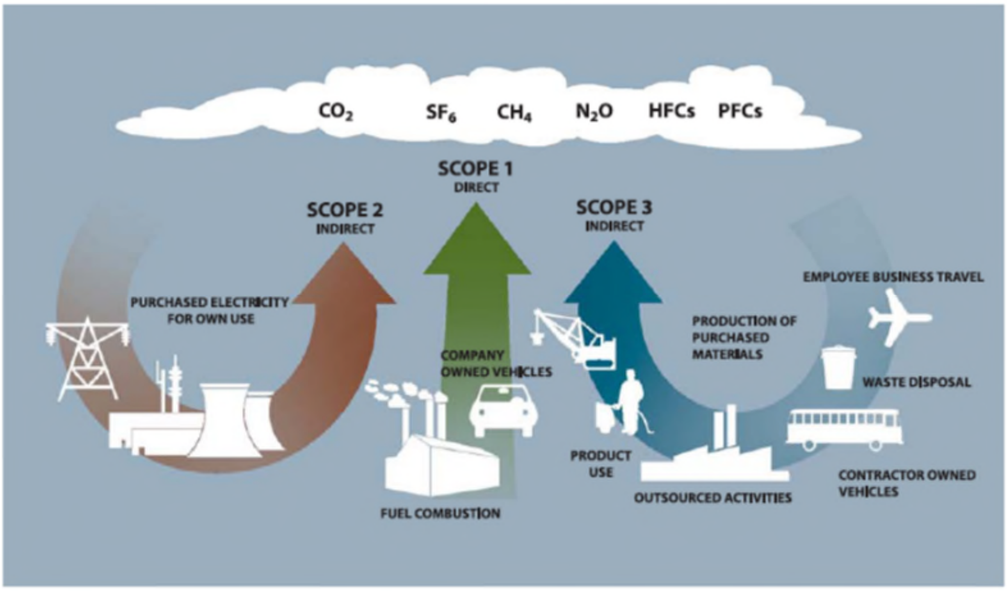


Figure 5.2.1: GHG Emissions Boundary (Source: Greenhouse Gas Protocol)

Consistent with the requirements of the international best practices, the scope of emissions that have been assessed for the Vares Project are primarily within Scopes 1 and 2. Although some site works will be undertaken by a contract mining team this will fall under the operational control of the Project developers and therefore these emissions have been included in Scope 1.

Scope 3 emissions have not been considered at this stage, such as a high-level assessment of the embodied carbon within construction materials used on site. Details and figures for quantities of construction materials are not yet available. These are reported separately to the Scope 1 and 2 emissions and the chapter can be revisited at detailed design stage to include some Scope 3 emissions.

5.2.3 Emission Sources

5.2.3.1 Sources

Potential GHG emissions arising from the Project will occur throughout the life of the mine. The sources of Scope 1 GHG emissions associated with the Project include the following:

- Tree removal at Rupice;
- Fuel use for vehicles and equipment used in establishing the underground mine, and delivering materials to site constructing the surface buildings and Vares Process Plant;
- On-road vehicles for hauling of ore and returning tailings to the mine for backfill;
- Non-road vehicles for mining of ore;
- Container transportation of product to the rail loadout facility at Droskovac Railway Station;
- Heating requirements within the site;
- Transportation of staff to site via bus;

- Explosives for blasting; and
- Activities from the closure of the mine will also contribute to GHG emissions. These activities include the use of on-road and non-road vehicles for the removal and dismantling of ancillary mine facilities, and reclamation of the open pits, waste facilities.

Scope 2 emissions primarily relate to:

- Crushing plant at Rupice
- Blasting and Warehousing at Rupice
- Ventilation and other services at Rupice
- Coarse Ore Handling at VPP
- Grinding at VPP
- Flotation at VPP
- Concentrate Handling at VPP
- Tailings Handling at VPP
- Reagents Handling and Storage at VPP
- Plant Services at VPP
- Fuel Storage and Distribution at VPP
- Non-process Infrastructure at VPP

5.2.3.2 Calculation Approach

The GHG inventory for the project is based on the methodology detailed in the WBCSD and WRI GHG Protocol. The GHG emissions have been estimated using the activity data, i.e. information relating to combustion and other processes such as fuel used for plant machinery and the emission factors provided by IPCC for each activity.

GHG emissions = Activity Data X Emission Factor

There are several greenhouse gases including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), however, it is standard practice to report GHG emissions in tonnes of CO_2 equivalents (CO_2e)[5]. This approach accounts for the varying global warming potential of different greenhouse gases, which is a measure of the amount of infrared radiation captured by a gas in comparison to an equivalent mass of CO_2 over a fixed lifetime.

5.2.3.3 Exclusions

The emissions or sequestration arising from land use change that results from initial disturbance and then subsequent restoration of the site are anticipated to be minor, provided the mitigation proposed

5 A universal unit of measurement used to indicate the global warming potential of a greenhouse gas, expressed in terms of the global warming potential of one unit of carbon dioxide

in the soils chapter is adhered to and the soils are reinstated as part of the restoration process. These emissions have therefore been excluded.

5.2.4 GHG Emissions

5.2.4.1 Construction Phase

Pre-production works (construction of portals, declines, access, ventilation etc.,) for the underground mine are due to start in September 2021. By June 2022 it is anticipated that the first ore will be mined. Approximately 390kt of waste and some 280kt of ore will be removed before commissioning of VPP begins at the end of 2022. During this time the decline will be established, the wastewater treatment plant will be constructed, and the various buildings associated with the development will be erected.

Emissions associated with this work are estimated based on Year 1 annual diesel consumption figures provided by Adriatic Metals PLC. No detailed breakdown of construction electrical demand has been provided but it is anticipated that electrical demand will build as the underground works progress and the temporary “push” ventilation system is brought into operation.

Underground mines by nature require less vegetation clearance than open pit mines. Nevertheless, there will be some clearance required to establish the infrastructure at Rupice, temporary waste rock stock pile, Run of Mine (ROM) stockpile areas, the waste water treatment plant and the Tailing Storage Facility (TSF) and VPP. This will inevitably have a negative environmental impact and any vegetation clearance activity will generate emissions. Whilst these emissions have not been directly quantified (aside from the tree felling below), emissions are considered to be small in comparison to other site emissions and are unlikely to add significantly to the emissions calculated.

On-road vehicles, such as diesel-powered trucks, and non-road vehicles, such as bulldozers and loaders, will be used throughout the construction phase.

The proposed haul route is 24.5km long and has been designed to utilise 9km of existing roads and forestry tracks where feasible, as well as creating 15.5km of planned new road.

The main haul route between Rupice and the Vares Processing Plant traverses forestry and meadow land. Some tree felling will be required where trees are either directly in the path of the haul road, or where they pose a threat to safety by risking falling on to the road from the slopes above during heavy snowfall due to shallow root systems. The exact quantity of tree loss in this location has not yet been calculated. Existing tracks will be used, where possible, and felling will be minimised.

Tree felling is also required at the Rupice site where approximately 28.5ha of trees will need to be cleared. This has been quantified and in total some 5,404m^3 of wood (primarily comprising Spruce, Beech and Fir) is expected to be removed. Emissions associated with this wood removal have been calculated in line with IPCC methodologies and are estimated to be 13,344tCO_2e. It should also be noted that the quantification of the tree felling here has been undertaken in order to make payment to the Federal Ministry to compensate for the tree loss. The funding to be paid will nominally be used for the construction of a new forest, although this is not in the direct control of Adriatic Metals.

The TSF will be constructed in phases and the initial phase will be limited in size (0.69Mt capacity), with expansion occurring once the Mine and processing plant is operational up to a final storage capacity of 7.8Mt. Further tree clearance will be required to accommodate the TSF which is expected to have a land take of approximately 11ha upon completion. Detailed assessment of the trees in this area has not yet been undertaken but, based on the similar species involved, carbon losses have been estimated by extrapolation of the woodland clearance loss calculations at Rupice. This is expected to contribute a further 5,150tCO_2e.

During the construction and operational phases of development a substantial quantity of concrete will need to be used onsite. The cement production required to make the concrete will take place off-site and therefore emissions associated with its production are not included in this analysis. The concrete itself, once cured, will actually begin to absorb CO_2 as the concrete undergoes carbonation. This process will occur over a long-time scale of many decades but eventually, if left long enough, virtually all the CO_2 emitted in the cement production process will be reabsorbed. Whilst it might be disingenuous to consider the curing concrete to be a carbon sink *per se*, it is more correct to consider the emission and absorption of this CO_2 to be part of a cyclic process which is almost carbon neutral over a sufficiently long timespan. Therefore, CO_2 emissions associated with cement have been discounted from further consideration. However, the mixing of the concrete batches will be a direct energy use and result in emissions that are outside of this cycle. These have therefore been included as part of the onsite fuel use.

5.2.4.2 Operation Phase

The production schedule indicates that 9.006Mt of material (ore and waste rock) will be mined over the 14-year LoM. An average of 0.235t of waste will be removed and stored for every tonne of ore mined.

Scope 1 emissions

The operation phase of the mine will involve direct emissions from use of on-road and off-road vehicles for excavation, transportation and the processing of the ore and waste rock. The mine declines have been designed to allow for 42-tonne haulage trucks but they could also support 50-tonne trucks in the future. Ore mined from Rupice will be crushed at the surface then transported on road vehicles from Rupice 24.5.km to the Vares Processing Plant. After processing, dewatered tailings will be transported to the TSF, or back to Rupice for use in backfill. The product (concentrates) will be loaded into containers for transport to the rail loadout facility at Droskovac Railway station. Cranes will be used to either load the containers directly on to rail wagons or to temporarily store them in a storage facility until ready for onward shipment. Emissions associated with these phases of the operation have been included in the assessment up to the point where the containers are loaded onto the train.

Table 5.2.2 provides a breakdown of expected diesel use for the mining equipment, haulage trucks, mobile plant, container transport and the staff buses. The information has been provided by Adriatic or derived from provided information by WAI.

Table 5.2.2: Predicted Diesel Fuel Requirements During Operation

	Ave Diesel Requirements	**Ave Diesel Requirements**
	000 litres/annum	**Tonnes/year**
Rupice underground operations	906	802
Rupice surface operations	1,164	919
VPP Operations	283	251
Ore Haulage	345	305
Tailings Haulage	297	263
Container Transport	867	767
Staff Transport*	265	234
Total	**4,127**	**3,541**

Notes:
Tonnes per year estimated based on 365 day/yr operation, assuming diesel density of 835kg/m3
*Estimate

Additionally, emissions from the emulsion blasting agent will contribute to direct operating GHG emissions. The amount of emulsion used will vary depending on the stage of operation.

Staff transport from the wider area is to be provided in the form of two bus services which will operate once per shift, taking workers to and from the sites. A 50-seat bus will travel from Zenica, via Kakanj, Breza and Vareš to the park and ride scheme running to the VPP and to Rupice. This will be a trip of approximately 81km each way. A second 20 seat bus will run from Sarajevo via Breza to the Vareš park and ride, covering approximately 50km. Given the two shift patterns a day and the 365day operation, these bus services will also be considerable sources of emissions. It is estimated the two buses will generate circa 750tCO_2e per year.

It is difficult to estimate exactly how much carbon saving the use of buses will provide over private transport, since if individuals used their own cars to travel, they may not follow exactly the same route. The buses themselves may not be fully occupied for the whole trip, collecting and dropping off people along the way. Multiple workers could potentially car share as well, which would reduce their emissions, and emissions would be dependent on the car types and fuel types of the individuals' vehicles. However, if the assumption is made that each passenger-kilometre travelled by bus exactly correlated with a passenger-kilometre travelled (i.e. no car-sharing) by an average car using an undetermined fuel (based on UK emission reporting figures, which again, are not strictly appropriate for use in Bosnia but represent a suitable approximation) then the bus is estimated to emit 59.6% of the emissions that the cars would emit (i.e. circa a 40.4% CO_2e saving). It should also be noted that emissions would be considered Scope 3 emissions if the employees used their own vehicles, whereas the bus service laid on by Adriatic would be Scope 1 emissions since these fall under the direct control of the organisation.

Scope 2 Emissions

Scope 2 emissions arise from the use of grid electricity. The local national electricity grid is operated and maintained by the State company, JP Elektroprivreda BiH. A 35kV powerline runs to Tisovci village and will supply the VPP once upgraded.

The existing power distribution network infrastructure consists of a north-south 220kV and 400kV line in proximity to the town of Vareš. Additional 132kV network lines run north-south close to the Rupice mine site, alongside the main sealed road R444a. The construction of approximately 2.5km overhead line would be required to connect to the 132kV line. However, Elektroprivreda have proposed to supply Rupice from a sub-station in Vareš Majdan via a buried cable that will run next to the haul road connecting Rupice and Vares Processing Plant.

It is understood that Elektroprivreda BiH's grid mix comprises approximately 70% coal (lignite) and 30% hydro power, with a small amount of wind and solar beginning to be developed. According to its own website[6], the carbon intensity of its power grid fluctuates during the year depending on the amount of hydro generation available (see Figure 5.2.2). The average grid carbon intensity is around 860g/kWh. This is the carbon factor that has been used to estimate the Scope 2 emissions for the project.

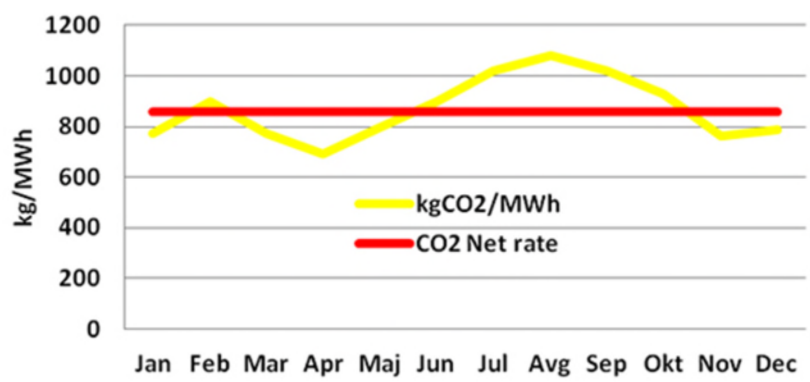


Figure 5.2.2: Grid Carbon Intensity

(extract from EP BiH website)

A detailed breakdown of electricity consumption for each year has not been made available but the expected annual consumption during the years of operation is as shown below in Table 5.2.3. These electrical demand figures have been scaled by the proportion of ore handled that year relative to the year of maximum ore extraction to estimate the annual variation in electrical demand over the LoM.

[6] https://www.epbih.ba/eng/page/energy-efficiency#enef-in-generation (Accessed: 29/07/2021)

Table 5.2.3: Average Annual Electrical Consumption during Operational Phase of Mine				
	Installed Cap	**Nominal Demand**	**Operating Hours Per Year**	**Consumption**
	kW	**kW**	**(h/y)**	**kWh/y**
Rupice Mine				
Crushing Plant	1,215	736	5,694	4,188,551
Blasting/Warehousing	260	189	5,694	1,074,888
Rupice Services	1,993	1,353	5,694	7,706,222
Total				**12,969,660**
Vares Processing Plant				
Coarse Ore Handling	337	219	8,000	1,749,533
Grinding	2,668	1,638	8,000	13,102,594
Flotation	3,397	1,872	8,000	14,976,203
Concentrate Handling	586	407	7,200	2,930,926
Tailings Handling	456	324	7,200	2,334,000
Reagents Handling and Storage	238	179	8,000	1,429,733
Plant Services	1,513	941	8,000	7,524,988
Fuel Storage and Distribution	104	78	8,000	624,490
Non-process Infrastructure	571	429	8,760	3,754,286
Total				**48,426,752**
Grand Total				**61,396,412**

The estimated GHG emissions for the entire life of the Rupice mine and VPP amounts to 573,012 metric tonnes of carbon dioxide equivalent (tCO_2e) which are summarized in Table 5.2.4 below. The use of diesel fuel for mining equipment and haulage is one of the main contributors but the emissions associated with the use of electricity at the process plant is the main source of operational GHG emissions. The GHG emissions are low during the construction phase of the mine (i.e. the period 2021–2022) as most of the mine development activities will be carried out during this period, prior to the main operational activities commencing. The GHG emissions will peak during 2026 at around $66{,}000tCO_2e$. The profile of emissions from the mine during its full life-cycle is presented in Figure 5.2.3.

Table 5.2.4: Summary of Total GHG Emissions during the Life of Mine				
	CO_2	CH_4	N_2O	CO_2e[(ii)]
	tonnes	tonnes	tonnes	tonnes
Scope 1				
Tree Felling at Rupice & TSF	n/a	n/a	n/a	18,494.93
Rupice Underground	40,861.86	2.29	15.77	45,105.31
Rupice Surface	46,857.10	2.62	18.09	51,723.16
VPP Operations	6,149.97	0.34	2.37	6,788.63
Ore haulage	7,490.96	0.42	2.89	8,268.88
Tailings haulage	6,448.74	0.36	2.49	7,118.43
Container transport to Rail	18,830.31	1.05	7.27	20,785.81
Explosives	n/a	n/a	n/a	1,104.32
Staff Bus Service	n/a	n/a	n/a	9,403.06
Scope 2				
Rupice Electric Load	n/a	n/a	n/a	85,884.59
VPP Electric Load	n/a	n/a	n/a	320,680.09
Total Scope 1 & Scope 2				575,357.22

Notes:

(i) CO_2, CH_4, N_2O emissions have been estimated based on IPCC National Inventory Methodology, Volume 2 Chapter 1 and IFC's Carbon Emissions Estimation tool

(ii) CO_2e emissions were estimated based on a global warming potential of 1, 28 and 265 for CO_2, CH_4, and N_2O, respectively (IPCC AR5, 2015).

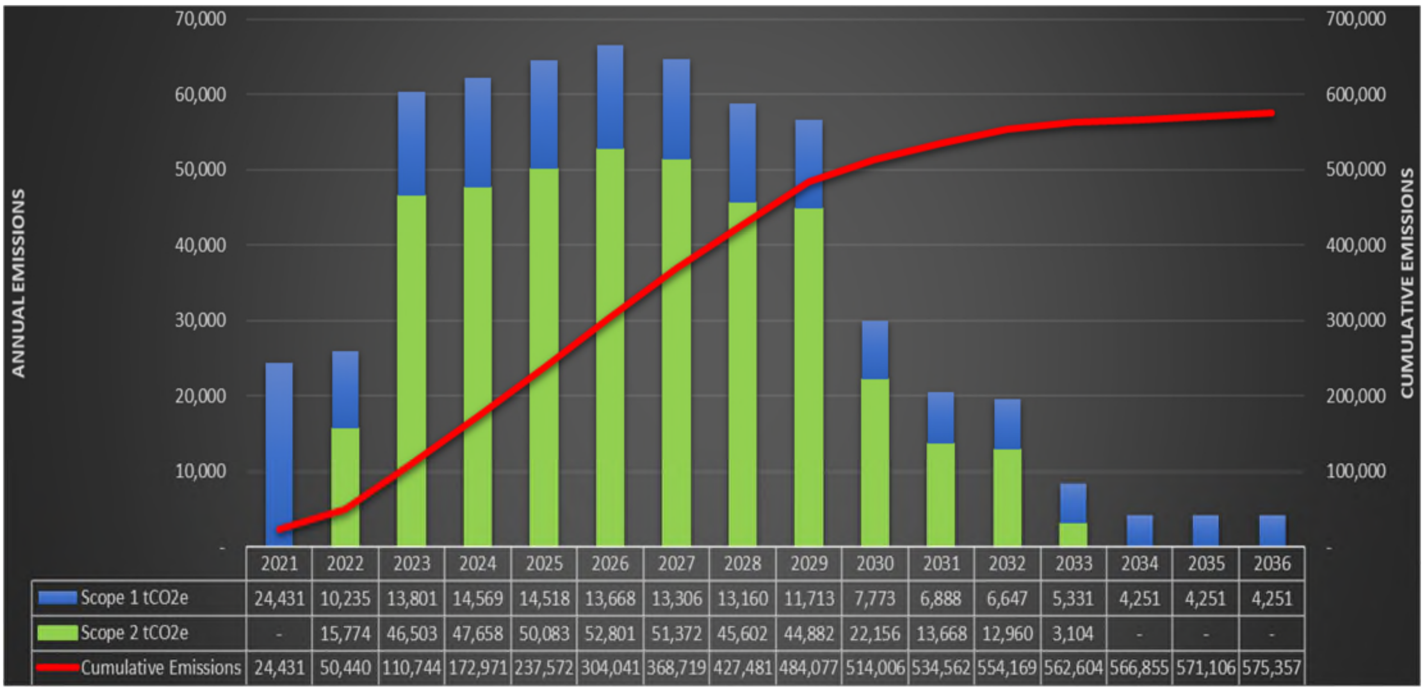


Figure 5.2.3: Cumulative GHG Emissions

5.2.5 Mitigation Measures

Section 5.2.4 has identified the main sources of GHG emissions associated with the project, namely due to fuel combustion and electricity usage. GHG emissions have already been reduced through the design of the Project as follows:

- minimizing the land clearance for project facilities;
- adopt mitigation strategies for preserving integrity of soil stockpiles;
- minimise tree felling (only trees needing to be removed for safety reasons above the haul road will be felled);
- providing improved building fabrics for buildings to minimize heat losses as well as reducing noise impacts;
- the use of modern, energy efficient electrical equipment and mobile plant with fuel-efficient engines.
- A 32.4kWp roof-mounted solar PV array has been included at the VPP admin building. This is expected to save at least 20.6tCO_2e per year

GHG mitigation opportunities are also being explored further as the project design is advanced and operational activities are further developed. These include:

- Although haulage works are likely to be undertaken by contractors, consideration will be given to the choice of vehicles used for both the mine fleet and the haulage fleet. Where possible fuel efficiency will be a factor in the selection of vehicles as this will not only reduce emissions but also reduce operating costs. There is currently considered to be limited potential for the use of biodiesel to help reduce emissions, however the Project will continue to monitor potential options;
- In addition to the efficiency of the fleet itself, opportunities will be sought for improving the use of the vehicles. Scheduling of excavation and haulage activities to optimize activities and avoid double handling, where this is operationally practical. As the mine logistics and scheduling are progressed, consideration will be given to the optimisation of vehicle and equipment movements to improve efficiency and reduce overall CO_2 emissions; and
- The upgrading of energy-intensive machinery over time will be used to improve efficiency and reduce CO_2 emissions compared to plant that has been removed. Further energy efficiency opportunities will also be investigated.

5.2.6 Residual Impacts

The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. Reporting, in compliance with EBRD and IFC requirements, which will be undertaken prior to commencement of development and annually for the duration of operations, will allow targeted efforts to improve efficiency and reduce emissions. Table 5.2.6 presents a summary of the anticipated GHG impacts and planned mitigation measures. It is acknowledged that whilst the main impact associated with GHG emissions is their contribution to climate change, the Vares Project is one of a myriad of human sources impacting the emissions of GHGs and contributing to climate change, and projected changes in local, regional, and global climate cannot be attributed in isolation to the proposed Project.

In considering the impact of the climate change potential, WAI are not making a straight judgement about the absolute emissions. Clearly, as the model shows emissions of over 575,000 tCO_2e over the life of mine, this is significant contribution. A more pragmatic approach is to assess the relative emissions compared to other extractive processes to determine whether the emissions in this instance are higher or lower than 'typical'.

The JORC compliant Mineral Resource Estimate for Rupice was updated in August 2020 by CSA Global in Perth and comprises of 12.0 Mt Indicated and Inferred Resources, with contained metals as set out in Table 5.2.5.

In their 2019 "*Gold and climate change: Current and future impacts*" paper, the World Gold Council reports global Scope 1 and 2 production emissions of 29,128tCO_2e/tAu. The equivalent global figure for silver has not been identified but in its 2019 v3.0 update, the Inventory of Carbon and Energy (ICE) database reports a much lower 'CO_2 only' embodied carbon figure for silver of 6.31tCO_2/tAg. Similar figures have been obtained from the same source for zinc, lead and copper, as shown below. An approximate carbon intensity for Barium Sulphate has also been used[7]. These figures allow an estimate of average emissions for each metal to be obtained.

Table 5.2.5: Vares Project MRE Classification and embodied emissions

JORC Classification	Contained Metal						
	Zn (kt)	Pb (kt)	$BaSO_4$ (kt)	Au (koz)	Ag (Moz)	Cu (kt)	Sb (kt)
Rupice							
Indicated	465	294	2,730	500	54	52.1	21
Inferred	23	18	218	27	4	4.1	3
Total	**488**	**312**	**2,948**	**526**	**58**	**56.1**	**24**
Emission Factor *(tCO2e/t)*	4.18	3.37	6.00	29,128	6.31	3.81	4.73 [i]
Embodied Emissions *($ktCO_2e$)*	2,039.8	1,051.4	17,688.0	434.4	10.4	213.7	113.6
Total ($ktCO_2e$)	**21,551.4**						

Notes:
(i) In the absence of a reliable source of embodied emissions, this figure has estimated from the average of the embodied emissions associated with the other metals (excluding Gold).

If the above 'typical' embodied emission rates are applied to the weight of metals being produced at VPP then it would be expected that emissions would total 21,551.4$ktCO_2e$. It must be pointed out that these embodied emission rates include Scope 3 emissions, such as further processing of the metals,

[7] Eurocolour "*Pigments and Fillers – Product Carbon Footprint*" Published: 03/2012 https://bayferrox.cn/uploads/tx_lanxessmatrix/brochure_carbon_footprint_en_2012_06.pdf (accessed 29/07/2021)

smelting, transportation to market etc, which means they have a much wider remit than just the Scope 1 & 2 emissions included in this assessment. The Vares Project will also produce a concentrate rather than finished metals, so allowance must be made for the fact that further processing will be required offsite to achieve fully equivalent products.

It must also be noted that it has not been possible to identify a reliable source for the embodied emissions associated with Antimony extraction. In the absence of this detail, a figure equal to the average emissions from all of the other metals (excluding gold) has been used. This is evidently not completely accurate but is expected to be a suitable proxy, given the relatively low amount of Sb expected to be recovered.

The analysis shows that the predicted Scope 1 & 2 emissions for this site (575.4ktCO_2e) equate to only 2.67% of the embodied Scope 1, 2 & 3 emissions that would be expected for this quantity of metal production, were it to be produced elsewhere from a typical source (21,551.4ktCO_2e). Typically Scope 1 & 2 emissions account for anywhere between 2 and 20% of the total emissions for other similar projects globally. Scope 3 emissions are generally higher as they account for both upstream and downstream indirect emissions. 2.67% is at the lower end of comparative figures.

On this basis, the predicted emissions are at the bottom end of those expected, per unit produced. Consequently, it is concluded that, although emissions are significant in absolute terms, in relative terms per unit of metal recovered they are not considered significant. The reason for the emissions being towards the lower end of the spectrum is assumed to be because there are so many varieties of metals being produced from this ore that production efficiencies, economies of scale and reduced waste per unit production are likely to be lowering the GHG effects on a unit basis. Another factor that will have helped to reduce emissions is that this is an underground mine rather than an open pit, hence there will be lower volume of waste rock production and haulage. Efficiency improvements have been sought with the vehicle movements as well. Rather than using two fleets of trucks, one for ore and one for waste, each running fully laden in one direction and unladen in the other, the same fleet will be used for both activities so it operates fully laden for most of the time, with the bulk of the tailings returned to the underground mine. This will help reduce unnecessary emissions despite the length of the haul route, providing up to an estimated 40% reduction in haulage emissions across this activity compared to operating two fleets[8].

[8] Estimate obtained using comparative emission factors for laden and unladen HGV's from UK Government (BEIS) "*Greenhouse Gas Conversion Factors for Company Reporting*" 2021 (Accessed 24/09/2021) *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005677/conversion-factors-2021-full-set-advanced-users.xlsm*

Table 5.2.6: Summary of Mitigation and Residual Impacts				
Impact	**Mining Stage**	**Impact before mitigation**	**Key Mitigations**	**Residual Impacts**
Greenhouse Gas emissions from onsite power generation, onsite stationary and mobile plant, heating plant and explosives emissions, tree felling and vegetation clearance, and use of imported grid electricity.	All	Significant Adverse (in absolute terms – 575,357tCO_2e) Neutral (in relative terms compared to global average emissions for gold and silver recovery)	Energy efficiency measures incorporated into engineering design. Require use of modern, energy-efficient mobile plant. Implement logistics management of haulage and excavation activities to minimise idling and double-handling. Perform regular maintenance on mobile plant. Installation of 32.4kWp solar PV array on administration building Seek additional opportunities for GHG emissions reduction throughout Project lifecycle, including consideration of additional renewable energy opportunities. During detailed design, energy-intensive uses such as the crusher plant will be assessed for energy efficiency opportunities.	Significant Adverse (in absolute terms – less than 575,357tCO_2e) Neutral (in relative terms compared to global average emissions for gold and silver recovery)

5.2.7 Climate Risk Assessment

5.2.7.1 Introduction

This section of the report will provide a brief overview of some of the projected global climate change impacts before narrowing its consideration to more regional predicted changes. On the basis of these likely regional changes, the potential vulnerability of the Project to climate effects is discussed. As recommended by the Equator Principals (EP4), this Climate Risk Assessment has been structured to align with the transitional and physical risks identified by TCFD (June 2017)[9].

5.2.7.2 Global Climate Projections

Table 5.2.7, below, discusses at a high level some of the most likely global climate impacts that could be observed over the coming years. Some of these impacts, such as sea level rise, will have no direct impact on the Project but could potentially affect supply chains and market access. Other effects have potential to affect the Project directly and these are discussed further in the following sections.

9 TCFD, "*Recommendations of the Task Force on Climate-related Financial Disclosures*", Final Report, June 2017, https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf

Table 5.2.7: Projected Global Climate Change Impacts	
Issue	**Projected Global Impact**
Solar Radiation	Long term projected changes in surface solar radiation, as a result of global warming, would suggest a decrease in available solar power due to a decrease in downwelling shortwave radiation, likely linked to the increase of water vapour[10]. This is considered to be anthropogenic strengthening of "natural" decadal variability in irradiance, known as global dimming and brightening, which is influenced by synoptic weather patterns, cloud variations and atmospheric aerosols[11].
Heat Waves	The IPCC[12] predict that temperature extremes will increase more rapidly than global mean surface temperature, with the number of hot days projected to increase in most land regions. In the 1.5°C warming scenario heat waves in mid latitudes could warm by up to 3°C. Heat waves could lead to more severe and longer periods of drought.
Extreme Rainfall and Flooding	The IPCC predict that human exposure to increased flooding would be substantially lower under a 1.5°C warming scenario compared to 2°C of global warming, although it accepts that projected changes create regionally differentiated risks[12].
Rising Sea Levels and Flooding	The most recent modelling indicates global sea level rise of 0.26-0.77m by 2100, under a 1.5°C warming scenario[12]. Risk is amplified on small islands and in low lying coastal areas and deltas.
Storms and Winds	Atmospheric circulations have large variability across interannual through to decadal time scales, which makes forming projections with any reasonable confidence very difficult. There is more robust evidence in the Northern Hemisphere that since the 1970s there has been a general poleward shift of storm tracks and jet streams and near-surface terrestrial wind speeds have been declining by approximately 0.1-0.14 m s^{-1} per decade across land[13]. Despite anemometers being used for decades to measure near surface wind speed, the data has rarely been used to analyse trends and lacks important instrumentation meta data. In general, confidence is low in wind speed projections due to large uncertainties across global data sets.
Cold Spells and Snow	While global warming is likely to lead to generally higher temperatures, these warmer temperatures could cause an increase in snowfall in certain locations "*owing to the increased moisture-bearing capacity of a warmer atmosphere*"[14]

5.2.7.3 Regional Climate Projections

There are many global climate models available to the scientific community to help decision makers understand the projections of future climate change and related impacts. These models attempt to account for many hundreds of variables so different models produce slightly different results. Some of the most widely used are the '*Coupled Model Intercomparison Project, Phase 5 (CMIP5)*' models, which were included in the IPCC's Fifth Assessment Report (AR5) [15]. The Climate Change Knowledge

10 Bartok et al. (2016). Projected changes in surface solar radiation in CMIP5 global climate models and in EURO-CORDEX regional climate models for Europe. Climate Dynamics

11 Parding et al. (2016). Influence of Synoptic Weather Patterns on Solar Irradiance Variability in Northern Europe. American Meteorological Society 29.

12 IPCC (2018). Special Report on Global Warming of 1.5°C (SR15). Summary for Policy Makers.

13 Vautard et al. (2010). *'Northern Hemisphere atmospheric stilling partly attributed to an increase in surface roughness'*. Nat. Geosci., 3 and McVicar et al. 2012. '*Global review and synthesis of trends in observed terrestrial near-surface wind speed: Implications for evaporation*', J. Hydrol. (within IPCC, 2014. Fifth Assessment Report: Chapter 2.)

14 Intergovernmental Panel on Climate Change (IPCC) (2014). Fifth Assessment Report: The Physical Science Basis.

15 In the past few months, the very latest IPCC report, 'AR6 - The Physical Science Basis', has been released containing new scenarios for Shared Socioeconomic Pathways (SSPs). These include emission pathways without climate change mitigation, as well as new low CO_2 emission pathways. As noted in the report, "*Modelling studies relying on the Representative Concentration Pathways (RCPs) used in the AR5 complement the assessment based on SSP scenarios for example at the regional scale. A comparison of simulations from CMIP5 using the RCPs with SSP-based simulations from CMIP6 shows that about half of the increase in simulated warming in CMIP6 versus CMIP5 arises because higher climate sensitivity is more prevalent in CMIP6 model versions; the other half arises from higher radiative forcing in nominally corresponding scenarios (e.g., RCP8.5 and SSP5-8.5; medium confidence). The feasibility or likelihood of individual scenarios is not part of this assessment, which focuses on the climate response to a large range of emissions scenarios.*" Although the emissions scenarios

Portal (CCKP) supports the analysis of climate impacts using multi-model ensembles, as they represent the range and distribution of the most plausible projected outcomes when representing expected changes. RCP8.5 is the high emission scenario used in AR5. In theory this represents a worst-case scenario among the mainstream climate change scenarios considered by the IPCC, but as time progresses it looks like an increasingly realistic trajectory.

The following climate projections have been reproduced from the World Bank Group's 'Climate Data Projections' for Bosnia and Herzegovina[16].

Temperature

BiH has been experiencing temperature increases of 1.2°C in the summer months and 0.8°C in the winter[16]. Climate change is expected to produce increases in monthly maximum temperatures, which are expected to exceed the historical mean by the mid-century by 2.4°C, under a RCP8.5 scenario. The number of hot days in BiH is predicted to increase by 6.3 days by 2040-2059 days, under a RCP8.5 scenario. These changes will result in increased incidence of drought, heat waves, and associated crop losses.

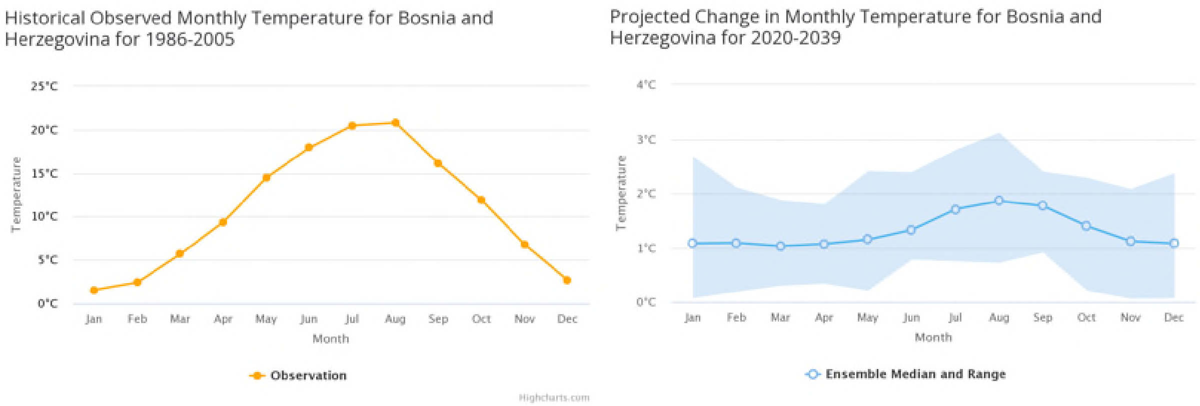


Figure 5.2.4: Projected Variation in Temperature in Bosnia and Herzegovina 2020-2039

(Monthly Temperature, Scenario: RCP 8.5 (High Emission), Ensemble Model, Source: Climate Change Knowledge Portal)

Precipitation

Bosnia and Herzegovina is ranked third in the world in terms of vulnerability to intense rain and prolonged rainfall[17]. The country is expected to experience increasingly variable patterns of precipitation, as well as increased frequency, variability and intensity of extreme events.

are higher in the very latest figures, the absence of consideration of the likelihood of them occurring at this stage of the reporting process means that the RCP emission scenarios are still considered to be the most useful model for this assessment.

16 World Bank Group, Climate Knowledge Portal - Climate Data Projections (Accessed 29/07/2021) *https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-projections*

17 World Bank Group, Climate Knowledge Portal, RCP 8.5 ensemble, 2020-2039 https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-projections (Accessed: 29/07/20201)

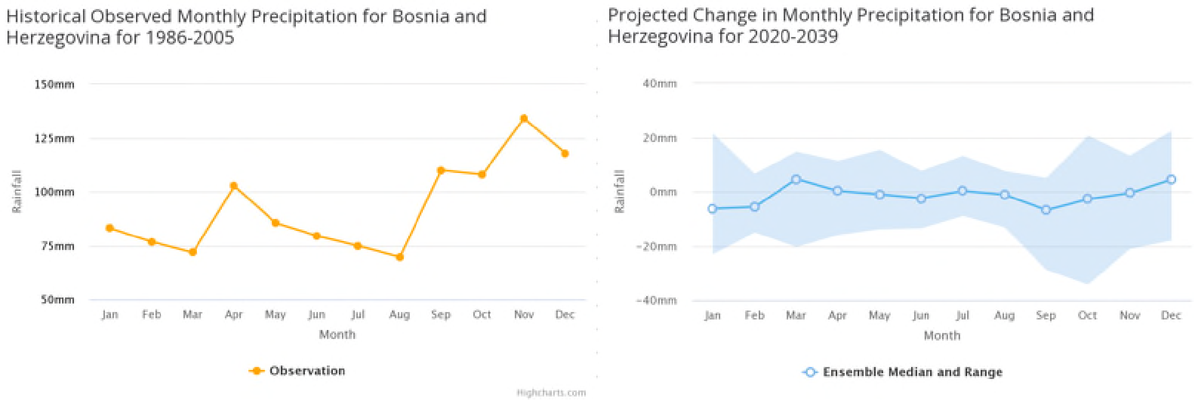


Figure 5.2.5: Projected Variation in Precipitation in Bosnia and Herzegovina 2020-2039

(Monthly Precipitation, Scenario: RCP 8.5 (High Emission), Ensemble Model, Source: Climate Change Knowledge Portal)

Over the LoM, the change in rainfall patterns is expected to be minor although there may still be individual extreme events. Over the period 2040-2059 precipitation is actually expected to fall by 4.2mm under the RCP8.5 ensemble scenario, but over the same timeframe the annual maximum 5-day rainfall (25yr RL) will rise by 8.66mm, suggesting less frequent but more intense rainfall is likely.

5.2.7.4 Transition Risks

Climate change transition risks can occur when moving towards a less polluting and greener economy. There is a general recognition that although going through such a transition could be costly and change the value associated with certain assets, the risk of not taking action could be far worse. Factors affecting the transition risks can include the speed of change, and exposure to affected markets.

Policy & Legal

These risks arise when either policy changes happen without advanced warning or a Developer is not cognisant of changes before they happen, and consequently gets caught out with an approach that is inconsistent with their legal obligations or government policy. An example includes Government withdrawing support for a polluting industry without providing prior notification, maybe due to commitments under the Paris Climate Agreement. If a company has already invested in certain infrastructure or equipment, then it might find itself left exposed.

In this case the Developer has had ongoing dialogue with various ministries and government officials, and authorities have been kept appraised of plans throughout the development process. Whilst there can never be any guarantees about a change in position from the status quo, the risks of this happening are considered to be small.

Technology

With any technological development, the success of certain technologies will fluctuate over time with some designs being favoured and others falling by the wayside. That situation is not fixed, and fortunes may reverse in the future. Climate change is one of the factors that can drive such variability. An example is the electrification of mining plant. Over recent years there has been a considerable increase in the interest in electrified plant as this tends to have lower associated emissions. In this particular instance, because the carbon intensity on the EPBiH grid is high due to the proportion of coal in the grid mix, the benefits will be more restricted. However, if EPBiH is able to transition to a lower carbon intensity through adding more renewables, this situation will improve over time.

As interest builds in more electrification of plant, so the research and development emphasis increases, and the product improves, making it even more attractive. Other technologies get left behind and become more expensive to maintain and repair. There is therefore a real risk associated with not ensuring the most appropriate technology is deployed on a Project, especially if that technology is not sufficiently capable to react to potential changes to the local climate and environment.

Generally, electrification in mining is becoming more mainstream because of its potential to lower emissions, however, in this instance, as a considerable amount of the grid electricity is derived from coal generation, the benefits will be minimal. As the electricity grid decarbonises over time then this will become a more attractive proposition and, should this change take place over the LoM, it is recommended that electrified vehicles be considered for any replacements required on site.

Other technological risks should be managed appropriately by sourcing the most up-to date and efficient technology available within the budgetary constraints of the project.

Market

This risk of divestment in the marketplace is considerable but it is not the only risk associated with markets. Climate change has the potential to affect supply chains thus impacting the availability of equipment, fuel, and the supply of labour, as well as disrupting demand for the end product. Such effects could be short-term, for example if a market is affected by a single extreme weather event, or longer term, for example if demand for a particular product falls out of favour due to perception about the climate impacts of its production processes.

Divestment has potential to affect any high emitter, but resources are essential around the world and primary materials need to come from somewhere. Whilst it is not possible to eliminate all risk, risks can be reduced by demonstrating that actions are being taken to minimise emissions where possible. The risks of disruption to supply chains from climate related events is largely out of the control of the developer although it would be prudent to put contingency plans in place to ensure that if one supply chain is critically affected then alternative arrangements can be adopted.

Reputation

Over time, climate change has become a more fundamental consideration of any project, especially an operation that has potential to both contribute to that change, and be affected by the rate of change. Furthermore, the company behind such an operation needs to secure ‘buy in’, both from the local community (Social Licence to Operate) and from its investors and shareholders (Corporate Social

Responsibility). The reputational risk of failing to properly account for climate risks can be environmentally catastrophic as well as hugely costly.

The best approach to protect the reputation of a company is to put in place the procedures and mechanisms to properly address any risk. This will likely involve establishing a management plan to monitor the changing environmental conditions on site over time and take any necessary amelioratory actions to correct issues, as well as providing ongoing monitoring of GHG emissions. Transparency is also important for reputational risk management. In the event of any problems materialising they should be addressed with lessons learned rather than concealed as this could damage investor confidence and increase environmental and social harm more than the original issue.

5.2.7.5 Physical Risks

Climate change is recognized to have potential to significantly impact on disaster management efforts and pose a significant threat to the efforts to meet the growing needs of the most vulnerable populations. Physical risks can be classified as 'Acute' or 'Chronic' depending on whether they are one-off 'freak' events, such as an individual episode of extreme weather, or longer-term shifts in climate patterns, such as a sustained warming trend.

As the Climate Change Knowledge Portal notes, "*The projected impacts from climate change make BiH increasingly vulnerable to natural hazards: droughts, heat waves, heavy precipitation, landslides, and floods. The most common natural disasters are associated with heavy rainstorms that may cause mudslides and flooding of large areas of agricultural land, houses and industrial buildings, and lead to other changes in the environment. Droughts may become more frequent in some areas due to river runoff decrease or drying in the country's lowland areas as well as from increased demand and consumption from economic development and population growth. Climate change is expected to increase risks and severity of natural disasters in BiH through more intense temperatures as well as rainfall patterns, prolonged heat waves, and water scarcity.*"

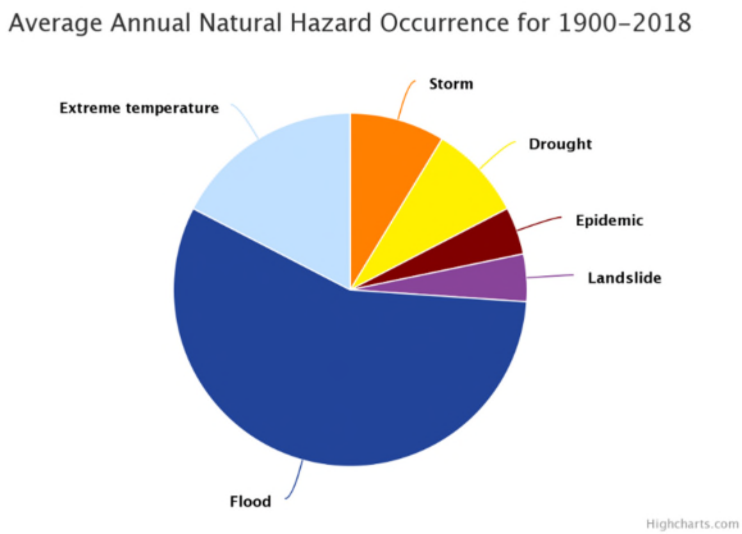


Figure 5.2.6: Average Annual Natural Hazard Occurrence in Bosnia and Herzegovina 1900-2018
(Source: Climate Change Knowledge Portal)

To assess the physical risks that Climate Change poses to the project the following matrix has been developed to identify what those risks are, how serious a threat they pose and any potential mitigation or adaptation that can be used to address the risk.

Table 5.2.8: Projected Physical Risk of Climate Change Impacts on Project

Climatic Factor	General Impact	Component/sub structure impacted	Vulnerability	Adaptation
Soil Drying	Increase will affect water tables and could potentially adversely affect foundation structures.	Increased risk of basement heave or subsidence, water ingress, consequential damage to finishes and stored items. Ground shrinkage can lead to failure of electrical, fuel and water pipes, foundations and sub-structures.	**Low** The finishes are likely to be of low importance in an industrial setting but alertness to possible physical damage should be high.	Regular monitoring and maintenance of site infrastructure will be undertaken to identify early signs of failings and take corrective action.
Temperature	Maximum and minimum changes will affect heating, cooling and air conditioning costs. Frequency of cycling through freezing point will affect durability. Daily maximum and minimum temperature will affect thermal air movement.	Existing air conditioning and ventilation loads may increase. Overheating of mechanical and electrical equipment effecting lifespan, reliability and potential health and safety issues. Plastic materials will have a reduced lifespan. Structure/cladding/roofing membranes, sealants, pavements and roads have increased risk of cracking. Reduced capacity of overheated power lines (there is no external connection to the power transmission grid, but overheating may be an issue even on the local onsite connections). Building overheating (due to increased fabric efficiency and incorrect implementation). Decreased labour productivity.	**Medium** Average monthly temperatures in Bosnia and Herzegovina are projected to increase by between 1-2°C over the next 20yrs based on current levels of warming (using the RCP8.5 scenario, which is looking increasing realistic). In summer in particular, temperatures could increase by as much as 3°C which would be significant. Drier environment and potential heat waves could mean higher risk of fires as well as dehydration and heatstroke.	Additional air conditioning will be considered in areas where increased temperatures may adversely affect the workforce or vulnerable machinery and equipment. Adequate provision will be made to ensure explosive stores and fuel stores are maintained at safe operating temperatures. Ensure proactive monitoring and maintenance procedures in place for building materials and site infrastructure. Provision of potable and non-potable water will be increased as required to ensure workers and processes are sufficiently hydrated. Monitoring of fire risk will be routinely undertaken and active steps to remove possible ignition sources and fuel sources, particularly in dry weather will be undertaken.
Relative Humidity	Increase will affect condensation and associated damage or mould growth.	Timber framed construction may be vulnerable. Internal walls, finishes and stored items.	**Low**	Monitoring will be undertaken for any mould growth, which has potential to cause health and safety issue. High levels of humidity can make heat stroke more likely, so

Table 5.2.8: Projected Physical Risk of Climate Change Impacts on Project				
Climatic Factor	**General Impact**	**Component/sub structure impacted**	**Vulnerability**	**Adaptation**
				provision will be made to ensure workforce safety.
Precipitation	Increase and decrease will affect water tables; durability and risk of water ingress will be affected by combination of precipitation increase and gales.	Increased risk of roof failure, increased chances of flooding. Structure/ cladding/ roofing membranes and sealants have increased risk of cracking due to different moisture movements. Potential damage to foundations and basements. Delays in construction and increased costs. Increased risk of subsidence.	**Low** The median rainfall levels are projected to fall although the intensity of individual events may increase. Higher intensity events may lead to more risk of flooding and potentially landslides and mud slides.	The VPP site elevation creates a ground surface fall away from the nearby Tisovci settlements. Stormwater and runoff is collected by onsite and perimeter drains which outflow to the Mala river. The potential for an intense thunderstorm event to overwhelm the site drainage is low as the drainage has been designed for a 1 in 100 year recurrence interval. Further information can be found in the Hydrology and Hydrogeology chapter at Section 5.7.3.1) At Rupice, during construction, sedimented run-off from site clearance and earthworks will drain to settlement ponds with decant to the Vruci Potok (Hot Stream) valley. Surface infrastructure and groundworks are all located on the western side of the Kiprovac ridge, below the ridge line and therefore no expected overland flow routes are present connecting to the Borovicki river. The Vruci Potok is currently subject to frequent heavy sedimentation and turbidity from non-project related forestry activities. One of the first scheduled construction activities will be the excavation and lining of the non-contact water settlement pond which is located at the foot of the site and within a natural drainage line that collects from the site footprint. The settlement pond is designed to retain two days residence water collected from the site and has sufficient capacity to hold a design stormwater flow. Where appropriate, the use of flood-proof barriers in doorways will be considered. Any vulnerable electrical infrastructure will be elevated to a safe height to prevent water ingress.

Table 5.2.8: Projected Physical Risk of Climate Change Impacts on Project				
Climatic Factor	**General Impact**	**Component/sub structure impacted**	**Vulnerability**	**Adaptation**
				The stability of banks and hillsides in working areas of the mine as well as the processing areas and access tracks will be regularly assessed to confirm it is safe to operate near them. Similar consideration will be given to the haul route to ensure it is not at risk of flooding or of landslides/mudslides. As temporary facilities the waste rock stock pile and run-of-mine stock piles have been designed at Rupice to withstand a 1:25 year rainfall event. The remaining infrastructure has been designed to 1:100 year events. The monitoring regime will be stepped up during periods of prolonged or intense rainfall.
Gales	Increase will affect need for weather tightness, risk of water ingress, effectiveness of air conditioning, energy use, risk of roof failures.	Increased risk of damage to roofing and higher risk of failure. Increased risk of materials and dust blowing around. Risk of damage to property or life either through direct wind action or through trees being blown over. Delays to work.	**Low** The baseline assessment indicates that average wind speeds and even maximum gusts are not expected to be a significant issue in this location.	Wind speeds will be monitored for climate-related increases. If observed appropriate action should be taken.
Radiation	Increase may affect need for solar glare control.	Window specification and glare control requirement.	**Low** Glare is unlikely to be an important consideration in this situation.	If this is found to be a problem, it would be relatively easy to retrofit tinted coverings to glass or issue sunglasses.
Cloud	Increase/decrease in seasonal lighting needs.	Changes in lighting systems and glare control requirement.	**Low** Most operations will either be underground or indoors. Either way, lighting systems will be available to ensure safe operation can continue.	If this effect is observed, then lighting may need to be improved either by installing brighter bulbs or more lights, but this is not expected to be a significant risk to the project.
Snow fall	According to the CCKP, winter precipitation		**Medium**	Active measures to minimise the risk of flooding, particularly

Table 5.2.8: Projected Physical Risk of Climate Change Impacts on Project				
Climatic Factor	**General Impact**	**Component/sub structure impacted**	**Vulnerability**	**Adaptation**
	rates are not predicted to vary significantly over the LoM, however the temperatures are expected to increase consistently by 1-2^{o}C so this may increase the risk of flooding.		Winter precipitation is not expected to vary significantly but the warmer temperatures may mean this is more likely to fall as rain rather than snow. If it does fall as snow and then temperatures rise sharply, there may be a greater chance of flooding from snow melt.	during winter will be implemented where necessary. Flood-proof barriers in doorways will be installed if the risk of flooding increases. Any vulnerable electrical infrastructure will be elevated to a safe height to prevent water ingress.

5.2.7.6 Liability Risks

The Bank of England has identified a third TCFD risk category – that of liabilities. "*These risks come from people or businesses seeking compensation for losses they may have suffered from the physical or transition risks from climate change*."[18]

This category covers the risk of investors seeking compensation for inadequate disclosure if a business makes a loss due to climate-related events on which they were not sufficiently informed about the risks. It also covers the risk of liability arising directly from people who have suffered from physical events linked to climate change, such as flooding, as a result of the development proceeding.

In this case the mine site is very remote and the likelihood of direct climate related impact on nearby communities is considered small. Appropriate mitigation procedures to reduce flood risk on site are being proposed and therefore the risk of the development itself directly increasing climate-related flood risks downstream are minimal.

5.2.8 Conclusions

This chapter has considered two aspects of Climate Change impact.

Firstly, the impacts of the Development on the Climate. This has been assessed by modelling the energy use and other relevant emission sources on site that are expected to occur as a result of the development over the Life of Mine. These emissions have been calculated to be 556,862tCO_2e in total. In absolute terms this is a considerable amount of carbon emissions and would be considered a significant adverse effect of project development. However, that assumes that zinc, lead, barium

18 Bank of England Knowledge Bank "*Climate change: what are the risks to financial stability?*" (accessed 14/07/2020) https://www.bankofengland.co.uk/knowledgebank/climate-change-what-are-the-risks-to-financial-stability

sulphate, gold, silver, copper and antimony are not required by society and could be done without. Assuming it is accepted that this is not the case, then predicted emissions compare favourably with predicted emissions per unit recovered of these metals from a typical mine, based on available global averages, even before mitigation measures. The mitigation proposed amounts to improving operational efficiency where possible. This is sensible behaviour in any circumstances and should be automatic practice from a business perspective. Once mitigation measures have been adopted, residual emissions will be lower, although precise quantification of this benefit has not been carried out at this stage.

The second part of the assessment has been to consider the way in which the climate is expected to vary over the Life of Mine based on local projections for Bosnia and Herzegovina. These projections have been used to help undertake a vulnerability assessment as to potential risks to the project itself from changing climatic patterns. Precipitation rates are expected to vary only slightly over the next 20 years (a small reduction in rainfall is expected overall, although there is expected to be a higher intensity of rain from single events), whereas temperatures are expected to rise 1-2°C throughout every month of the year, with the greatest increases seen in the summer months. This could have significant consequences in terms of increasing rainfall runoff in winter (rather than snowfall), increasing flooding events from snow melt, increasing risks of landslides, and increasing the chances of heating waves and fire risk during Summer. These risks should be considered and actively managed throughout the Life of Mine.

The most significant potential climate vulnerabilities are considered to relate to increased temperature and increased snowfall. Increased peak temperatures could adversely affect the workforce (dehydration/heat stroke) and cause plant and machinery to overheat. Since most of the project area is surrounded by forestry, increased temperatures may result in increased risks of forest fires. Consideration will be needed to ensure explosive stores and fuel stores are safely maintained at higher temperatures and fire risks will need to be routinely monitored, with active steps to remove possible fuel and ignition sources, particularly during intense periods of dry weather.

Although overall precipitation rates are expected to decrease, higher intensity events may occur and increased temperatures in winter may mean that snowfall melts more quickly than was previously the case and this, in turn, could increase the risk of flooding. The design of both Rupice and VPP allows for accommodating drainage and storage from intense stormwater events. However, the haul road may be at increased risk of surface damage, wash outs and landslides.

5.3 Soils and Contaminated Land

5.3.1 Introduction

This chapter considers the likely significant environmental effects of the proposed development in regard to soils and contaminated land that will directly affect land within the Project Footprint and potential secondary affects in the surrounding Project Affected Area. The mitigation measures needed to prevent, reduce or offset any significant adverse impacts, and the likely residual effects after these measures have been evaluated.

Based on the baseline assessment of soils and contaminated land (Chapter 4.4) there are elevated levels of certain contaminants above BiH agricultural guidance and Canadian Council of Ministers of the Environment (CCME) for industrial soils guidance. These are focused in the Vares Processing Plant and historic Veovaca open pit where previous mining activities were concentrated. Along the haul route contaminant levels exceeding BiH agricultural guidelines were seen however these only also exceeded CCME industrial guidelines for elements that were naturally elevated, likely from the mineralisation across the region. As such this impact assessment will provide general guidance for all activities associated with soil and a focused assessment for regions where elevated contamination already exists, and industrial activity will take place as part of the project.

5.3.2 Guidance in Assessing Impacts on Soils

Soils are an important receptor as they provide a diverse range of ecosystem services. The land within the Project Footprint can be divided into soils that:

- Support forestry, which comprises the majority of the land use within the project affected area;
- Are used, or are available, for agricultural production including food crops and grazing / hay meadows; and
- Provide substrate on previously disturbed land, specifically around Vares, where secondary vegetation has established on skeletal soils, following abandonment of the mine during the 1980s.

The relevant EBRD Performance Requirements are set out in Table 5.3.1, and inform the interconnectivity of the ecosystem services that soils provide. The Performance Requirements have been used to determine receptor sensitivity in Table 5.3.2. The sensitivity of soils has been assessed in relation to the main Project components that result in disturbance of soil resources including the construction phase of the Project and the subsequent storage of the soil resource for use in mine reclamation and rehabilitation.

Table 5.3.1: Relevant EBRD Requirements that Relate to Soils		
Performance Standard / Requirement		Requirements
PR1	Environmental and Social Appraisal and Management	Consider in an integrated manner the potential environmental impacts, including that of soil, associated with the proposed project. Minimize, mitigate, or offset / compensate for adverse impacts and to identify, and where feasible, adopt opportunities to improve environmental performance.
PR3	Pollution Prevention and Abatement	Technical characteristics of the installation, its geographical location and local / ambient environmental conditions shall be considered to apply pollution prevention and control technologies and practices (techniques) that are best suited to all polluting activities in all economic activities, and from effluents and emissions at the facility level, to a regional and global level where appropriate.
PR6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	The sustainable use and management of natural resources, in all types of habitats, irrespective of whether they have been disturbed or degraded previously, or whether or not they are protected or subject to management plans. This is to achieve no net loss / net gain of biodiversity in the affected habitat. Soils support these habitats and the ecosystem services they provide, and consequently are to be considered in the same way.

5.3.3 Project activities and prediction of impacts

5.3.3.1 General Project activities that will influence soils

The project activities and associated activities that have the potential to impact land and therefore soils within the Project Footprint include:

- Stripping and stockpiling of soil resources;
- Traffic on soils through use of mobile plant and equipment;
- Use and storage of chemicals;
- Stockpiling of tailings and waste rocks; and
- Deposition of dust from mining activities onto the surface of the soil, causing contamination over a period of time.

Stripping and stockpiling - Where soils are to be stripped for the construction of project infrastructure, the soil resources will be removed for the creation of foundations. During these activities, the soil resources will be removed from their in-situ location, handled and stored in stockpiles or exported off site. This also includes the removal of trees and stumps which help stabilise in situ soils.

Traffic on soils from project associated machinery - Where construction machinery travels over unprotected soils pressure is applied to the surface. Areas trafficked by heavy vehicles will have an increased impact as well as areas that will receive high volumes of traffic.

Use and storage of chemicals - Storage of chemicals, disposal and handling of storage containers increases the risk of spillages which can impact on soil resources, causing contamination and degrading the quality of the soil, reducing functionality and potentially limiting or preventing reuse.

Stockpiling of waste rocks and disposal of mine tailings - Mine tailings and waste rock can contain high concentrations of metals associated with the ore being mined. Waste rock has the potential to produce acidic leachate containing high concentration of a wide range of elements, which if uncontrolled, would impact the soil resources which come into contact with the leachate. This impact, known as Acid Rock Drainage Metals Leaching (ARD ML), is discussed further in the chapter on Geochemistry (Chapter 5.8). Tailings contain the residues from the processing of ore including chemical additives used to release the metals and enhance recoveries. Potential impacts on soil resources can result from uncontrolled release of tailings from the area in which they are stored, or from pipes or other means of transporting the tailings. The design of the tailings storage facility (TSF) has been considered in Chapter 3 (Project Description), including the environmental controls that will be implemented to avoid release of tailings into the environment.

Deposition of dust from mining activities – The deposition of dust onto the surface of the soil from mine related traffic, other mobile equipment and operations such as crushing and screening is likely to take place. Dust deposition over prolonged periods of time during the life of the mine can result in changes to the chemistry of the affected topsoil. The sensitivity of the receptor depends on the land use and the physical composition of the soil.

5.3.3.2 Predicted Impacts from General Project activities that will influence soils

Based on the identified project activities (identified in section 5.3.3.1) the potential impacts on soil resources have been predicted. The assessment considers the relevant activities that take place throughout the lifespan of the project including mine closure and rehabilitation.

Predicted impacts on soil resources resulting from direct project activities and associated activities include:

- Deterioration of soil structure; and
- Loss of bulk soil resources, through
    - handling and storage of soils;
    - erosion; and
    - contamination.

The subsequent effects of these changes have the potential to reduce the capacity of the soil for forestry and agricultural uses. The ecosystem services provided by the soils, as described in Table 5.3.1, may also be inhibited.

Loss of bulk soil resources – Soil resources may be lost due to earthworks if not appropriately handled, stored and reinstated. The loss may be a result of mixing of topsoil with subsoil which would result in partial loss of their function, mixing with underlying parent material, and removal off-site. This is likely to have the highest potential impact when top and sub soils are removed and stored in mounds during the earthworks phase to enable the operations, such as construction of haul roads, waste rock dumps, storage of the stripped soil itself, and rock extraction.

Loss of soil structure/ soil degradation - Soils may become compacted and lose structure as a result of handling, storage, frequent movement of traffic and compaction. The main cause of soil degradation as a result of handling operations during conditions when the soil is wet and more vulnerable to long term damage. There is an increased risk of loss of resources from erosion from degraded soils, which can result in secondary effects such as pollution of watercourses, the impact of this has been considered in the Hydrology Impact assessment (Chapter 5.7).

Erosion - The soils may be gradually lost through wind and water erosion. The sensitivity of the soil, slope, local climate and surface vegetation cover will all influence the extent to which erosion will cause the loss of soil resources. Sensitivity will also be increased due to the removal of forest cover which act to stabilise soils. The exposed edge of plantations can also be subject to wind throw of trees and soil erosion. Erosion of soil due to rainfall and surface water flow can also contaminate watercourses through sedimentation, and when eroded by wind, soil can lead to a reduction in air quality. Soil erosion can lead to fugitive dust emissions during the removal of soil and overburden during earthworks; the impact of this has been considered in the Air Quality Impact Assessment (Chapter 5.5).

Contamination - Natural soils can be contaminated during mining operations with the potential for change to the soil functioning or ability to provide the same ecosystem services as the baseline. This includes contamination from sources such as mining waste, rock fragments, contaminated water (e.g. acid rock drainage discharge, highly alkaline water discharges), vehicle fuel and oils (e.g. fuel refilling station for haul vehicles, along haul route between Rupice and VPP), construction materials, and through mixing with soils that are already contaminated.

Acid Rock Drainage (ARD) and leaching from Tailings – There is the potential for contamination and degradation of soils specifically from ARD effluents with elevated concentrations of iron and other heavy metals, if not controlled at source. This potential impact is considered in the Geochemistry Impact Assessment (Chapter 5.8). The potential for leaching of contaminants from the weathering of tailings in the Tailings Storage Facility has the potential to contaminate soils within the area of the TSF and down gradient.

5.3.3.3 Specific project activities that will impact soils

As the mine at Rupice will be underground, the project activities that directly affect soils will mainly take place during the construction and closure phases of the project. Potential impacts from the operational phase of the project at Rupice will likely be restricted to possible contamination. Operational phase impacts in the vicinity of the TSF and along the haul route are likely to include contamination and loss of soil resource quality during storage. Details of the specific project activities (see Chapter 3: Project Description), have been considered in conjunction with potential impacts associated with each aspect of the mine and associated infrastructure, in the following sections.

Haul Route

- Construction:
  - Widening of existing tracks and roads;
  - Construction of new sections of road in currently forested areas, removal of trees will expose the soil profile, with potential for erosion;
  - Stripping of soil materials from the project footprint for reuse; and
  - Transportation and storage of soil resources until needed or disposal/reuse of surplus soils.
- Operation:
  - Deposition of pollutants from entrained dust, vehicular emissions and spillages; and
  - Ongoing maintenance.
- Closure:

Roads will be left intact for the local community use and maintenance by the municipality, although reducing width of the roads will be considered.

Rupice

- Construction:
  - Removal of trees and stumps across the area exposing the soil profile;
  - Stripping of topsoil and subsoil ahead of the construction of buildings and infrastructure; and
  - Storage of surplus soil for the remediation of the site at the end of the project.
  - .
- Operation:
  - Contamination and degradation of soil resources as a consequence of mining operations; and
  - Loss of soil resources through erosion for exposed surface and soil profiles.
- Closure:
  - Demolition and removal of plant and equipment, impacting on adjacent undisturbed soils; and
  - Soil handling and replacement in accordance with the mine closure and rehabilitation plans.

Vares Processing Plant and Tailings Storage Facility

- Construction:
  - Removal of trees and stumps in the TSF area exposing the soil profile which will increase the risk of soil erosion and downstream sedimentation of watercourses which have been classed as highly sensitive (Biodiversity Impact Assessment Chapter 5.4);
  - Stripping, handling and disposal of potentially contaminated soils ahead of the construction of buildings and associated infrastructure; and
  -
  - Suitable handling and remediation/disposal of contaminated soils.
- Operation:

  - Progressive removal of trees in the TSF area to enlarge the footprint of the dry stack facility;
  - Ongoing expansion of the Tailings storage facility including the removal of topsoil for covering and remediation (Chapter 3: Project Description, Section 3.6.1: Tailings Storage Facility);
  - Potential for contamination and degradation of soil resources during TSF operations; and
  - Loss of soil resources through erosion.
- Closure:
  - Demolition and removal of plant and equipment, impacting on adjacent undisturbed soils; and
  - Soil handling and replacement in accordance with the mine closure and rehabilitation plans

5.3.4 Evaluation of impacts

5.3.4.1 Receptor sensitivity

Sensitivity of soil resources have been determined using the Receptor Sensitivity Scale outlined in the ESIA methodology (Chapter 5.1) to include the EBRD requirements that relate to soil (Table 5.3.1). These include the abundance and potential substitution of the soil resources as well as the importance of soils as determined by the functions they fulfil and current land use. The main soil functions are:

- Producing food and other materials such as timber;
- Filtering water;
- Controlling the rate at which rainwater reaches watercourses;
- Storing carbon and facilitating gas exchange;
- Supporting habitats for a plants and animals; and
- Protecting archaeological heritage.

To consider the sensitivity of the soil resources in terms of abundance and substitution, the land take and estimated affected soil volume has been calculated. Project activities and current land use have also been considered. The overall sensitivity of soil resources at each location are shown in Table 5.3.2.

Table 5.3.2: Receptor Sensitivity by Location and Land Use						
Location	**Local soil characteristics**	**Project activities**	**Land use(s)**	**Land take (ha)**	**Approximate total soil volume (m^3)***	**Sensitivity of soil resources**
Rupice	Slightly acidic soils, organic matter rich and ranging in texture within the site from clay rich to sandy loams	Removal of trees, and ground preparation and construction works. Above ground mine infrastructure and ancillary plant	Forestry	28.5	142,500	Low to Medium
Haul Route	Ranging from acidic to alkali, ranging in organic matter content, predominantly sandy loam in texture	Removal of trees, and ground preparation and construction works for new road sections. Haul roads, transportation of ore, workers and chemicals	Forestry with small regions of former industrial, meadows of mixed land use and residential	28	92,500	Negligible to Medium
Vares Processing Plant	Neutral to slightly alkaline pH, lower carbon content, heavily contaminated	Mineral processing plant and ancillary plant including tailings storage	Former industrial and	4.5	20,300	Negligible to Low
Tailings Storage Facility	Slightly acidic, good carbon content, sandy clay texture	Removal of trees, storage of tailings	Forestry	11	53,000	Medium
Total				**77**	**2,208,000**	
*Estimated based on the average soil profile depth from the soil surveys and the land take area rounded to nearest 5000m^3.						

5.3.4.2 Magnitude of change

This section evaluates the potential magnitude of change caused by the identified project activities on the land within the Project Footprint. The magnitude of change is considered in relation to the change from the baseline conditions (Chapter 4.4). Considering the potential for change from the baseline of the land within the Project Footprint, natural soils are at the greatest risk to change, especially within regions where project activities may have the greatest impact.

The baseline chapter covering soils and contaminated land (Chapter 4.4) highlighted the elevated background levels of heavy metals in the region that were present in the natural soils at Rupice, along the haul route and in the Vareš area. There are also areas that have been identified with historic contamination containing levels of metals that exceed BiH and CCME guidelines, particularly within and adjacent to the former Vares Processing Plant.

Table 5.3.3: Magnitude of Change by Location and Project Activity and Land Use					
Location	**Project activities**	**Land use(s)**	**Land take (ha)**	**Likelihood and magnitude of change from the baseline**	**Magnitude of change**
Rupice	Above ground mine infrastructure and ancillary plant	Forestry	28.5	Land is currently used as forestry, within the project footprint, trees will require clear felling and stumps removed. Remaining soil will be removed before construction can begin. These soil resources will be stored for the duration of the project for mine rehabilitation. There is a high likelihood that the soil resources will be lost in stump removal and the structure of remaining soils adversely affected by handling and storage operations.	Medium
Haul Route	Haul roads, transportation of ore, workers and chemicals	Forestry with small regions of former industrial, meadows of mixed land use and residential	28	Construction of haul roads and upgrade to existing tracks would result in the loss of soil resources. However, these can be stockpiled and used for rehabilitation following mine closure. There is a high likelihood that the soil resources will be adversely affected by handling and storage operations.	Low - Medium
Vares Processing Plant	Mineral processing plant and ancillary plant	Former industrial, residential	4.5	The area has been defined as contaminated brownfield land, with poor quality of in situ soil resource. The contaminated soils require specific mitigation to avoid the risk of releasing to uncontaminated areas adjacent.	Low - Medium
Tailings Storage Facility	Tree removal, soil stripping and tailings storage	Forestry	11	Land is currently used as forestry, trees will require clear felling and stumps removed. Remaining topsoil will be stripped and stored before preparing the TSF prior to tailings storage. Stored topsoil will be utilised for covering the TSF. The site sits in a steep valley increasing the risk of erosion. There is a high likelihood that soil resources will be lost in stump removal and the structure of remaining soils adversely affected by handling and storage operations.	Medium
Total			**77**		

5.3.4.3 Discussion of Impacts by land use

Land with a history of industrial activity - From the baseline studies this includes the land within and adjacent to the Vares Processing Plant and sections of the haul route. At VPP the land has a history of mineral processing and there are elevated levels of soil contamination. Due to the scarcity of natural soils, potential impacts on these resources are considered minimal. The portion of the haul road within urban areas of Vares passes through land affected by previous industrial use, including the former iron ore open pit. The impact on soil resources will be limited, associated with the widening of existing roadways and disturbance of natural soils is limited. Removal and handling of contaminated soils require specific mitigation, implemented through the Soils, Contaminated Land and Erosion Control Management Plan.

Forestry - Forestry is the major land use within the project affected area, including Rupice mine, together with the haul route and the footprint of the tailings storage facility downstream of the Vares Processing Plant. In areas where forestry is the main land use there is likely to be more substantial impacts to soils as the trees will need to be felled, the stumps removed, and remaining soil resource removed within the project footprint. The soils within the Rupice project area range in texture from clay soils to sandy loams; clay soils require specific management to reduce the potential for damage when handled in wet conditions. Sandy textured soils, which make up the majority of the haul route, are more resilient to change when moved and stockpiled.

Meadows and mixed land use - The areas where the project will affect this land use is limited to the haul route, this will involve widening existing tracks as well as constructing new haul roads. The land is generally not in agricultural use but has value for its biodiversity. There is also the possibility that the fields are used for grazing and hay crops. Construction will require removal and stockpiling of top and subsoil horizons. These soil resources will be used for rehabilitation post mine closure. There is also the potential that soils adjacent to the haul road could become contaminated through dust deposition and ore or tailings spillage during the operational phase of the mine. Salt spreading in winter conditions could also have an effect on adjacent soil microbiome and associated vegetation. These impacts could result in a long-term effect on the composition of the grassland. The Biodiversity Impact Assessment (Chapter 5.4) identifies that mountain hay meadows are susceptible to change where the soil nutrient balance changes. Although this is not a short term impact, areas of industrial activity can cause increased nitrogen and sulphur deposition in nearby soils.

Residential - The areas where the project will directly influence residential land is mainly in existing tracks and roadways. The proportions of residential land near to the Vares Processing Plant are at an increased risk from contamination due to deposition if emissions are not well managed. This is only likely to cause concern for soils where land adjacent to residential buildings may be used for food production. This has been considered in the Ecosystem Services Impact Assessment (Chapter 5.12) and is addressed in the Community Health, Safety & Security Management Plan.

5.3.5 Mitigation measures

5.3.5.1 Overview

The Soils, Contaminated Land and Erosion Control Management Plan will be in place before the commencement of works and cover the mitigation measures required for all stages of the project through to rehabilitation and aftercare. This will reduce the impacts as much as possible and provide measures that can be taken to alleviate negative impacts throughout all phases and project activities.

A summary of project activities, predicted impacts, mitigation measures and residual impacts is presented in Table 5.3.4 and discussed further below.

5.3.5.2 General Soil Mitigation Measures

To reduce soil degradation, including loss of bulk soil resources and loss of soil structure, all works involving the extraction, handling, moving and storage will be undertaken following appropriate soil handling guidance. There are currently no guidelines for BiH, Europe, EBRD or IFC for the handling and storage of soils. Alternative guidance can be sought for other countries for the sustainable use of soils on construction sites[1,2], but will need to be used and adapted with appropriate knowledge of local soils. General good practice for soil handling includes:

- Not mixing topsoil and subsoil horizons;
- Safeguarding the topsoil resource to avoid contamination with rocks or other materials that would impair soil functioning; and
- Handling soils when the weather conditions are appropriate where soils are friable in dry conditions to reduce compaction from handling and storage.

Where soil storage mounds will be in situ for several years and not temporary (i.e. < 6 months), they will be seeded with vegetation to cover and help stabilise the bare soil. This will decrease the risk of erosion from runoff and wind, and natural processes should maintain the soil quality. Topsoil will be stored in separate mounds to those containing subsoil. All mounds will be maintained, and vegetation mown annually, as a minimum. Appropriate guidance for the building of soil storage mounds will be sought[2].

Risk of soil erosion is widespread in BiH due to the light sandy soil texture and steep slopes. Therefore, soils will be managed with appropriate storage and soil management strategies, including not leaving soils surface bare of vegetation. Light textured soils, such as those along the haul route and in the VPP area are susceptible to erosion from wind and water, particularly when disturbed after clear felling and stump removal. The soils at Rupice have a heavier texture and are at an increased risk of loss of soil structure during handling and storage. In all areas where trees are to be removed there will be an increased risk to soils from soil erosion which requires appropriate management and is included in the Soils, Contaminated Land and Erosion Control Management Plan.

The Emergency Preparedness and Response Plan contains procedures to reduce the potential for soil contamination. Contamination may arise from mining waste, rock fragments, contaminated water (e.g. acid rock drainage discharge, highly alkaline water discharges), vehicle fuel and oils (e.g. fuel refilling station for haul vehicles, along haul route between Rupice and VPP), and construction materials, among others.

[1] UK, DEFRA's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf

[2] UK, MAFF's Good Practice Guidance for Handling Soils. This outlines the best practice for stripping, storing and reinstating soils. Available at: https://viking-link.com/media/1572/cda31-maff-agricultural-land-classification-in-england-and-wales-a-good-practice-for-handling-soils-april-2000.pdf

5.3.5.3 Design Specific Mitigation Measures

Soil Storage at Rupice - The soils at Rupice are mostly natural and uncontaminated. As such they are an asset for rehabilitation post mine closure. Clear felling and stump removal will result in loss of soil resource. Remaining soils will be removed to the full depth of the profile and stockpiled after the removal of the tree stumps. These clay rich soils should only be handled in dry weather conditions, while the soils are friable but not sufficiently wet to be compacted during handling. The potential volume of good quality natural soil resource will be retained to reuse in rehabilitation. Storage mounds will be located to provide visual screens for mining infrastructure, where appropriate.

Veovaca Open Pit (potentially for soil storage, though unlikely) - The former Veovaca open pit will be used to store soil and other materials during the construction phase of the project. There are some elevated levels of contaminants within the pit. As such, procedures are required to limit the amount of material that is mixed with in situ soils to reduce the potential of contamination during handling and stockpiling. These measures are outlined in the Soils, Contaminated Land and Erosion Control Management Plan.

Soil Storage/Removal at Vares Processing Plant - Soils in the Vares Processing Plant that are contaminated will be treated as hazardous. Contaminated soils from within the VPP have been stripped and contained or capped/covered to contain the risk during the demolition process. Therefore, the potential pathway for these contaminants to receptors has been removed. During the construction phase, procedures for dust suppression will be implemented during dry weather to reduce the risk of fugitive dust and potential impact on human health from contaminate present in the soil horizons. These measures are outlined in the Soils, Contaminated Land and Erosion Control Management Plan and the Air Quality Management Plan.

Tailings Storage Facility at Vares - Current design criteria for the TSF outline that the footprint will be clear felled, and stumps removed. Remaining topsoil will be stockpiled nearby for reuse. The remaining subsoil will be compacted, to provide a slowly permeable layer with basal drainage network to recirculate leachate to VPP. On closure of the mine, the TSF will be suitably covered by a mineral cover layer or membrane before reinstatement with subsoil and topsoil, or suitable soil forming materials, to be revegetated. There are specific project design measures in place to reduce the impact from the stored tailings (see the Project Description, Chapter 3, Section 3.6.1). The removal of trees and increased risk of erosion has the possibility of impacting the downstream water courses including the Mala River which has been classed as highly sensitive in the Biodiversity Impact Assessment (Chapter 5.4) and mitigation measures in the Hydrology Impact Assessment (Chapter 5.7, Section 5.7.4) include a sedimentation pond at the base of the TSF to capture all sediments that may be moved through water induced erosion. The TSF will be covered and vegetated progressively, to reduce the areas susceptible to erosion.

Waste rock stockpile at Rupice - The waste rock stockpile at Rupice will be a temporary stockpile and the material will be combined with tailings material and used as backfill for the mine. The area where it will be located has contained drainage which will divert any leachate to the water treatment plant to reduce the risk of contamination from leachate to surrounding soils. The stockpile will be fully depleted in year 8 of project development, thus leaving only the platform and drainage ditches. At the end of the project any remaining infrastructure or footprint will be contoured to minimise the risk of runoff, compacted and covered in topsoil followed by revegetation. If the slope is more than 30 degrees, the area will require terracing before topsoil and revegetation occurs.

Ore stockpiles at Rupice – During operation of the mine the ore will be stored in ROM pads before being transported to VPP with all drainage contained reducing the risk of contamination to nearby soils. At the end of the operational phase of the project all ore will have been removed from Rupice and processed at VPP. The tailings will then be stored either in backfill material or in the dedicated TSF.

Haul Road - The design for the haul road will be established with the necessary features required for the avoidance of surface erosion, these include, but are not limited to run-off cut-off drains, rock anchors, inclined batters & catchment berms. The haul road will be designed in full during the detailed design period, by the end of 2021.

5.3.6 Residual impacts

Re-assessment of impact significance after mitigation is applied (assuming effective implementation of mitigation measures) is undertaken to derive residual effects from Project activities. This assessment is based on the same methodology and Impact Significance Matrix used to assess unmitigated impacts. Appropriate risk analysis will continue based on the monitoring programme targeted to assess the effectiveness of the mitigation measures on potential impacts.

Table 5.3.4: Predicted Impact before and after Mitigation for Soils Split by all Stages of the Project									
Project stage	**Location**	**S***	**Project Activities**	**Potential Impact**	**M***	**Impact before mitigation**	**Mitigation Measures (Including Project Design)**	**M***	**Residual impact**
Construction	Haul Route – Industrial soil locations	L	Upgrade to existing road. Driving width of 5 m plus an additional 0.5 m pavement and 0.5 m embankment.	Degradation of soil resources through mixing of topsoil and subsoils and soils with non-soil material.	L	Minor	Stripping, transporting and storing materials separately.	N	Negligible
		M	Storage of soil material in the former Veovaca open pit mine or another suitably identified location(s), a proportion of which to be used in the groundworks for the haul road including embankments.	Veovaca has levels of soil contamination, potentially contaminated soils stored in the area.	M	Moderate	Lining the soil storage areas, not picking up soil or material currently in situ at Veovaca.	L	Minor
		L	Soil materials superfluous to the installation of the road.	Unless reused will be disposed of and lost.	L	Minor	Superfluous uncontaminated soil repurposed or stored for the restoration after the project.	N	Negligible
	Haul Route - Natural soil	M	Installation of new road. Driving width of 5 m plus an additional 0.5 m pavement and 0.5 m embankment.	Degradation of previously undisturbed soil resources through mixing of topsoil and subsoils and soils with non-soil material. Increased erodibility of soils after tree removal.	M	Moderate	Previously undisturbed soils will be handled and stored with extra care as they can be reused for the embankments and remediation during closure.	L	Minor
	Rupice - Natural soils	M	Stripping of topsoil and subsoil ahead of the construction of infrastructure, including: Waste rock stockpiles for feed into the paste and backfill plant. Infrastructure including buildings. Infrastructure for roads.	Degradation of previously undisturbed soil resources through mixing of topsoil and subsoils and soils with non-soil material. Increased erodibility of soils after tree removal.	L	Minor	Previously undisturbed soils will be handled and stored in accordance with procedures in the management plan, potential to reuse for visual screens to reduce visual impacts during the duration of the project and be used for remediation during closure.	N	Negligible
	Vares Processing Plant - Industrial soils	M	Infrastructure including buildings. Infrastructure for roads.	In situ soils are contaminated and although there is a minor risk that they will be impacted further during the project, they will be dealt with as hazardous.	M	Moderate	Stripping and containment or sealing of in situ soils due to current elevated contamination level. If soils are needed excess soil from the construction of the haul route could be used.	L	Minor
	Vares Tailings Storage Facility - Natural soils	M	Preparation for the TSF will include the stripping and storage of topsoil and implementation of drainage collection.	Loss of soil structure due to earthworks, potential for erosion. Increased erodibility of soils after tree removal.	L	Minor	Appropriate handling and storage of the topsoil which will be stored in the Veovaca Open Pit (close vicinity) or another suitably identified area to reduce the need to transport and store the soil elsewhere.	N	Negligible
Operation	Haul route – Natural and Industrial Soils	L	Soil in the vicinity of the road where deposition of vehicle emissions, spillages and pollution may occur.	Contamination leading to limited reuse and potential contaminant spreading.	M	Minor	Appropriate standard operating procedures in place that will limit the chance of spillages and appropriate measures in place to deal with them quickly and thoroughly (To be included in the Emergency Preparedness and Response Plan). Efficient vehicles with lower emissions.	N	Negligible

Table 5.3.4: Predicted Impact before and after Mitigation for Soils Split by all Stages of the Project									
Project stage	**Location**	**S***	**Project Activities**	**Potential Impact**	**M***	**Impact before mitigation**	**Mitigation Measures (Including Project Design)**	**M***	**Residual impact**
	Rupice – Natural Soils	M	Extraction and movement of mine tailings, waste rock dump, vehicles and general mining operations.	Potential contamination, erosion and soil degradation.	L	Minor	Include soil storage and stockpiling in the SMP and store soils in an appropriate location to reduce the change of contamination that may result from leaching.	N	Minor
	Vares Processing Plant - Industrial soils	L	Use of chemicals and processing of mine tailings.	Contamination of soils.	M	Moderate	Chemicals, tailings and machinery is generally contained. Chemical storage will have. Drainage ditches collecting run off, dust suppression in place.	L	Minor
	Vares Tailings storage Facility – Natural Soils	M	Dry stack tailings delivered to the TSF after 19 months. Initial capacity phase 1 – 0.69 Mt Capacity phase 2 extension – 3.61 Mt Capacity phase 3 – 3.51 Mt Total capacity 7.8 Mt Total tailings produced calculated to be 7.3 Mt and stored here starting month 19 to operation.	Potential for contamination of adjacent soil resources and risk of erosion polluting downstream water courses.	M	Moderate	Timely coverage of stockpiles and tailings with soil and vegetation. Installation of a sedimentation pond downhill of the TSF to catch all sediment that has been generated due to erosion.	L	Minor
Closure	Rupice – Natural soils	M	Rehabilitation and post closure reclamation	Loss of soil structure and increased erosion through the exposure of bare soils. Soil compaction.	L	Minor	Soils will be handled in accordance with procedures in the soil management plan. A programme of establishing vegetation following soil replacement. Surface water drainage installed to reduce the chance of gullying and soil erosion.	N	Negligible
	Haul route – Natural and Industrial soils	L	The road will be left intact for transport infrastructure in the region	Ongoing maintenance and risk of pollutant deposition once release to the country?	N	Negligible	n/a	N	Negligible
	Vares (Industrial soils in the VPP and more natural soils in the TSF)	M	Covering the Tailings storage facility	Potential for contamination of adjacent soils from ARD drainage from the TSF.	M	Moderate	Design measures to manage the waterflow in the area and cover the TSF with 1m low permeable shaley) material, 1m cover of crushed rock capping to avoid erosion, and 0.5m soil and for grass revegetation. Cordon off this area so that it can't be used for agriculture.	L	Minor
*S = Sensitivity, M = Magnitude. Sensitivity and magnitude levels denoted as: N=Negligible, L = Low, M = Medium, and H = High.									

5.3.7 Soil Volume Balance

Based on the project designs and the mitigation measures already detailed, a soil balance of the project affected area has been calculated to provide indicative values for the quantity of soil to be removed, stored and surplus soil (Table 5.3.5).

Table 5.3.5: Project Footprint and Estimated Soil Volumes Affected

Location	Infrastructure or area	Approximate total soil volume to depth of soil profile (m3)	Notes	Estimated maximum volume to be removed during construction (m3)	Estimated volume to be re-used (m3)	Surplus soil volume (m3)	Source (if applicable)
Haul Route	Upgrade to existing road 9 km and installation of new road 15.5 km.	93,000	Driving width of 5 m plus an additional 0.5 m pavement and 0.5 m embankment. Total road length is 24.5 km.	Topsoil category 3 - 119,793 Subsoil category 4 - 158,549 Subsoil category 4 and 5 - 179,680	Topsoil reuse during road construction (for embankments) Category 3 - 120,864	**157,478**	Saraj Inzenjering - Preliminary design for the road from Rupice to VPP 25 km
	TOTAL	**93,000**		**278,000**	**121,000**	**157,000**	
Rupice	Administration, fuel station, lube and flammable storage	11,000	Assuming: Topsoil (approx 40 cm deep) is stripped. Subsoil is used for foundations and ground levelling.* Separation of topsoil and subsoil may be difficult where stumps have been removed and the profiles disturbed.	8,500	No specified design to reuse soils. Soils are not contaminated and will be stored in stockpiles which will also create a visual barrier for the plant during operation and then can be used for remediation during closure. 115,000	0	Calculated from the proposed project footprint shapefiles and soil depths likely to be removed for construction and reused for remediation.
	Blasting accessories storage and emulsion	1,600		1,300			
	Crushing plant pad	37,000		29,000			
	Ore stockpile	3,000		2,400			
	Paste Plant	6,300		5,000			
	Stockpile pad	4,700		3,800			
	ventilation decline	200		200			
	waste rock stockpile	4,800		3,900			
	water treatment plant and water tank	200		100			
	remaining footpaths, roads and connectors	76,000		61,000			
	TOTAL	**144,000**		**115,000**	**115,000**	**TBC**	
Vares Processing Plant	Vares Processing Plant	22,000	Assuming: all soil is stripped and disposed of due to the high contamination levels	22,000	Soil is already heavily contaminated and will be treated as hazardous. 0	22,000	Calculated from the proposed project footprint shapefiles and soil depths likely to be removed for construction and reused for remediation.
	Tailings Storage Facility (all phases)	110,000	Assuming: Topsoil (approx 15 cm deep) is stripped. Subsoil is used for foundations and ground levelling.* Separation of topsoil and subsoil may be difficult where stumps have	34,000	Some signs of contamination, the design of the tailings storage includes drainage channels, soil under the stockpiles are at high risk of contamination. Stripped topsoil has been	0	

Table 5.3.5: Project Footprint and Estimated Soil Volumes Affected							
Location	**Infrastructure or area**	**Approximate total soil volume to depth of soil profile (m3)**	**Notes**	**Estimated maximum volume to be removed during construction (m3)**	**Estimated volume to be re-used (m3)**	**Surplus soil volume (m3)**	**Source (if applicable)**
			been removed and the profiles disturbed.		identified as a covering material in the Project Description (Chapter 3), additional subsoil may be required. 34,000		
	TOTAL	**132,000**		**42,000**	**34,000**	**22,000**	
TOTAL		**368,000**		**435,000**	**270,000**	**179,000**	
Excess subsoil can be used for the rehabilitation of the tailings storage facility at Vares. Values over 10,000 m^3 have been rounded to the nearest 1,000 m^3, values under 10,000 m^3 have been rounded to the nearest 100 m^3. *Does not take into account the volume of tree stumps and roots in the soil, and is based on the depth sampled during the soil survey. This is likely to be an overestimate.							

5.3.8 Area required to store soil

In the current project design, there is a large volume of soil intended for reuse during the ongoing coverage of the TSF and during closure and remediation. To store this soil areas of land will be identified that will be suitable for soil storage, helping to maintain the quality of soil resources during storage. Areas intended for soil storage will be, where possible, on:

- Open areas with good accessibility for the creation, maintenance and removal of the soil storage stockpile;
- Areas of dry ground, away from streams, ditches, and away from areas which may disrupt overland water flow; and
- Areas where the ground is not too steep as to encourage excessive loss through erosion, however stockpiles can be created on sloping ground into the hillside with appropriate management.

5.3.9 Monitoring and auditing

The baseline data provided a means of quantifying the quality and level of contamination of the soils on site. To confirm the quality of soil resources that have been stored, the soils will require testing analysis for their suitability for the intended purpose. An outline of the monitoring and auditing for the project is outlined in Table 5.3.6.

Table 5.3.6: Soil and Contaminated Land Quality Monitoring and Audit	
Baseline Assessment	A programme of soil sampling of natural and potentially contaminated soil was undertaken in 2020 and 2021 in order to establish baseline conditions at key locations within the Project area (see Chapter 4.4).
Management Plans	The management plans based on this impact assessment, particularly the Soils, Contaminated Land and Erosion Control Management Plan, outlines: • All soil handling and storage requirements for the project; and • An accurate soil volume balance based on the finalised design criteria of the project, specifically to include all ground works and storage locations.
Standard Operating Procedures	Standard operating procedures outline the requirements for: • Reporting instances of spillages or potential sources of contamination that may arise due to the project works; and • Regular checks of stored soils to check they are intact and not succumbing to erosion or degradation and methods for ongoing maintenance.
Auditing	Further sampling at regular intervals to assess changes to soil conditions. This includes: • 5 yearly assessments of soils in key locations and those that are at increased risk of contamination (including VPP and downhill of the Tailings Storage Facility); and • Guidelines for actions where there may have been a significant change to the baseline conditions.
Closure	Prior to closure sampling will be done to assess the change in the baseline conditions so that appropriate implementation of remediation measures can be implemented during the closure of the mine. Particular importance will be placed on locations which are particularly susceptible to human health or environmental pollution.

5.3.10 Conclusions

The soils within the project area are similar in terms of sensitivity given the similar properties and texture within the region. As such the predicted magnitude of change was the biggest driver of the overall impact on the soils. By limiting the magnitude of change through mitigation measures and managing existing elevated levels of contamination to reduce the risk to environmental health the likely impact on the soils is negligible - low. Appropriate handling and storage of soils during the construction phase of the project will ensure the quality of soil resources for the remediation of the project area after mine closure.

The sensitivity of receptors was discussed in section 5.3.4.1 and the magnitude of change predicted to occur to the receptors based on project activities in section 5.3.4.2. Both receptor sensitivity and magnitude of change have been discussed in relation to land use. Using all of this the impact to soils before mitigation, mitigation measures, and impact after mitigation have been summarised in Table 5.3.4. A soil balance based on the current project design details that were available, and some assumptions and indicative soil balance has been calculated and presented in Table 5.3.5. A programme of ongoing monitoring and auditing has been outlined in Table 5.3.6.

5.4 Biodiversity

5.4.1 Introduction

This Biodiversity Impact Assessment (BIA) chapter follows the data collection and biodiversity baseline study outlined in Chapter 4.5. Data collection to inform this BIA included desk study and field surveys, covering Ecologically Appropriate Areas of Analysis (EAAA) which varied depending on the species or habitat being studied. The aim of the baseline studies was to identify all priority biodiversity features (PBF) and areas of critical habitat (ACH) and/or the species/habitats that warrant their designation.

To comply with the requirements of the European Bank for Reconstruction and Development's Performance Requirement 6 (EBRD PR6), it is expected that there will be:

1. PBF: To ensure no net loss and preferably a net gain of priority biodiversity features over the long termfor and the habitats and ecological functions that support them.
2. ACH: For ACH, there should be no measurable adverse impacts on the biodiversity features for which the ACH was designated. There should be a net gain for ACH affected by the project and no net reduction in the populations of any EN or CR species over a reasonable time period. A critical habitat conservation viability can't be jeopardised within the ecologically appropriate area of analysis, and its national or global population cannot be reduced.
3. Compliance with EBRD's PR6 further requires the Project to follow the intent of EU law with respect to conservation of habitats and species, notably according to the requirements of the EU Habitats Directive.

Section 5.4.2 provides an overview of the approach taken to assessment of impacts on biodiversity and ecosystems as a result of the Project. Section 5.4.3 identifies the "priority" biodiversity components that have been selected for detailed consideration, although impacts on biodiversity in general have also been considered. Section 5.4.4 identifies the main Project activities or components expected to give rise to ecological impacts and the biodiversity receptors likely to be exposed to them. In Section 5.4.5, the likely significance of impacts is considered, based on the sensitivity and vulnerability of affected biodiversity. This provides the basis for development of an effective mitigation strategy for biodiversity and ecosystems as discussed in Section 5.4.6.

Table 5.4.10 presents a final summary of the conclusions of this Chapter, showing the predicted significance of impacts on biodiversity pre- and post-mitigation. Proposed offsets are identified, as well as any further work needed (through the implementation of a Biodiversity Action Plan (BAP)) either to confirm that further offsets are necessary or to provide the evidence needed to ensure that they will be appropriate and effective.

5.4.2 Overview of Approach, Assessment Criteria and Overall Mitigation Strategy

Biodiversity data was collected in 2019, 2020 and 2021 through desk study and field surveys undertaken by Enova Environmental Consultants and the University of Zenica, Institute 'Kemal

Kapetanovic' of Zenica (Zenica Institute). The baseline report and this BIA chapter were also informed by a site visit undertaken by WAI in April 2021.

Since the ESIA process commenced formally in 2019, results of ecological surveys have been used systematically to inform Project design. Regular dialogue has taken place between the feasibility study, engineering and biodiversity teams and others involved in environmental and social studies for the ESIA.

Information regarding particularly sensitive ecological receptors or constraints has been provided to the Project design team throughout the data collection process. This has permitted modifications to the design where required to avoid or minimise significant impacts in line with the mitigation hierarchy. The current Project design therefore benefits considerably from "in-built" avoidance and mitigation measures to safeguard biodiversity and ecosystems before any impacts could occur as a result of the Project.

Chapter 6, Alternatives Assessment, describes instances of Project design elements being adjusted to address biodiversity concerns (amongst others). These include the following where impacts were anticipated and avoided:

- Areas of Critical Habitat *Nardus stricta* species rich grassland within the Rupice concession boundary were identified at an early stage, which enabled the route of the proposed haul road to be modified to completely avoid this (precautionarily designated) Annex I priority habitat[1].
- The re-routing of the haul road also enabled the ACH caves Sajnovicki Kamen and Grcki Kamen to be avoided at a much greater distance (over 2km), as well as areas of likely PBF silicate rocky slopes and the PBF Borovički stream. The caves are known ACH due to their habitat for protected or PBF species.
- Stone crayfish *Austropotamobius torrentium* was found in the Borovički stream on the border of the Rupice concession. As the stone crayfish is IUCN DD, but FBiH VU and likely to be decreasing, a precautionary approach has been taken with regards the importance of this species and it is considered treated as a PBF.

This BIA therefore applies to the current Project design as described in Chapter 3 with "in-built mitigation" incorporated.

The overall aim of this BIA is to determine whether points 1 to 3 above could be achieved for the various biodiversity receptors in the residual situation, taking account of efforts to avoid or mitigate impacts during Project design and implementation, and to offset any significant residual impacts according to the mitigation hierarchy.

Impact sources

- Impact sources were identified based on Project infrastructure and activities.

[1] EU Habitats Directive

Receptors

- Receptors are ecosystems or any biodiversity component identified during baseline surveys and assessments for which specific consideration of impacts was considered necessary. These generally fall under the categories of PBF and ACH, which are defined in detail in the Baseline Report under section 4.5.2 'Definition of Terms'. Where species are not considered PBF or ACH they are generally widespread, of low conservation concern and are not addressed specifically within this BIA.

How receptors might respond to Project activities and impact sources depends on the following key considerations:

1. Whether or not the receptor will be exposed to a Project activity or its effects.
2. The sensitivity of the receptor to the activity or its effects (will it respond?).
3. The vulnerability of the receptor to impacts (will it decline or be damaged?).
4. The ability of the receptor to recover independently, without intervention in the form of mitigation.
5. The effectiveness of mitigation in reducing impacts to a point that is acceptable with regards impacts on PBF and ACH or their qualifying features (as defined in 5.4.1).
6. If significant effects remain after mitigation, the ability to compensate or offset so that the criteria in 5.4.1 are adhered to.

These have been defined or interpreted as summarised in the following subsections:

Receptor Exposure

Whether or not a receptor is likely to be exposed to an impact source 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 desk study or survey suggests it could be present at the time or location concerned. Without exposure, there is no impact, and these cases were 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 significant 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 impact.

Receptor Vulnerability

As used in this approach, receptor "vulnerability" refers to the consequences of a change caused by a Project activity for a receptor that is both exposed and sensitive to an impact. WAI, Zenica Institute and their specialist consultees have considered the extent to which the impacts 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 therefore been considered where appropriate, as well as the extent to which habitats or populations of species are stable, increasing or declining.

Receptor Resilience and the Need for Mitigation

In order to achieve NNL, and where appropriate, a net gain for biodiversity in line with PR6, any receptor exposed to a measurable adverse effect must either recover spontaneously without the need for any intervention, or must be restored to or greater than pre-impact levels or condition, through mitigation. The resilience of a receptor and its ability to recover determines the need for mitigation to achieve NNL or net gain and depends on the impact source being considered (its type, magnitude, frequency and duration).

For example, species that are mobile, adaptable and breed readily are likely to be more resilient than species with slow population growth that are highly specific in their habitat requirements and relatively immobile. It is also generally easier for populations to recover if a relatively small proportion of the original population is lost as a result of an impact. In this BIA, a "resilient population" has been defined as one able to recover within a reasonable timescale and to a level within the bounds of normal variation without mitigation. Similarly, resilient habitats can re-establish through natural regeneration, without restoration or translocation. If receptors are not judged to be resilient in this way, mitigation is needed and if there is any uncertainty, further assessment may be needed in the pre-construction phase of the Project to confirm the need for mitigation.

The above criteria inform the sensitivity scale referred in Table 5.4.1:

Table 5.4.1: Receptor Sensitivity Scale

Sensitivity of receptor	**Description of receptor**
Negligible	No or negligible exposure; Negligible or not sensitive to activity; Abundant; Local importance or scale; Negligible vulnerability; Highly resilient. Able to recover without mitigation within a short timescale.
Low	Low levels of exposure to activity; Low to medium sensitivity; Relatively abundant; Regional important or scale; Reasonably resilient to change; Potential for recovery within a reasonable timescale without mitigation.
Medium	Frequent exposure to activity; Medium to high sensitivity; Relatively rare; National importance or scale; Vulnerable, low resilience and susceptible to change; Unlikely to recover without mitigation, over a longer time period.
High	Constant exposure; Very high sensitivity; Extremely rare; International importance or scale; Very fragile; Highly vulnerable, extremely low resilience and highly susceptible to change; Very limited potential for successful mitigation.
Note: the scale combines the description of the receptor together with its geographic extent. The general descriptions used in **Error! Reference source not found.** have been developed for each environmental aspect, taking into account the relevant performance standards that are applicable.	

The magnitude of change scale is outlined in **Error! Reference source not found.**.

Table 5.4.2: Magnitude of Change Scale	
Magnitude of change	**Description of change**
Negligible	Minimal detectable changes in baseline habitat or species/population. Changes are either of short duration or infrequent periodicity, such that direct control is not required to manage potential impact.
Low	Detectable change to the baseline habitat or species/population. During construction and operations there would be ongoing change in the underlying characteristics or quality of the baseline conditions.
Medium	Degree of change is such that loss of, or adverse alteration to, the baseline conditions of the habitat or species/population would occur. Post development characteristics or quality would be partially changed during construction and operational phases.
High	Degree of change is such that total loss of, or adverse alteration to, the baseline conditions of a habitat or species/population would occur. Post-development characteristics or quality would be fundamentally and irreversibly changed.

The type of impact relates to the positive or negative character of the effect and this can be perceived as below:

- Beneficial Impact – An impact that is considered to provide a net benefit to the receptor; and
- Adverse Impact – An impact that is considered to negatively affect the receptor and may require management activities to mitigate the effects.

The duration of the potential impacts associated with the Project are defined as either short, medium, long or very long-term. In regard to the environmental aspects, short-term has been defined as the construction and/or operational life of the Project and long-term as those which remain and continue post operation and after the post-closure stage of the Project. Very-long term refers to permanent changes.

Mitigation Measures

Mitigation is needed if the impact will result in a measurable change to the receptor that is outside the bounds of normal variation. In such cases, it will not be possible to achieve NNL or net gain unless mitigation is implemented.

Offsets

If NNL cannot be achieved even when mitigation is considered, a significant residual impact will occur. In cases where residual impacts have been identified for "priority biodiversity", the need for offsets has been considered. Note that the option to offset is only considered as a last resort if significant residual impacts on natural or critical habitat were predicted despite mitigation.

The overall significance of impacts is defined via the combination of the magnitude of change and the qualitative descriptions from receptor sensitivity, to create the Impact Significance Matrix as per Table 5.4.3.

Negligible and low significance will be considered as 'insignificant' impacts and will not require additional mitigation measures. Moderate and major significance will be considered 'significant' impacts and will be subjected to specific mitigation measures to reduce them to acceptable levels or as a last resort, offset. Significant impacts will have a post-mitigation evaluation, based on the same methodology and Impact Significance Matrix to determine the residual effects of the Project activities.

Table 5.4.3: Impact Significance Matrix

Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

Examples of the significance of ecological impacts of the Project may be:

- Negligible: no detectable change occurs, or the affected biodiversity/ ecosystems are of such low sensitivity that they are able to accommodate the change without any long-term consequences. The changes are within bounds of normal variation, or spontaneous recovery is likely. No specific mitigation measures are necessary beyond general good practice measures that form part of Project design.
- Minor: the Project causes detectable changes relative to baseline conditions and these changes are outside the bounds of normal variation (if known). No specific mitigation measures are necessary beyond general good practice measures that form part of Project design but will be applied where possible, and receptors will recover to a viable residual state or condition.
- Moderate/ offsetable: significant impacts occur if the Project will cause important habitats or populations of species and their supporting habitats to decline below baseline trends in the longer term (with or without mitigation). If there might be residual loss of "PBF" or a long-term decline in the range, distribution or population size of any species, scope for biodiversity offsets to achieve a NNL or net gain outcome (as necessary) has been considered. Use of offsets that have sufficient assurance regarding likely success may reduce a significant residual impact to a moderate level.
- Major/ not offsetable: there may be significant adverse impacts that cannot be offset because the impact is High to an area of ACH and an effective outcome cannot be assured, given available conservation or restoration techniques, or because suitable offset locations cannot be identified or secured or because it is not possible to restore habitats or species populations in reasonable timeframes. It is important to note that EBRD cannot finance schemes with non offsettable impacts.

In some cases, uncertainty will remain over impacts because certain information to predict impacts is not yet available and this is highlighted where this is the case.

The geographic scale used to assess impacts influences its significance. For example, the EAAA for a large carnivore is likely to be much larger than the EAAA for an endemic plant species of a specific localised habitat. As such the localised habitat for the endemic plant species might be highly significant for the endemic plant but of negligible significance for the large carnivore. A suitable geographic unit to consider impacts on biodiversity components is identified and varies between receptors and is explained within the proceeding BIA.

5.4.3 Important Receptors, Other Biodiversity and Protected Areas Potentially Affected

Based on the results of baseline surveys and assessments (Chapter 4.5), Table 5.4.4 identifies PBF or ACH features for which NNL or net gain needs to be achieved at Rupice. These features relate to habitats and species that may be affected by the project in the 'area of impact' (AOI).

Other biodiversity features that are not specifically protected at an international or national level, are sufficiently resilient, widespread and of low conservation concern are mentioned in baseline report only and specific impacts to those species/habitats are not addressed in this BIA.

Table 5.4.4: PBF and ACH qualifying species and habitats identified at Rupice AOI

Habitat or Species	**Rationale for importance**
Acidophilic spruce forests of hilly to mountainous belt (*Vaccinio-Piceetea*)	This habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF despite generally poor management due to forestry practices throughout the EAAA. This is the dominant habitat at the Rupice AOI.
Alpine rivers and their ligneous vegetation with *Salix elaeagnos*	Habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF – lower reaches of the watercourse flowing from/past the Rupice concession area.
The FBiH CR species marsh marigold *Caltha palustris*	This habitat also supports the FBiH CR species marsh marigold and further qualifies as PBF, although marsh marigold is common and widespread at a global scale. Also potential for downstream effects to other PBF/ACH.
Water courses from plateaus to the mountainous belt with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	This habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF. Found along the Vruči and Borovički watercourses. Also potential for downstream effects to other PBF/ACH.

Table 5.4.4: PBF and ACH qualifying species and habitats identified at Rupice AOI	
Habitat or Species	**Rationale for importance**
Agile frog *Rana dalmatina* Greek frog *Rana graeca* Green toad *Bufo viridis* Yellow-bellied toad *Bombina variegata*	Although these IUCN LC species are widespread and relatively common in the region they are listed under Annex IV of the Habitats Directive and are therefore qualifying species for ACH where they are present as a breeding species – along Vruči and Borovički watercourses.
Hazel grouse *Tetrastes bonasia*	This is an Annex I Birds Directive species which breeds in mixed and coniferous forest, observed within the Rupice area during the surveys and is considered a PBF.
Stone crayfish	This species is IUCN-DD but is FBiH-VU and relatively restricted in its habitats (clean, fast flowing water). As such it is treated as IUCN VU and therefore as a PBF as a precaution. It was found in the Borovički stream.

Other PBF or ACH that was identified during the desk study or field surveys is far enough away from any AOI that it is screened out from further discussion. At Rupice this includes:

- Acidophilic beech forests (*Luzulo-Fagetum*) – PBF within the concession boundary but well away from any impact zone.
  - The bark beetle *Osmoderma eremita* that was located in this habitat – PBF.
- Silicate rocky slopes with hazmophitic vegetation – PBF within the concession boundary but well away from any impact zone.
  - The range restricted and FBiH VU plant species Bosnian sandwort *Minuartia bosniaca* located in this habitat – PBF.
- Mat grass grassland (*Nardus stricta*) abundant with species – likely PBF as not considered species rich by Zenica Institute, but a precautionary approach treats it as ACH within the concession boundary but far enough away from any impact zone.

Table 5.4.5: PBF & ACH qualifying species & habitats identified at the Vares Processing Plant AOI	
Habitat or Species	**Rationale for importance**
Acidophilic spruce forests of hilly to mountainous belt (*Vaccinio-Piceetea*)	This habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF despite generally poor management due to forestry practices throughout the EAAA. This is the dominant habitat at the Vares Processing Plant AOI. Smaller enclaves of this habitat outside of the AOI along the Mala River were of

Table 5.4.5: PBF & ACH qualifying species & habitats identified at the Vares Processing Plant AOI	
Habitat or Species	**Rationale for importance**
	higher quality due to lack of forestry management.
Water courses from plateaus to the mountainous belt with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	This habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF. Found along the Mala River and its eastern tributary. Potential for downstream effects to other PBF/ACH.
Agile frog *Rana dalmatina* Greek frog *Rana graeca* Green toad *Bufo viridis* Yellow-bellied toad *Bombina variegata*	Although these IUCN LC species are widespread and relatively common in the region they are listed under Annex IV of the Habitats Directive and are therefore qualifying species for ACH where they are present as a breeding species – along the Mala River and the existing tailings dam.
White-clawed crayfish *Austropotamobius pallipes*	Two specimens of this Annex II, IUCN EN and FBiH EN species were found during the surveys and therefore this species qualifies as a PBF, along with its habitat – the Mala River downstream of the proposed TSF.

Other PBF or ACH that was identified during the desk study or field surveys is far enough away from any AOI that it is screened out from further discussion. At the Vares Processing Plant this includes:

- Semi-natural dry grasslands and scrubland on calcareous substrates (*Festuco-Brometalia*) – not rich with orchids so considered PBF rather than ACH. Within the concession boundary but well away from any impact zone.
- A former pump house building near the existing tailings dam which formed a day roost for lesser horseshoe bat *Rhinolophus hipposideros* – PBF. Within the concession boundary but well away from any impact zone.
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) Habitats Directive Annex I Priority habitat type and therefore qualifies as ACH. This habitat is located between the old tailings dam and the Veovaca open pit and is outside of any AOI.

In addition, one invasive species – Japanese knotweed *Reynoutria japonica* was found at a few locations near to the existing access road to Vares Processing Plant. PR6 requires the consideration of invasive species.

Although no roosting habitat will be affected by the Project, all bats are protected under the Habitats Directive and should be taken into consideration with regards lighting impacts over foraging areas (retained habitats).

Table 5.4.6: PBF & ACH qualifying species & habitats identified along the Haul Road AOI

Habitat or Species	Rationale for importance
Acidophilic spruce forests of hilly to mountainous belt (*Vaccinio-Piceetea*)	This habitat type is listed in Annex 1 of the Habitats Directive and is therefore considered a PBF despite generally poor management due to forestry practices throughout the EAAA. This is the dominant habitat along the existing and proposed haul road.
Mountain hay meadows	Located along the haul route at Položac to Semizova Ponikva. Habitat is listed in Annex I of the Habitats Directive and is therefore PBF.
Dinaric widowflower *Knautia dinarica* *Crepis conyzifolia*	Two Balkan endemic plant species were found in this habitat, which are considered to be PBF (although they are relatively common in their endemic region)
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Located on the proposed haul road section between Položac - Semizova Ponikva that passes north of the village of Položac for approximately 1.4 km. Habitat is listed in Annex I of the Habitats Directive and is therefore PBF.
The FBiH CR species marsh marigold.	This habitat also supports the FBiH CR species marsh marigold and further qualifies as PBF, although marsh marigold is common and widespread at a global scale.
Water courses from plateaus to the mountainous belt with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	This habitat is included in Annex I of the Habitats Directive (PBF) and is found along the Zagarski Stream for about 1km. The lower section of the stream (0.7km in length) has been culverted and therefore does not meet the Annex 1 criteria. The Bukovica river is also likely to meet this criteria which will be confirmed by ongoing survey work.
Haul road – spruce forest habitat Pančić blue sow thistle *Cicerbita pancicii* Heart-leaved ox-eye daisy *Telekia speciosa* Red helleborine *Cephalanthera rubra*	
Haul road – Zagarski Stream Liverwort *Hepatica nobilis*	In a Europe-wide context these are widespread but their VU status within Bosnia and likely

Table 5.4.6: PBF & ACH qualifying species & habitats identified along the Haul Road AOI	
Habitat or Species	**Rationale for importance**
Ox-eye daisy *Leucanthemum praecox* Forked spleenwort *Asplenium septentrionale*	decreasing populations in the Balkans means they have been considered an important biodiversity feature within this BIA.
Haul road – mountain meadow Angelica *Angelica sylvestris* Stemless gentian *Gentiana acaulis*	
Agile frog *Rana dalmatina* Green toad *Bufo viridis* Yellow-bellied toad *Bombina variegata*	Although these IUCN LC species are widespread and relatively common in the region, they are listed under Annex IV of the Habitats Directive and are therefore qualifying species for ACH where they are present as a breeding species – along the Zagarski stream.
Brown bear *Ursus arctos* Bosnian grey wolf *Canis lupus kurjak* Eurasian lynx *Lynx lynx balkanicus* Wildcat *Felis sylvestris*	The main habitats for these species are in the wider landscape to the north and east of the Project areas associated with Konjuh and Zvijezda mountains. Although the project areas do not form regular foraging, denning or breeding habitat for grey wolf, Eurasian lynx, brown bear or wildcat and therefore can't be considered critical habitat for these species, these wide-ranging and often elusive mammals are considered PBF and addressed in the impact assessment with regards the haul road as a precautionary measure.

Other PBF or ACH that was identified during the desk study or field surveys is far enough away from any AOI that it is screened out from further discussion. At the route of the haul road this includes:

- Clustered coral mushroom *Ramaria botrytis* - FBiH CR and therefore a PBF – within the survey area but located outside of any AOI.
- Eagle owl *Bubo bubo*. Annex I Birds Directive – this PBF species was recorded foraging near to the proposed haul road. The re-routing of the haul road avoids the rocky slopes and caves that this species uses as its main habitat and it is not expected to be regular within the AOI.

Reptiles

Rocky and open habitats such as *Nardus* grassland and hazmophytic rocky slopes that are highly suitable for reptiles have been avoided in favour mostly of dense forest and existing roads/infrastructure. Nonetheless several Annex IV reptiles have been found during the surveys, are likely to be widespread and fairly common throughout the EAAA and may be present in low numbers within the Project AOI at Rupice, along the haul road and at the VPP/TSF. Species include nose-horned viper *Vipera ammodytes,* wall lizard *Podarcis muralis,* smooth snake *Coronella austriaca,* sheltopusik *Ophisaurus apodus,* sand lizard *Lacerta agilis* and green lizard *L. viridis.*

5.4.4 Project Activities and Sources of Impact on Biodiversity and Ecosystems

Potential impacts to species and habitats (without mitigation) have been identified following examination of the Project's proposed activities as described in Chapter 3, Project Description. These potential impacts to different receptors during construction and operation are listed in Table 5.4.7.

The conceptual Mine Closure plan developed for the FS includes initial arrangements for decommissioning and the ecological implications of this are reviewed to the extent possible, given the level of detail available in the Plan. The table includes a brief description of the potential ecological implications of these activities. These potential implications are considered in the absence of the application of any biodiversity-specific mitigation measures.

At Rupice, the planned closure will be a full closure of the operation and all its associated infrastructure including the filling and sealing of access drifts and ventilation raises, removal of plant and equipment and remediation of the site but leaving the main access road and electricity supply in place. At the VPP, the site will be remediated to a status suitable for other light manufacturing or fabrication uses but closure will include removal of the processing plant and equipment.

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
Construction Phase		
Earthworks, site clearance and construction	**<u>Rupice:</u>** Land clearance, removal of vegetation for construction of underground workings, including ventilation drives and declines, backfill and shotcrete plant, waste rock and ore stockpiles, three stage crushing plant, three run-of-mine (ROM) stock piles of varying grade, haul truck maintenance workshop, refuelling station, water storage reservoir and water treatment plant for acidified runoff from the stockpiles. **Haul Road:** 24.5km long haul road, 15.5km of which will require upgrading from existing forestry tracks. **Vares Processing Plant (VPP):** Crushed ore handling, grinding facility, flotation circuits (silver-lead and zinc), concentrate thickeners and filters, tailings thickener and filter; concentrate loading, reagents handling and storage areas; tailings storage facility (TSF), Located in the valley directly south of the Vares Processing Plant.	There will be permanent ecosystem change with the works necessitating the loss of 28.5ha of degraded, but PBF acidophilic spruce forest at Rupice, 33ha lost along the haul road and 16.8ha lost at the VPP/TSF. Construction of the haul road over the Borovicki stream and the Vruci stream has the potential to cause localised damage through direct damage or pollution to the PBF 'Water courses from plateaus to the mountainous belt' and associated PBF marginal vegetation, including PBF marsh marigold and PBF stone crayfish. Construction of the haul road along the Zagarski stream will necessitate the loss of a section of PBF water course habitat approximately 1km in length. Construction of the haul road near aquatic habitats (Borovicki Stream, Bukovicki, Zagarski Stream) has the potential to kill individuals and remove breeding habitat for Annex IV amphibians yellow bellied toad, agile frog, Greek frog and green toad. Vegetation clearance and earthworks in general could kill Annex IV reptiles where they are present in the AOI. Any pollution causing reduced water quality to the Mala river has the potential to reduce available habitat for PBF white clawed crayfish. Construction of the haul road will necessitate the direct loss of 2.6ha of PBF mountain hay meadows and may result in indirect damage to PBF

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
		hydrophilous tall herb vegetation, as well as two PBF Balkan endemic plants; Dinaric widowflower and *Crepis conyzifolia* found in the hay meadow habitat as well as FBiH VU species of plants. Vegetation clearance and earthmoving has the potential to spread invasive Japanese knotweed already present in the area of the VPP. Loss of spruce forest at Rupice may remove breeding habitat of PBF hazel grouse. Construction of the haul road may cause a barrier effect or increase collision risk to larger mammals/keystone predators (brown bear, grey wolf, Eurasian lynx and wildcat).
	Rupice, Haul Road and VPP: Dust generated by truck movements and earth moving.	Dust deposition onto terrestrial and aquatic vegetation, reduced plant productivity within the deposition zone. Suitability of habitat for amphibians will also be reduced within the deposition zone. Dust deposition on PBF habitats outside cleared areas.
	Rupice, Haul Road and VPP: Vehicle exhaust emissions including NO_x, SO_x, CO, CO_2 and diesel particulates and dust from roads. Significant deposition and associated changes in natural vegetation predicted to occur within a 50 m buffer along roads.	Nutrient enrichment and changes in soil chemistry cause permanent changes in plant species composition. Transformation of relatively nutrient poor natural vegetation (e.g. mountain hay meadows) to more modified plant communities may occur.
	Rupice, Haul Road and VPP: Soil exposure.	Erosion and scour from rain or melting snow could have localised impacts on PBF habitats.
	Rupice, Haul Road and VPP: Changes in surface and groundwater hydrology.	Loss of aquatic habitat, disruption of flow, reduced recharge of wetlands, could reduce biomass of amphibians and availability of habitat for wetland birds.
	Haul Road	Altered soil chemistry and structure due to deposition of introduced

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
	Introduction of imported materials.	aggregate and graded material along boundaries of roads and tracks. Salt spreading in winter may alter the chemistry of soils locally, where there is surface run-off from roads and therefore alter vegetation composition. Plant community composition may be altered locally, with a transition from natural to more modified types, including by the spread of invasive weeds.
Import of materials and machinery	Traffic on access roads and public highways.	Disturbance to animal populations and barrier effects.
	Emissions of dust, exhaust, etc.	Dust covering of vegetation adjacent to transport routes, contamination by pollutants, reduced productivity.
	Introduction of invasive species.	Spread of Japanese knotweed from existing stands via vehicle or earth movement, and resultant ecological deterioration of habitats.
Operation Phase		
Mining		
Excavation, drilling and blasting at Rupice	Dust from excavation and blasting.	Reduced productivity of surrounding vegetation namely the PBF acidophilic spruce forest.
	Noise and disturbance.	If present, hazel grouse will cease to feed or breed at the AOI or potentially be displaced from nearby habitat outside the direct impact zone due to noise and general disturbance.
	Altered topography and substrate	Potential for runoff from waste rock dumps, tracks and storage areas to affect nearby watercourses (Vruci/Borovicki streams) and the PBF species they support.
Loading and hauling	Dust emissions.	Smothering of vegetation, contamination by pollutants, reduced productivity.
	Vehicle exhaust emissions.	Deposition of NO_x, SO_x, CO, CO_2 and particulates may cause localised changes in soils and plant communities (eutrophication), modifying forest habitat.
	Noise, light and disturbance.	Hazel grouse and large mammals may be displaced as noise and disturbance is 24-hour. Brown bear, lynx, grey wolf and wildcat likely to completely avoid the area, if passing through area.

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
Waste Rock Stockpile and Ore stockpiles and associated water treatment facilities	Dust emissions.	Dust deposited on surrounding retained vegetation PBF spruce forest) can alter its productivity and may cause long term changes in plant species composition due to changes in soil chemistry.
	Physical footprint (footprint of Waste Rock stockpile and ore stockpiles estimated at 3.5ha).	Loss of PBF spruce forest. Possible Acid Rock Drainage and metals leaching causing future changes in vegetation and aquatic habitat. Loss of biomass/breeding habitat and food supply for other species (e.g. amphibians)
	Downstream pollution from drainage and leachate.	Pollution of aquatic habitat with implications for invertebrates, amphibians, fish, plants. Risk of long term acid drainage and heavy metal contamination.
Crushing		
Crushing	Crusher, storage and transfer points.	Dust escaping at crusher, storage and transfer points has the potential to alter plant communities and possibly cause long-term soil quality changes.
	Noise during crushing.	Displacement of animals and birds potentially including hazel grouse and large mammals.
Haul Road		
Transport of materials	Permanent haul road between Rupice and the VPP of C10m width for 24.5km. Total footprint is 28ha with four haul trucks passing a given point within 1 hour.	Permanent footprint and change in substrate along areas of the route that are currently forestry track. New barrier for large mammals dispersing through the spruce forest potentially using the caves at Sajnovicki Kamen and Grcki Kamen. Cumulative noise, disturbance, salt run-off and dust impacts, including to the Zagarski stream where the road will be constructed for approximately 1km.
Processing		
Process plant and supporting infrastructure	Dust. Vehicle exhaust fumes.	Dust generated from transport and crushing activities, earthworks, reshaping heap and dump sides, and setting up safety berm around pit perimeter could affect small remnants of Juniper scrub vegetation and reduce its viability.
Concentrate and	Reagents: Sodium metabisulphite – SMBS, Zinc	Although reagents will be stored and handled only under contained,

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
chemical treatment/storage	Sulphate (Heptahydrate) - ZnSO4, Copper Sulphate (Pentahydrate) - CuSO4, Aerophine 3418A Methyl Isobutyl Carbinol – MIBC, Sodium Isopropyl Xanthate – SIPX, Magnafloc 10 (flocculant)	controlled conditions, the risk of leaks and spills which could have effects on biodiversity receptors must be considered.
Water runoff	Water runoff	Sedimentation, damage to aquatic habitats and supporting species. Pollution of aquatic habitat with implications for invertebrates, amphibians and PBF habitat. Water from Rupice will leave the site through an engineered channel and settlement pond system to the Vrući Potok
Tailings Storage Facility (TSF)	Water pollution as a result of TSF seepage or drainage.	Any contact and seepage water will be captured in drainage ditches and an underdrainage system to be pumped back to the process plant or used for dust suppression and moisture control of the tailings. The lining system has been designed to collect any surface seepages and channel them through the drainage blanket to the bottom of the valley and out through the base of the embankment via a drainage pipe. There is no guarantee this will be 100% effective and as such there is a risk of pollution of the Mala River downstream and the white clawed crayfish PBF it supports.
Backfill		
Backfill plant constructed at Rupice	Cemented Aggregate Fill (CAF) and Paste Aggregate Fill (PAF) to be created and pumped underground.	Dust from transport of raw materials from VPP. Storage and spillage of materials could damage retained habitats including adjacent PBF habitat.
Supporting infrastructure		
Domestic wastewater treatment and non-hazardous waste	Physical footprint of works, possible enriched wastewater released into watercourses. Litter and other waste leaching into the environment.	Sanitary effluent from VPP will be discharged into the existing sewerage infrastructure operated by JKP. Sanitary effluent from Rupice will require treatment using a package wastewater plant with associated sludge and odour management. Wastewater sludges will be collected and disposed by an authorized company (namely JKP doo Vareš) under contract with the project owner. Any leakage or inappropriate treatment may cause the loss

Table 5.4.7: Potential Sources of Ecological Impact (Pre-Mitigation) Associated with the Project		
Project component	**Main source or driver of biophysical change**	**Potential ecological implications**
		of biotope/ habitat and possible eutrophication of watercourses, damage to retained habitats.
Refuelling Station at Rupice	Fuel storage and refuelling.	Damage to retained habitats and water pollution as a result of fuel spillage, fire risk. A fire water tank is included at Rupice.
Employment	Presence of people and associated traffic.	Increased number of bus journeys associated with park and ride/transport around the project areas. Disturbance of mammals and birds at Rupice.
Ancillary Buildings	Ancillary facilities at Rupice includes the administrative, lamproom and change house building, workshop, warehouse, fuel and lube storage building, mine storage building and compressor building.	Included in project footprint AOI. Buildings include material and fuels storage and therefore have the potential for fuel or pollutant leakage.
	Ancillary facilities at the Vares Processing Plant include laboratory, reagents storage, tailings storage, administration building, concentrate storage areas, security, workshop/warehouse and laydown areas.	
Security measures	Lighting including from vehicles.	Disturbs nocturnal species including bats and night-flying moths. Could also disrupt animals dispersing past Rupice or haul road at night such as wolf, bear or lynx.
Associated Facilities		
Rail Load Out Facility	Rail load out facility: Droskovac in Vareš, a previously operational facility that is being restored for operation, considered as an associated facility.	Abandoned buildings, two of which are confirmed or have high potential to support bat roots. Potential for disturbance of bats or loss/damage to their roosts.

The next section of the BIA assesses impacts identified in Table 5.4.7 and their significance for specific receptors. To support this assessment, the following assumptions have been made about the extent of areas occupied by mine and supporting infrastructure, the haul road and areas potentially affected by pollution.

- The direct "physical footprint" is as follows:
  - 28.5ha at the Rupice project area including all storage, waste rock, buildings and ancillary structures;
  - 28km of haul route, 15.5km of which is new road, the remainder follows existing tracks; and
  - 16.8ha in total at the Vares Processing Plant (VPP 4.5ha and TSF 12.3ha).
- There is a "buffer zone" within which deposition of dust, contaminated runoff, noise, physical disturbance and atmospheric pollutants could theoretically occur. For the purposes of this assessment, 50m has been used as a likely suitable buffer zone but this may locally be more or less depending on the source of impact and the receptor.
- Water supply to Project areas will come from the Bukovica stream via an existing but disused pumping station, along a 5km pipeline buried alongside the haul road.

5.4.5 Exposure, Sensitivity and Vulnerability of Biodiversity to Project Impacts

This section discusses impacts on the biodiversity receptors identified in Table 5.4.4, Table 5.4.5, and Table 5.4.6. Impacts are summarised in Table 5.4.8 and Table 5.4.9. Potentially significant impacts on PBF (or ACH if relevant) are discussed in more detail below. Unless stated otherwise, the potential impacts apply during the construction, operational and decommissioning phases of the Project.

Table 5.4.8: Project Physical Footprint on Habitats Designated as PBF or ACH

Habitat Type	Area/length in Project footprint (ha.) or (m)	50m Buffer around footprint (ha.) or (m)	Additional Restricted Area (ha.) or (m)	Total area/length potentially affected (ha.) or (m)
PBF Acidophilic Spruce Forest				
Rupice	28.5ha	54.7ha	N/A	83.2ha
Haul Road (10m width)	33ha	121.4ha	N/A	154.4ha
VPP (including TSF)	16.8ha	25.6ha	N/A	42.4ha
Subtotal	**78.3ha**	**201.7**	**N/A**	**280ha**
PBF Mountain Hay Meadows				
Haul Road	2.6ha	10ha	N/A	12.6ha
PBF Hydrophilous tall herb fringe communities				
Haul Road	N/A	1.3ha	N/A	1.3ha
Total Area Habitats	**80.9ha**	**213ha**	**N/A**	**293.9 ha**
PBF Water courses from plateaus to the mountainous belt				
Haul Road (Borovicki stream, 2 crossings)	20m	200m	N/A	220m

Table 5.4.8: Project Physical Footprint on Habitats Designated as PBF or ACH				
Habitat Type	**Area/length in Project footprint (ha.) or (m)**	**50m Buffer around footprint (ha.) or (m)**	**Additional Restricted Area (ha.) or (m)**	**Total area/length potentially affected (ha.) or (m)**
Haul Road (Zagarski stream)	1,000m	N/A	N/A	1,000m
Rupice (Vruci stream)	18m	100m	N/A	118m
Total Length Stream Habitats	**1,038m**	**300m**	**0**	**1,338m**

Habitats

As shown in Table 5.4.8, the dominant habitat type in the vicinity of all Project areas is acidophilous spruce forest. Although it is managed poorly and therefore in an unfavourable condition ecologically, it is classified as Annex I habitat and therefore a PBF under PR6. It also falls into the WWF Global 200 Ecoregion 'Dinaric Mountains mixed forests'[2] but no high-quality examples of this habitat are found within or near to the AOI of the Project. Higher quality forest associated with this Ecoregion are found outside of the AOI including steeper slopes either side of the Mala River and far to the north towards Konjuh. There are smaller areas of PBF habitat or ACH which are less common locally and nationally which have been deliberately avoided (e.g. *Nardus* grassland) by re-routing the haul road into the spruce forest areas along existing forestry tracks. Being the dominant habitat type, this was considered the least impactful approach. There were no options for relocating infrastructure and haul roads to completely avoid PBF spruce forest (managed as forestry) due to its dominance at a landscape scale. Application of the mitigation hierarchy allowed the ACH *Nardus stricta* grassland to be avoided completely – a habitat in decline across the region due to anthropogenic and natural factors.

Generally, the spruce forest itself is low in botanical diversity across a large area due to selective felling and restocking in high density and uniform age class. Even with potential dust deposition or road run-off within 50m into this habitat, it is unlikely to affect the species composition or conservation status of the forest over and above those impacts resulting from existing forestry practices.

Within the spruce forest are three FBiH VU species found occasionally; Pančić blue sow thistle, heart-leaved ox-eye daisy and Red helleborine. Although these species do not qualify as PBF and the Project does not likely threaten their local populations, they are VU at a national level. Management of retained and offset habitat will be sufficient to maintain or improve the conservation status of PBF plant species (Balkan endemic, FBiH VU or CR species). Howeveras an additional mitigation tool, translocation to retained and restored habitat will be included prior to vegetation clearance and construction as discussed in the Mitigation section.

PBF mountain hay meadow habitat is located along the proposed haul route between Položac and Semizova Ponikva and will be directly impacted by the construction of the haul road. This habitat is

[2] https://www.worldwildlife.org/ecoregions/pa0418

listed in Annex I of the Habitats Directive and is therefore PBF. At a European Union scale, this habitat is declining and threatened, and although no data exists for its extent and status within BiH, it appears to be relatively frequent in mountain areas as a result of hay making and light grazing. Two Balkan endemic plant species (Dinaric widowflower and *Crepis conyzifolia*) were found in this habitat, which are considered to be PBF (although they are relatively common in their endemic region). Two FBiH VU species Angelica and stemless gentian are also found in this habitat. Although not PBF, the conservation status of these species will be maintained or enhanced through habitat management, and translocation to retained and restored habitat will also be included prior to vegetation clearance and construction as an additional mitigation measure.

PBF Hydrophilous tall herb fringe communities are found along a section of the proposed haul road. Although direct impacts to this habitat are not expected, this habitat, which supports FBiH CR marsh marigold, may be affected by dust deposition, changes to hydrology and salt added during winter months which could affect the biotope and cause changes in species abundance and distribution. Marsh marigold is common, widespread and not threatened at a global level but is associated with wetlands which are vulnerable to degradation generally.

Direct impacts to most PBF watercourses have been avoided with the exception of crossing small areas of the Borovicki stream (in the vicinity of Rupice), and an area of the Zagarski stream (close to VPP). These areas will be impacted by the construction of the haul road between Rupice and VPP. Avoidance of this PBF habitat has not been possible due to concerns around human safety when other options were considered. 0.7km of the Zagarski stream has already been culverted leaving approximately 1km of PBF affected by the Project.

No critical habitats (Annex I priority *habitats*, nationally protected or significant areas of CR, EN *habitats*) will be affected either directly or indirectly by Project activities through built-in avoidance (see Drawings 4.5.10a, b and c). Although aquatic habitats themselves (Water courses from plateaus to the mountainous belt) are not critical habitat *as a habitat*, this habitat was found to support breeding populations of Annex IV amphibians including yellow-bellied toad, agile frog and Greek frog – discussed below. Although no Greek frogs were found along the Zagarski stream, their presence has been presumed as a precaution. The Zagarski stream also supports FBiH VU Liverwort, ox-eye daisy and forked spleenwort, which are not PBF. The forest, hay meadow and wetland management/creation will ensure the conservation status of these species is maintained or enhanced, but as an additional measure, translocation to retained habitat will also be included prior to vegetation clearance and construction.

Species

Annex IV species of amphibian were found breeding along watercourses within the Project areas. Generally impacts to watercourses are minimal and localised except for the Zagarski stream. Although the stream itself as a habitat is a PBF, it is also considered critical habitat due to the presence of breeding yellow bellied toad, (potentially Greek frog), agile frog and green toad. This means that the Project must ensure (i) that the ecological functionality of breeding sites and resting places for these species are not damaged or destroyed; and (ii) that the Project will not result in disturbances that affect the species' survival or breeding success or reduce its area of occupancy.

The green toad lives in a wide range of habitats and may be present in modified areas including urban centres, city parks and gardens. This species often benefits from disturbed habitats. Spawning and larval development occurs in a diverse range of temporary and permanent waterbodies including all types of running and still waterbodies[3].

The breeding habitats for yellow bellied toad are typically unshaded temporary pools within, or close to all types of woodland. The species is tolerant of slight water pollution and has been recorded at very high densities in areas of cleared woodland e.g. in the Carpathian Mountains[4].

Greek frog is a largely aquatic, montane species associated with cold, small, clear rivers, streams and springs often located in shady deciduous and mixed forest. Breeding and larval development takes place in these waterbodies and it is presumed that the species can tolerate some slight habitat modification[5].

Agile frog is generally not normally associated with running water and coniferous forest and its main habitat is likely to be downslope in deciduous and mixed woodland, meadows and shallow wetlands. All of these species may be directly affected by the construction of the haul road, lose breeding and resting habitat including terrestrial habitat disturbance up to 50m from construction areas. Greek frog is the most specialised in its habitat and therefore likely the least resilient.

Several species of Annex IV reptile are found throughout the EAAA, largely associated with open and rocky habitats or forest edge and herbaceous vegetation. Project AOI are not critical to support local populations and reptiles within working areas are likely to be transient individuals or at very low numbers of resident animals as their main habitats are outside of Project areas. Reptile species most likely to be encountered are relatively common and widespread in BiH despite being Annex IV Habitat Directive and therefore ACH qualifying species.

One PBF bird, hazel grouse, was found within or near to the spruce forest at the Rupice AOI and the haul road. This species is thought to be declining at a European level due to climate change as well as poor management of its coniferous and mixed forest habitat. Hazel grouse was not confirmed as breeding within any of the Project areas and individuals were likely feeding or during post fledge dispersal. However, the coniferous and mixed forests in the region are generally suitable for this species as nesting habitat. The Project areas are not likely to support important local populations of this species due to generally poor existing management practices but this species, if present nesting at the time of construction, could be affected by loss of habitat and disturbance, as well as potential collision risk with increased traffic along the haul road.

[3] Bufotes viridis (Green Toad) (iucnredlist.org)
[4] Bombina variegata (iucnredlist.org)
[5] Rana graeca (Greek Stream Frog) (iucnredlist.org)

White clawed crayfish was found in the Mala river downstream of the historic TSF. Stone crayfish were found in the Borovički stream. Both species require clear, clean, well oxygenated water in order to survive and breed. The habitat of these species will not be directly impacted but impacts could come from sedimentation and pollution of watercourses should this occur.

The Project AOI does not form critical habitat for any species of large mammal and no suitable denning habitat is located within the AOI or within 150m. However, records of brown bear, grey wolf, Eurasian lynx and European wildcat are known from the wider landscape, with recorded dispersal of brown bear near to the Rupice AOI and also near the general area of the VPP and TSF. The main impact to these species is likely to come from the proposed haul road which potentially creates a dispersal barrier between identified critical habitat further to the north associated with Konjuh and Zvijezda, and the potential ACH caves at Sajnovicki Kamen and Grcki Kamen. Impacts arise from physical collision with haul-road traffic, from noise and visual disturbance associated with the mining work including lighting.

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
Habitats and Plant Species				
Acidophilous Spruce forest (PBF)	All of the Rupice AOI, a large percentage of the haul road and most of the VPP/TSF footprint falls within this habitat type which will require permanent clearance. Adjacent retained areas of forest open to dust deposition, changes in humidity or windthrow.	High (vegetation removed)	Low. The condition of this habitat within the AOI is poor due to historical and ongoing forestry practices. This type of habitat is dominant at higher elevations and abundant in the region including the EAAA. Higher quality areas of this habitat are avoided.	Moderate (Significant)
	Pančić blue sow thistle heart-leaved ox-eye daisy Red helleborine	High (vegetation removed)	Low. These species are only FBiH VU and found sporadically along the haul road route.	Moderate (Significant)
Mountain Hay Meadows (PBF)	Section of haul road between Položac and Semizova Ponikva constructed in this habitat which will be cleared. Retained vegetation nearby exposed to invasive species and dust deposition.	High (vegetation removed)	Medium. Habitat is threatened by natural succession; over and under-grazing, abandonment, fertilisation and climate change.	Major (Significant)
	Balkan endemic Dinaric widowflower and *Crepis conyzifolia*	High (vegetation removed)	Low. Species are relatively common Balkan endemics, with	Moderate (Significant)

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
			likely robust local populations in the EAAA.	
	FBiH VU Angelica and stemless gentian	High (vegetation removed)	Low. Species are not threatened within the EAAA or globally but are FBiH VU. Found in nearby retained habitats.	Moderate (Significant)
PBF Hydrophilous tall herb fringe communities	Section of haul road between Položac and Semizova Ponikva. Direct impacts are not anticipated but changes to hydrology, dust deposition and invasive species could alter this habitat.	Medium (habitat retained but immediately adjacent to proposed road)	Medium. Habitat is threatened regionally due to drainage, pollution, farming changes, over and under grazing, natural succession.	Moderate (Significant)
	Dust deposition and salt run-off in construction and operation. FBiH CR marsh marigold			
Water courses from plateaus to the mountainous belt	1km of the Zagarski stream that is classified as PBF habitat will be permanently degraded by culverting the watercourse beneath or alongside the proposed access road[6]. This will permanently degrade a long section of the biotic conditions that enable the habitat to qualify as PBF; aquatic animals,	High (habitat removed) and road left in place after decommissioning.	High. A 1km section of PBF watercourse will be permanently altered through construction of a haul road.	Major (Significant)

[6] Exact design details not yet known

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
	plant life and habitat niches.			
	Destruction of plants as a result of road construction. Dust deposition and salt run-off in construction and operation. • Liverwort • Ox-eye daisy • Forked spleenwort	High (plants destroyed)	Negligible. Species are relatively frequent and populations likely to be stable within the EAAA. Found in disturbed habitats.	Minor (Not significant)
	Small areas of the Borovicki stream and Vruci stream will be crossed by the proposed haul road directly impacting 20m and 18m respectively of this habitat. An estimated 50m buffer zone either side may be affected by dust and runoff without mitigation.	High (habitat modified)	Low. Relatively small sections of these watercourses will be crossed by access roads.	Moderate (Significant)
	Abstraction from the Bukovica stream may reduce water levels especially during low flow and in combination with other extraction projects.	Medium	Medium. Potential abstraction impacts reliant on further survey, may be cumulative.	Moderate (Significant)

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
Fauna				
Annex IV amphibians (ACH qualifying species) • Yellow-bellied toad • Green toad • Agile frog	Killing of amphibians, destruction of breeding and nearby terrestrial habitat. The terrestrial and breeding habitats are in and around the watercourses. In the AOI this is along the Zagarski, Borovicki, Bukovica and Vruci streams as well as the Mala river. They also breed around standing water including the old TSF.	Medium. These species are relatively common and widespread in the EAAA as well as nationally in FBiH. They are relatively resilient to change and adaptable to breeding in different habitats.	Medium. Habitats Directive Annex IV species, declining in parts of their European range although not generally threatened in the Balkans	Moderate (Significant)
Annex IV amphibians (ACH qualifying species) • Greek frog		High. This species is more restricted in its habitat preference to clean, upland streams.		Major (Significant)
Annex IV reptiles • Nose-horned viper • Wall lizard • Sheltopusik • Green lizard • Sand lizard • Smooth snake	Killing of reptiles during vegetation clearance/ground works	Medium. These species are relatively common and widespread in the EAAA as well as nationally in FBiH. Their main habitats will be avoided by the Project and large areas of suitable habitat will remain intact.	Medium. Habitats Directive Annex IV species, declining in parts of their European range although not generally threatened in the Balkans	Moderate (Significant)
Annex I birds (PBF) • Hazel grouse	Permanent removal of potential breeding and foraging habitat, disturbance from retained habitat, disturbance of birds during breeding, collision with vehicles.	Medium. Species prefers mixed forests and therefore main habitat will not be impacted.	Low to Medium. Annex I species declining due to forestry mismanagement/ climate change across Europe.	Moderate (Significant)

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
Invertebrates • White clawed crayfish (PBF)	Deterioration of watercourse habitat through pollution runoff/sedimentation, changes in water levels.	High. Species very sensitive to changes in water quality and levels. IUCN EN, FBiH EN, Annex II. Sign of good water quality. Population downstream of proposed TSF. Presence assumed in the Bukovica until survey data returned (commissioned and being undertaken in Q3 2021)	Medium. Species vulnerable in the EAAA to water quality and levels changes resulting from the TSF construction and operation.	Major (Significant)
• Stone crayfish (precautionary PBF)		Medium. Species sensitive to changes in water quality and levels. IUCN DD, FBiH VU, Annex II. Sign of good water quality. Known population far from AOI but presence assumed in the Bukovica until survey data returned (commissioned and being undertaken in Q3 2021).	Medium. Areas of impact to stream habitat are relatively minor but species threatened by changes to water quality and levels.	Moderate (Significant)

Table 5.4.9: Summary of Potential Pre-Mitigation Ecological Impacts (for PBF, ACH and Invasive Species)				
Receptors	**Potential exposure to impacts**	**Sensitivity**	**Magnitude of Change**	**Significance**
Annex IV large mammals (ACH qualifying species) • Brown bear • Grey wolf • Eurasian lynx • European wildcat	Dispersal barrier along proposed haul road route; disturbance to transient animals, road collisions. Induced conflict with local population due to food storage at more remote site (Rupice).	Medium. ACH qualifying species not found using the Project areas during surveys. Evidence of transient animals (brown bear) only, however can be elusive and sensitive to disturbance. No suitable denning habitat in the AOI, and main habitats known are outside of the AOI to the north. Generally the poorly managed spruce forest habitat in the AOI is not likely to form more than occasional habitat for any of these species.	Medium. Critical habitat for these species is located outside the EAAA to the north, as well as potentially in two caves to the south of the proposed haul road. Hall road creates a dispersal barrier with frequent lorry traffic.	Moderate (Significant)
Invasive Species • Japanese knotweed (JK) *Reynoutria japonica*	Without mitigation JK could be spread widely by vehicles along haul roads, potentially damaging PBF habitats through competition with native species.	Medium. Effect on native species and habitats would be negative and would progressively deteriorate as the plant spreads.	Medium.	Moderate (Significant)
Associated Facility: • Bats	Lighting over existing mine tunnel and 'Building 4' (Administration building) could disturb roosting bats. No other buildings at the Droškovac transfer station are suitable for roosting bats.	Medium. Known small number of lesser horseshoe bats use the abandoned administration building as a day roost. Mine tunnel could be suitable for breeding and hibernating bats.	Medium. Could disrupt the breeding or hibernating of Annex IV and EN species.	Moderate (Significant)

5.4.6 Mitigation for Impacts on Biodiversity and Ecosystems

The previous sections considered potential impacts to PBF or ACH and other biodiversity features that might result from the Project. Significance of impacts were considered in the absence of any mitigation.

In reality, mitigation has been considered from the start of the Project in line with the requirements of PR6. These measures follow the mitigation strategy:

Avoid

- "Built-in" biodiversity-related avoidance measures identified and implemented at the start of and throughout Project design where possible. Where avoidance has not been possible;

Minimise

- General accordance with mitigation measures following good mining industry practice, which will help to minimise risks or impacts on biodiversity;
- Mitigation measures primarily aiming to reduce non-biodiversity impacts (e.g. to prevent pollution of surface water), but which also minimises potential impacts on biodiversity and ecosystems; and

Mitigate

- Specific mitigation measures designed to address impacts on biodiversity and ecosystems.

Table 5.4.10: Mitigation Measures for Impacts on PBF/ACH Habitats or Qualifying Species	
Project Approach	**General Mitigation Measures**
General Biodiversity Mitigation	
Avoid	• Built-in avoidance as described previously for ACH habitats and species. • Pre-construction surveys will be carried out immediately prior to vegetation clearance or ground disturbance to confirm that the biodiversity baseline as reported in this ESIA has not changed significantly and that additional avoidance is not required. • A pre-clearance check of potential refugia will be undertaken and any small mammals, reptiles or amphibians encountered will be moved to retained habitat. Any individuals that become trapped in working areas will be removed by a suitably qualified ecologist. • In open habitats e.g. grassland, vegetation will be strimmed following a hand search, to around 150mm in height. This will encourage any reptiles to disperse to surrounding habitat. Strimmed areas to be left for at least 3 days prior to ground works to give time for reptiles to vacate the working area to adjacent retained habitat.
Minimise	***Footprint*** • The footprint of Project infrastructure and the areas of land to be cleared will be minimised as a fundamental design principle. • When feasible, any required power lines will be installed below ground or adjacent to existing cables to minimise risk of collisions with birds, particularly at higher elevations. • Vehicular access to the Project-affected area will be minimised. All workers will arrive on site via park and ride bus (see Chapter 3) ***Site management*** • All site workers will have awareness training on biodiversity issues and particularly the provisions that have been made to minimise impacts on biodiversity, both prior to initial access to site and on an as-needed basis throughout the project (via tool-box talks etc.). • The Project site will be maintained in a clean and uncluttered state. • Litter will be removed from water bodies and areas within the restricted access zone. • A waste management plan will be implemented. Waste disposal facilities will be operated in a manner that prevents animals from foraging or being attracted to waste (e.g. bears). • Areas to be disturbed during construction and operation will be will clearly delineated and marked out in advance, and encroachment outside these areas will not be permitted. In particular, off-road/track driving will be prohibited. • Vehicle speeds on access and haul roads will be controlled to minimise dust emissions and the risk of mortality of animals (see also Chapter 5.5, air quality impacts). • Instruction on driving safety and observation of speed limits will be included in the contractor induction, new employee orientation and

Table 5.4.10: Mitigation Measures for Impacts on PBF/ACH Habitats or Qualifying Species	
Project Approach	**General Mitigation Measures**
	annual refresher training and in task training for specific job assignment (see also Section 5.5, air quality impacts). • Vehicles considered to have the potential to introduce invasive plant species or spread existing invasive plants to areas where they do not currently occur will be washed before entering site or current weed-free locations (wash water to be contained). ***Dust (see Section 5.5)*** • Crusher with dust suppression techniques; • Use of water sprays at material stockpile/hopper loading points and other identified dust emission points, updated as required by the Air Quality Management Plan • Road control programmes – Appropriate dust suppression techniques will be undertaken, including spraying roads/vegetation with water and/or application of stabilising agents; likely to be gravel/sand, or environmentally inert chemicals, as appropriate to reduce changes to soil chemistry that can occur through the use of salt. In addition, adequate equipment and personnel will be supplied to maintain road surfaces to control dust on the haul and access roads; • Speed and off-road restrictions – Establishing and enforcing Project safety rules, including the posting and enforcement of speed limits on Project haul and access roads and restricting off-road travel to the maximum practical extent will limit the potential for additional fugitive dust emissions, as well as public safety hazards. Those employees whose jobs include driving as well as haulage contractors will be advised of the safety rules and that driving off established roadways is not allowed. Instruction on driving safety and observation of speed limits will be included in the new employee orientation and annual refresher training and in task training for specific job assignment. This aspect is developed in the Traffic Management Plan. ***Water management (Section 5.7)*** • No hazardous materials are expected to be transported along the haul routes. During construction and operations of the haul routes, given the inbuilt environmental management mitigations that will be in place including silt traps and construction material control, no significant hydrological change is expected to occur to the associated water courses. • Personnel trained in diesel or lubricant spillage and spill kits to be available where needed. • No discharge is proposed for anti-scalants at VPP. • The tailings and ore material within the plant site curtilage creates a possible risk of acidic and metalliferous leaching discharging with site drainage and runoff into the Mala river. The mitigations built into the project include segregation of contact and non-contact drainage systems and recirculation of sump collected water back into the process water inventory. • During decommissioning, mitigation for potentially acid generating tailings are as follows: Mitigation in design that is being included (WAI, June 2021, Report ST18587 BoD) comprises: i) isolation of tailings from the centre-line small temporary stream running down the valley by construction of an underdrainage system to convey surface water beneath the TSF, ii) a low permeability mineral lining system placed

Table 5.4.10: Mitigation Measures for Impacts on PBF/ACH Habitats or Qualifying Species	
Project Approach	**General Mitigation Measures**
	above the underdrainage (synthetic HDPE liner is not suitable for this setting), iii) TSF phases will be closed by blinding over with a 1m thick layer of low permeability soils, encasement of the valley sides with a 2m layer of (carbonate) waste rock and a 0.5m thick waste rock layer on the lift surface. • The project's water demand appears well within the existing network capacity and therefore impacts to Studenac and Bukovica from abstraction are likely of negligible effect. Water will be provided under licence or contract with JKP to ensure an assured reliable supply with minimal change to the existing utility footprint and avoids potential impacts installing new infrastructure. • During construction and operation at Rupice, sedimented run-off from site clearance and earthworks will drain to settlement ponds which decant to the Vruci Potok valley. The settlement pond is designed to retain two days residence water collected from the site and has sufficient capacity to hold a design stormwater flow. The effect of the construction works site run-off is expected therefore to be negligible. No expected overland flow routes are present connecting to the Borovicki river. • The effect of the accidental spillage of contaminants during construction works at Rupice is expected to be negligible as spillage would enter settlement ponds and could be treated under the provisions of the EMP before effects materialised. ***Noise (Section 5.6)*** • Designed mitigation measures prior to start up should be in place before tests on crushing plant are commenced. Soil mounds constructed adjacent to haul roads could be located to provide additional attenuation between the haul trucks and the nearest community; and • During the detailed design stage, the use of noise barriers, baffles, or enclosures to provide abatement for noisy equipment such as generators, compressor, pumps and gearboxes should be considered; furthermore, an adequate distance between the stationary noise sources and the nearby communities should be maintained. • The façade of the proposed processing building should provide a minimum of 39dB Rw. • All mobile plant should undergo regular inspection and maintenance to ensure that they have designed mufflers, which are performing to an adequate standard and that worn parts are replaced; and • Maintain the surface of haul roads in good condition and impose a speed limit. • Workers will be trained in noise abatement best practices, including avoiding unnecessary revving of engines and switching off equipment when it is not required; • Haul routes will be well maintained and where steep gradients are required operatives will be trained to minimize engine noise through avoiding unnecessary revving etc; • Drop height for materials will be minimised;

Table 5.4.10: Mitigation Measures for Impacts on PBF/ACH Habitats or Qualifying Species	
Project Approach	**General Mitigation Measures**
	• Vehicle and plant start-ups will be sequenced to avoid simultaneous noise bursts; • All vehicles will be fitted with reversing alarms set at lowest level subject to health and safety considerations; • Provide an air inlet silencer and exhaust silencers for stationary combustion engines and other units (for example generators); • Perform regular inspection and maintenance of material handling vehicles and equipment to ensure that they have quality mufflers installed, worn parts are replaced, and lubricants are applied so that the design noise-output specifications continue to be met; • When plant equipment has to be replaced, the selected plant will have a sound power level equal to or less than the plant that it is replacing; • Blast design will include face profiling and explosive packing to maintain high level of environmental performance for each blast; • The static plant located in the crusher and processing areas will be housed within a building, and breakout points in the facade of these buildings (i.e. doors, windows etc.) will be minimised, as well as minimising the reverberant noise inside the buildings, which will be controlled through sound absorptive material; • Noise monitoring will be undertaken in accordance with the Noise Management Plan and following any complaints from within the affected community receptors; and • All measured data will be logged and maintained as a record for the site EMS, which should be available on request and published annually for the duration of the Project. ***Light (see section 5.11 landscape and visual)*** • Only the minimum artificial lighting necessary to ensure safety will be employed. Downward-directed lighting will be employed to minimise light pollution for nocturnal species. • Windows in buildings will, where possible, be shuttered to prevent light spill at night. • There will be minimal security lighting in external areas (sensors will be used to ensure it does not get left on). • Lighting of work sites will be restricted to agreed working hours and that which is necessary for security. Light sources for night-time construction and operation activities will be pointed downward and away from retained habitats (adjacent forest). • Vehicle and mobile plant machinery operators and drivers will be instructed in the appropriate use of headlights (high and low beams) to reduce impacts.
Restore or Repair	A comprehensive soil and vegetation restoration programme will be employed to reinstate appropriate vegetation types post-impact. Ecologists have worked closely with landscape specialists to identify suitable native species with general aims being to permit areas of natural regeneration and give a 'head start' to re-establishing a forest ecosystem that matches the Dinaric Mixed Forests Ecozone. Such

Table 5.4.10: Mitigation Measures for Impacts on PBF/ACH Habitats or Qualifying Species	
Project Approach	**General Mitigation Measures**
	species will include but not be limited to Norway spruce, silver fir, sycamore, beech, hazel and a range of locally native shrubs and sub-shrubs to generate ecotones and a diverse vegetation structure. Where appropriate European black pine *Pinus nigra* may be part of the species mix. Hay cuts taken from local flower-rich meadows can be spread onto areas not planted with trees to encourage native grassland vegetation to establish, much of which could be allowed to develop naturally into a mosaic of scrub and young trees over time. The haul road will be a permanent feature and where it is built over Hay Meadow PBF or PBF watercourses, permanent offsetting is required in order to ensure NNL of PNF habitat. All re-vegetation carried out for the Project will be carefully reviewed and monitored to avoid accidental introduction of invasive alien species.

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
PBF/ACH habitats or feature:				
Acidophilous Spruce Forest (PBF)	Footprint on this habitat type has been unavoidable as this is the dominant habitat type in the locality. Higher quality areas of this habitat type have been avoided.	Existing forestry tracks have been chosen wherever possible for the haul route to minimise habitat and species loss.	Following mine closure, the land at Rupice and at the VPP will be restored to native forest through a mixture of locally native species planting and natural regeneration from the surrounding forest. Natural succession will allow a range of vegetation types and communities to develop spatially and temporally in places and planting will help work towards re-establishing PBF forest habitat. It is assumed 75% of the Project restoration area will be planted with native forest species and 25% will be available for natural regeneration/ complimentary habitats such as species rich grassland. All re-vegetation carried out will be monitored to	78.3ha of this habitat will be lost to construction with approximately 40ha restored at Rupice and the VPP/TSF. As the haul road will remain this will be a permanent loss in those areas. Due to long term degradation and loss associated with the Project, restorative management of existing forest will be explored as an option in order that there is no net loss (if not a net gain, in terms of quality) of PBF spruce forest. Generally, the forestry practices in the EAAA are preventing regional forests from reaching a favourable ecological condition due to over-exploitation for timber.

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
			avoid introduction or spread of invasive alien species.	Spruce forests within the EAAA are typically single species stands with minimal age structure, and a correspondingly poor understorey. It is recommended that an area of spruce forest within the Project concession boundary will be managed with the aim of restoring it to a favourable forest structure aiming to meet the criteria for the Dinaric Mountains mixed forests ecoregion. It is suggested that 50ha is managed restoratively, to include a core area and peripheral area which could include a no-harvest area, thinning, creation of standing and fallen dead wood, forced veteranisation of trees, locally native species reinforcement planting (e.g. silver fir, beech, sycamore), to be managed as such in the long term. This would enable a net gain in quality of forest when combined with decommissioning restoration. Adriatic Metals are committed to establishing suitable areas and programmes for ensuring no net loss/ net gain. The final plan for implementation is being determined and Adriatic are in discussions with the Vares Forestry Commission and

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
				local biodiversity specialists.
Pančić blue sow thistle Heart-leaved ox-eye daisy Red helleborine			Forest and meadow restoration/management will be sufficient to retain or even enhance the habitat for local populations. As an additional measure, individuals of these species will be identified along the route of the haul road within spruce forest during the pre-construction walkover and translocated to retained suitable habitat nearby.	Residual impact neutral following forest, meadow and hydrophilous tall herb fringe restoration/management.
Mountain Hay Meadows (PBF)	Part of the haul road route necessitates the permanent loss of 2.5ha of this habitat.	Measures to reduce dust deposition, invasive species on retained habitat. Measures to control use of vehicles on undamaged vegetation. Measures to control soil erosion and impacts of wash-out on remaining vegetation.	Areas within the Rupice concession (approx. 25%) will be sown with local hay harvested from species rich meadows nearby in order to re-establish PBF grassland as part of the progressive restoration/ decommissioning. Some of this grassland can be managed permanently as hay meadow. It is likely that this restored area would remain of lower quality than the habitat lost due to the associated biota being disturbed/lost during construction. For that reason, an offset is also required to ensure NNL or even a net gain in area and quality of habitat in the long term.	Other mountain hay meadow habitat has been identified within the EAAA, including an area bordering the Veovaca open pit. This retained habitat is undergoing natural succession with hawthorn *Crataegus monogyna* scrub and without intervention extensive areas of the species rich grassland vegetation would be lost within twenty years. An area of this retained habitat will be managed through targeted tree and scrub removal in order to maintain the continuity of mountain hay meadow PBF within the EAAA. In order to achieve net gain in quality and quantity of this habitat, it is suggested that 5ha of hay meadow currently threatened by lack of management/over-management is purchased and restored to

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
				high quality habitat. Potential locations are currently being explored by Adriatic. With management of this PBF habitat in the EAAA, much of which would otherwise naturally succeed to scrub and relatively low-quality forest, a net positive residual impact on this PBF is likely in the long term.
Balkan endemic Dinaric widowflower and *Crepis conyzifolia*			Forest and meadow restoration/management will be sufficient to retain or even enhance the habitat for local populations. As an additional measure, individuals of these species will be identified along the route of the haul road within suitable habitat during the pre-construction walkover and will be translocated to retained suitable habitat nearby within the EAAA.	Residual impact neutral following forest, meadow and hydrophilous tall herb fringe restoration/management.
FBiH VU Angelica and stemless gentian				
PBF Hydrophilous tall herb fringe communities	The proposed haul road route avoids direct impacts to this habitat which was identified as a PBF during the April survey by WAI and Zenica Institute		Areas of this retained habitat is undergoing natural succession by spruce and willows *Salix sp.* In places this adds to structural diversity but without grazing or management areas of this habitat will revert to scrub and forest over the medium term (10 to 20 years). This retained habitat will be managed through targeted tree and scrub removal in order to maintain the continuity of this PBF vegetation type and the botanical diversity it supports.	In order to achieve net gain in quality and quantity of this habitat, it is suggested that 5ha of hydrophilous tall herb vegetation currently threatened by lack of management/over-management is purchased and restored to high quality habitat. Potential locations are currently being explored by Adriatic. With management of this PBF habitat in the EAAA which would otherwise naturally succeed to

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
				scrub and relatively low-quality forest, a net positive residual impact is likely.
Marsh marigold	The majority of the habitat for this species has been avoided (hydrophilous tall herb communities, stream vegetation)		Wetland creation and management of hydrophilous tall herb fringe vegetation will be sufficient to maintain or expand the habitat for this species. As an additional measure, individuals of this species will be identified along the route of the haul road within suitable habitat (Zagarski stream and crossings over the Borovicki stream/Vruci stream) during the pre-construction walkover and will be translocated to retained suitable habitat nearby within the EAAA.	Residual impact neutral following wetland creation and hydrophilous tall herb fringe restoration/management.
Water courses from plateaus to the mountainous belt	The Project has avoided a dam on the Mala River, has avoided water abstraction on the Vruci stream and Borovicki stream. It has not been possible to avoid impacts to this habitat along the Zagarski stream as this is the required route of the haul road.	Potential impacts from water abstraction have been minimised by utilising existing infrastructure on the Bukovica stream, which has extra capacity for water abstraction (TBC) in order to maintain stream function. Pollution prevention measures, dust suppression,	The river water quality in the Mala River is generally good at present. Impacts (ref chapter 5.7 hydrology) are expected to be at most minor with mitigation outlined in chapter 5.7. Impacts on watercourses from works to the Borovicki and Vruci streams are at most minor with mitigation. Water monitoring throughout the process will ensure water quality is maintained. Crossing over the Vruci stream to be restored following site closure.	With the exception of the Zagarski stream, effects can be minimised to acceptable levels such that there will be no net loss of PBF without requiring offset. As a length of 1km will be culverted (See below*) and PBF lost permanently, the Project will offset this loss through implementing a river restoration scheme within a nearby catchment, which could include but may not be limited to; litter and invasive species removal, weir removal and assisting the local angling society with restocking. Adriatic will engage with local government, relevant societies and NGOs regarding the scheme's set-up, and will

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
		preventing runoff.		establish an endowment or similar mechanism to ensure financial support for the offset (see section 5.4.7).
Annex IV amphibians (ACH qualifying species) • Yellow-bellied toad • Green toad • Agile frog	These species are relatively common and widespread in BiH and so complete avoidance by the Project has not been possible.	Minimising impacts to several watercourses will ensure minimal impact to the populations of these species within the EAAA, except in the AOI along the Zagarski stream.	In order to ensure no net loss of these species within the EAAA, a new area of breeding habitat alongside improved terrestrial habitat will be created, and possible locations are currently being explored. This will consist of a number of breeding ponds of different size, some ephemeral and near to suitable terrestrial habitat. Positive management of nearby forest to improve vegetation structure and create standing and fallen dead wood. These are pioneer species and local populations are expected to colonise the new wetland area naturally. However as an additional complimentary measure, prior to construction, a hand search by an ecologist will be undertaken of habitat along the proposed haul road where it impacts suitable amphibian habitat and captured animas will be moved out of the construction impact zone to retained/enhanced terrestrial habitat.	Requirements within PR6 can be met i.e. that the conservation viability of these species will not be jeopardised within the EAAA, and their national or global populations will not be reduced, with mitigation and offset. Residual impact will be positive (a net gain of these species in the EAAA which is necessary to impacts on ACH qualifying species). These pioneer species are known to quickly make use of newly created ponds; both permanent and temporary. New/restored breeding habitat alongside suitable terrestrial habitat will be monitored to ensure colonisation is successful and will enable any remedial actions to be undertaken to ensure a positive outcome. Monitoring of river restoration and pond creation schemes will ensure proactive ongoing mitigation is successful.
Annex IV amphibians (ACH qualifying species) • Greek frog			The offset work to improve habitat quality in retained streams within the EAAA, and the mitigation work for the other Annex IV amphibians, including pond creation and translocation prior to construction, will ensure	

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
			no net loss of populations within the EAAA.	
Annex IV reptiles (ACH qualifying species) • Nose-horned viper • Wall lizard • Sheltopusik • Green lizard • Sand lizard • Smooth snake	Avoidance of the preferred habitat for these species has been achieved by following existing roads and tracks, avoiding *Nardus* grassland and rocky slopes.	Strimming open vegetation such as grassland and leaving the area for a few days to allow reptiles to disperse (in active period)	Hand search by an ecologist of any suitable reptile habitat (under fallen logs, stones etc.) prior to clearance, capture of reptiles and move to retained habitat. Restoration plan will include areas of natural regeneration which will create good reptile habitat mixed with restored forest.	There will be a neutral residual impact on these species of reptile. The creation of alternative breeding amphibian habitat within the EAAA will also provide additional habitat for several species of reptile.
Annex I birds (PBF) • Hazel grouse	Main habitat (mixed forests) for this species have been avoided.	Vegetation removal during the bird breeding season will be minimised wherever possible.	If vegetation removal is undertaken during nesting season, a nest check will be undertaken by an ecologist and an appropriate buffer established until the nesting attempt is complete. The mitigation/offset work that will be undertaken in respect of PBF spruce forest will benefit this species due to improvement in forest structure and diversity.	Residual impact is likely to be positive (net gain for population of PBF species within the EAAA) in the longer term when habitat enhancement of retained spruce forest is considered and restored forest habitat develops.
Invertebrates • White clawed crayfish (PBF)	Dams on the Mala River have been removed from the	Minimising impacts on the Mala River from construction	Sediment traps will prevent runoff from construction reaching the Mala River through temporary tributaries during wet weather.	Residual impact likely to be neutral (no net loss of PBF) since available evidence suggests there is existing capacity in the

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
	scheme, avoiding potential downstream impacts from this activity.	and operation downstream from the proposed TSF will ensure impacts on this species are also minimised.	Water quality monitoring will enable a proactive approach to be taken with regards maintaining good water quality in the Mala River Further study work is being undertaken to be completed in Q3/Q4 2021 on the Bukovica river to determine the presence of any PBF or ACH receptors that may be affected by water quality and quantity changes.	Bukovica for water abstraction and there are no expected overland flow routes connecting to the Borovicki river. Monitoring will be carried out due to the proximity of the Project and the relatively restricted habitat of these species. If monitoring suggests water quality and levels are failing to meet sufficient criteria to maintain any crayfish populations as a result of Project activities then appropriate mitigation will be considered. Impact assessment dependent on further information.
• Stone crayfish (precautionary PBF)	Crossing limited upstream sections of the Borovicki have been unavoidable but stone crayfish populations are far downstream of these impact areas.	Standard pollution prevention measures will minimise impacts on watercourses and therefore this species. Extraction on the Bukovica river uses existing infrastructure.		
Annex IV large mammals (ACH qualifying species) • Brown bear • Grey wolf • Eurasian lynx • European wildcat	The known areas of critical habitat for these species has been avoided and no denning habitat was found in any of the Project impact areas. Re-routing of the haul road avoided approaching the	Minimising noise impacts from haulage and blasting will reduce the potential area of disturbance from Project activities.	A speed limit will be implemented on the haul road and appropriate signage will be installed along the route informing drivers of the potential presence of large mammals, especially at night. Beneficial management of retained forest is likely to benefit these species through increased cover and foraging resource. Appropriate food waste disposal especially at the Rupice project area (more remote) will	Requirements within PR6 can be met i.e. that the conservation viability of these species will not be jeopardised within the EAAA subject to mitigation measures, and their national or global populations will not be reduced.

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
	Sajnovicki Kamen and Grcki Kamen at a much greater distance (over 2km).		ensure bears are not attracted to working areas where there could be conflict. Site personnel to receive briefings about litter disposal. Remote camera monitoring of potential mammal crossing points along haul road, as well as Sajnovicki Kamen and Grcki Kamen to establish use by large mammals and to inform any ongoing mitigation (See below**). Restorative management of retained spruce forest will improve the foraging and denning resource (dead wood piles) for these species.	
Invasive Species • Japanese knotweed (JK)	Avoidance of spreading this plant is unlikely due to proximity to roads.	Not relevant	All locations of this plant will be clearly identified during an update survey within the growing season (May to September). Stands within or near to the project areas will be demarcated with a suitable buffer whereby plant material cannot be spread by project activities. A treatment plan will be implemented using approved herbicide, applied regularly until the plants have died. Any regrowth monitored and treated as necessary. If areas of JK require excavation, all excavated material should be buried deeply/treated as	Annual monitoring for any new growth of Japanese knotweed and a treatment programme to prevent additional spread. Successful treatment and eradication of JK from the EAAA will ensure no residual effects on PBF or ACH or other biodiversity receptors.

Table 5.4.11: Specific Biodiversity Mitigation - Including Offsets				
Priority receptors	**Avoid**	**Minimise**	**Mitigate/Restore**	**Residual impact/ requirement to offset**
			hazardous waste although treatment in-situ is the preferred option.	
Associated Facility: • Bats	Avoid any works to the abandoned administration building (Building 4) which supports a confirmed lesser horseshoe roost.	Minimise light spillage over nearby vegetation to reduce effects on retained foraging and commuting habitat. Minimise any light spillage or disturbance to the disused mine entrance which has high bat roost potential.	Additional mitigation may be required if Building 4 is required to be affected by the project.	Residual impact neutral (unless impacts to Building 4 become unavoidable).

* ***Zagarski River Culvert:***

An approximate 1km section of the Zagarski stream will require engineering solutions to ensure the feasibility of the haul road. An engineering study will be undertaken as part of the detailed design work by Saraj inženjering to confirm the approach to be taken to culvert this stream, taking environmental, social and economic factors into consideration. As far as feasibly possible a culvert that will allow the stream to maintain ecological integrity and the existing hydrological regime, through a natural substrate bottom will be selected. It is likely that a combined approach will be taken to implement environmental requirements whilst ensuring the occupational safety of the road is maintained and the economic feasibility of selected culverts.

*****Large Mammal Crossings:***

In the section of road between Rupice and Semizova Ponikva a number of crossings for large mammals will be installed to ensure the connectivity between denning habitats and the forested area to the north is maintained. It is anticipated that approximately 5 crossings will be required along this section of road to ensure sufficient linkage, designed in accordance with published guidance[7]. Crossings may be box culverts or ecological bridges, dependent on the topography and engineering characteristics of the location. All crossings will be protected and designed in such a way to incorporate with the surrounding landscape and vegetation. Box culverts will be a minimum of 2.5m high and 3m wide, whilst ecological bridges will be a minimum of 7m wide, all crossings will have a 100m section of fencing, or natural fencing, on either side to lead wildlife to them. The exact location, number and specification of the culverts will be determined by Saraj inženjering during the detailed design phase, and will be guided by the in country biodiversity specialist to ensure the effective placement of crossing locations.

[7] http://www.elkhornsloughctp.org/uploads/files/1182793716carnivoresafepassage.pdf

5.4.7 Mitigation Actions and Biodiversity Action Plan (BAP)

A BAP has been developed which provides additional detail regarding creation, management and monitoring of habitats, and a timeline for their application. The BAP also includes greater detail regarding all of the elements outlined in Table 5.4.10 above including progressive restoration of habitats. The BAP ensures that the stipulations within PR6 can be met but is not a static document. Where additional information from further survey or monitoring is encountered, the BAP will be updated.

The BAP includes thirteen key actions that enable the project to meet the requirements of PR6 within an acceptable time frame; (BIO.01 to BIO.13).

5.5 Air Quality

5.5.1 Introduction

This section of the report provides an assessment of the potential impacts of pollution on the project affected area and communities resulting from emissions to air. The methodology for undertaking the assessment of potential impacts is in accordance with that set out in Section 5.1. The requirements for health and safety at work have not been specifically addressed in this Chapter, but they are referenced through the specific policies and management requirements developed by Adriatic Metals PLC.

The significance of an environmental impact for air quality emissions is determined by the interaction of magnitude and sensitivity. The methodology for determining the magnitude of impact and sensitivity of the receptor with regard to air quality is shown in Table 5.5.1 and Table 5.5.2.

Table 5.5.1: Methodology for Determining Sensitivity for Air Quality

Sensitivity	Methodology
Minor	The location is tolerant of change without detriment to its character, and is of low or local importance, for example industrial and agricultural activities, that are at a low risk from being affected by changes in air quality.
Medium	The location has moderate capacity to absorb change without significantly altering its present character or is of high importance. For example, residential dwellings and communities.
High	The location has little ability to absorb change without fundamentally altering its present character, or is of national importance. For example, hospitals, and commercial / industrial premises, which have a requirement for clean air to maintain operations; and vegetation that is sensitive to changes in air quality and / or the deposition of particulates in terms of species composition and habitat quality.
Very High	The location is of the highest sensitivity to changes in air quality, or is of international importance. For example, highly sensitive high-tech operations that require clean air and operate air filtration units; and specific habitats that are of international importance and sensitive to changes in air quality and / or particulate deposition.

Table 5.5.2: Methodology for Determining Magnitude of Impact

Impact	Change compared with baseline or difference in predicted level compared to guideline level
Negligible	Minimal discernible change in the baseline environmental conditions, within margins of error of measurement (annual mean increase or decrease <1%).
Low	Impact resulting in a discernible change in baseline environmental conditions with undesirable/desirable conditions that can be tolerated (annual mean increase or decrease in range of 1 – 5%).
Moderate	Impact resulting in a discernible change in baseline environmental conditions predicted either to cause relevant objectives or guidance levels to be marginally exceeded or to result in undesirable/desirable consequences on the receiving environment (annual mean increase or decrease in range of 5 – 10%).

Table 5.5.2: Methodology for Determining Magnitude of Impact	
Impact	**Change compared with baseline or difference in predicted level compared to guideline level**
High	Impact resulting in a substantial change in baseline environmental conditions predicted either to cause relevant objectives or guidance levels to be exceeded or to result in undesirable consequences on the receiving environment (annual mean increase or decrease >10%).
Note: Based on published criteria for assessing the magnitude of change[1]	

For the purposes of this air quality assessment, the level of significance for air quality effects will be ultimately determined by using the magnitude criteria detailed in Table 5.5.2, together with the sensitivity of the receptor, as detailed in Table 5.5.1, using the significance matrix detailed in Chapter 5.1, Table 5.1.3.

5.5.2 Potential Air Emissions

5.5.2.1 Overview

Potential air quality emissions considered within this air quality assessment are categorised as:

- *Fugitive dust*: Particulate matter generated from mining operations, earthmoving, material transport and handling, and unpaved road traffic, crushing and screening of ore;
- *Combustion emissions*: Internal combustion engines (heavy and light vehicles, equipment motors, back up generators); and
- *Nuisance odours*: Non-health-related gas emissions affecting employees or nearby residents.

The project activities will involve use of significant quantities of fuel for operation of plant, equipment and machinery, resulting in greenhouse gas emissions (GHG) during construction and operation phases of the project. These GHG emissions have been addressed in Section 5.2 of the report. There is no requirement for on-site power generation (using heavy oil or diesel generators) as the site will have access to mains power from the local electricity grid (supplemented by solar power generation at the VPP admin building).

5.5.2.2 Potential Fugitive Dust Sources

During construction earth works associated with surface infrastructure and initial earth movements at Rupice, as well as along the haul route, at the VPP and within the TSF area could all lead to the potential emission of fugitive dust.

[1] Significance in Air Quality, Institute of Air Quality Management (2009)

The Vares Project comprises of the polymetallic underground Rupice Mine and the Vares Processing Plant (VPP) with associated infrastructure. The following infrastructure is associated with the Project:

- Rupice Infrastructure, comprising:
  - underground workings, including ventilation shafts and primary crusher;
  - Waste Rock Stockpile;
  - Three Run-of-mine (ROM) stockpiles of varying grade;
- Haul Route: 24.5km long haul route, connecting the Rupice mine to the Vares Processing Plant utilising existing (sealed and unsealed) roads, new planned roads and forest tracks.
- Vares Processing Plant Comprises of:
  - Grinding facility with 3 stage crushing;
  - Emergency stockpile and crushed ore receiving hopper (enclosed with dust collector);
  - Coarse ore day bins with conveying system (dust collector at transition points); and
  - Dry-stack Tailings Storage Facility (TSF).

During operations, the potential for dust and fine particulate matter emissions from the mine activity at Rupice is very low as the work will take place below ground.

Crushed ore will be transported by haul road to the Vares Processing Plant to the southeast, where it will be stockpiled before being processed.

The erosive action of vehicle traffic on haul roads is considered to be a significant potential source of dust as the mechanical action of wheels on the road surface causes dust lying on the road surface to be thrown up and become entrained in a moving airflow. The deposition of this dust is dependent on the particle size and meteorological conditions. The erosivity of unsealed haul roads depends on the number and size of wheels, vehicle speeds and the moisture content of the surface material.

During closure, the demolition and removal of buildings at VPP could lead to dust emissions, though as earth works will be limited, these are not expected to be significant. Earth works at Rupice may lead to some short lived dust emissions. As the haul route will not be altered post-closure no additional dust emissions are expected to occur.

5.5.2.3 Combustion Emission Sources

These could include emissions from diesel fired back up power generators (Mains power from the nearby electricity grid, supplemented with solar power will be utilised by the project). The use of plant equipment and machinery for mine operations will also result in emissions of nitrogen oxides, particulate matter, sulphur oxides and carbon monoxide.

5.5.2.4 Nuisance Odours

Nuisance odours during construction and operations could be generated from improperly managed domestic waste (storage and haulage) and domestic wastewater treatment/disposal.

Table 5.5.3 below presents a summary of the various types of emissions that could affect air quality during construction and operations, by Project component.

Table 5.5.3: Potential Sources of Air Quality Emissions

Project Component	Releases and Effects	Fugitive Dust	Combustion Gases	Nuisance Odours	Other	Characteristics
Construction						
Earthworks, site clearance and construction	• Dust and dust blow from exposed surfaces.	X				Fugitive dust generated by truck movements and earth moving equipment; short duration.
	• Vehicle exhaust emissions		X			NO_x, SO_2 and CO and diesel particulates; short duration.
Crushing, loading, hauling of aggregates used in construction	• Mobile crushing plant	X				Fugitive dust from mobile crushing plant, controlled by fitting plant with water spray to reduce emissions.
	• Dust generated by loading and vehicle entrainment	X				Fugitive dust generated from haul trucks on haul roads and construction access roads. Controlled with frequent maintenance of haul road surface and water sprays to dampen the surface in potentially dusty conditions.
	• Vehicle exhaust emissions		X			NO_x, SO_2, CO, CO_2, and particulate emissions
Mining						
Drilling and blasting	• Dust from drilling	X				Fugitive dust generated during drilling activities, mitigated by dust filters and contained within the mine.
	• Dust from blasting	X				Fugitive dust generated instantaneously during blasting; intermittent and contained within the mine.
	• Blasting gas		X			Combustion gases from blasting.
Loading, hauling and related mine traffic	• Dust generated by loading and vehicle entrainment	X				Fugitive dust from ore/waste rock may contain low concentrations of metals; only emitted during dry periods; controlled with watering of haul roads and at load out areas
	• Vehicle exhaust emissions		X			NO_x, SO_2, CO, CO_2, and particulate emissions.
Crushing and Ore Preparation						

Table 5.5.3: Potential Sources of Air Quality Emissions

Project Component	Releases and Effects	Fugitive Dust	Combustion Gases	Nuisance Odours	Other	Characteristics
Crushing Plant	• Dust	X				Fugitive dust escaping from crusher; controlled with water sprays.
Loading, hauling, and fine ore deposition	• Dust generated by loading and vehicle entrainment	X			X	Fugitive dust from fine ore may contain low concentration of metals; only emitted during dry periods; controlled with watering of haul roads, at load out areas and inherent moisture in the heap
	• Vehicle exhaust emissions		X			NO_x, SO_2, CO, CO_2, and particulate emissions.
Support Infrastructure						
Domestic wastewater treatment	• Nuisance odours			X		Septic tanks and wastewater treatment plant.
Closure						
Process plant and supporting infrastructure and traffic movements on roads	Dust	X				Dust generated from demolition activities, earthworks. Water spray where necessary.
Closure of Rupice and demolition of surface infrastructure	Dust	X				Dust generated from demolition activities, earthworks. Water spray where necessary.

The most significant source areas considered likely to contribute to dust emissions from the Project during construction have been identified as fugitive dust emissions from earthmoving activities taking place including the construction of haul roads.

Dust emission rates from construction and closure activities have not been separately calculated, because they would be short term, temporary and the dust emissions will follow the same dispersion patterns as the dust from operational activities.

The most significant sources of air emissions during operations are considered to be:

- Dust emissions from material haulage, tipping and crushing activities; and
- Vehicle exhaust gases (mobile and static plant fuelled by diesel), with emissions including NOx, particulates (PM_{10}) and CO_2.

5.5.3 Sensitive Receptors

Within the Project area, the majority of sensitive receptors are identified as inhabitants of residential properties. Table 5.5.4 lists where the sensitive receptors are located in relation to either the haul road or the processing plant.

Table 5.5.4: Location of Sensitive Receptors for Air Quality

Location	Monitoring Location	Latitude/Longitude	Approximate Number of Dwellings	Distance	Source
Položac	AQN8	44°10'21.67"N 18°17'21.27"E	2	60-170m	Haul Road
Vareš	AQ3	44°16'15.84"N 18°32'63.42"E	>100	280-1000m	Haul Road
South of Vareš	AQN7	44°14'42.46"N 18°32'18.09"E	20-30	80-300m	Haul Road
Bijelo Borje - Tisovci	N/A	44° 8'17.08"N 18°20'3.87"E	4	7-100m	Haul Road
Tisovci	AQN4 & AQN5	44°14'10.48"N 18°34'77.56"E	10	60-90m	Haul Road & Processing Plant
		44°14'20.02"N 18°34'81.46"E		60-120m	
		44°14'27.80"N 18°34'81.51"E		60-200m	
Przici	AQN3	44°14'74.56"N 18°35'62.13"E	10-20	400-800m	Processing Plant

Baseline monitoring at Gornja and Donja Borovica (monitoring location AQN9 and AQ4, respectively) was consistently well within air quality limits and objectives. Rerouting of the haul route during the design process means that there are no receptors in this area.

The haul route traverses northeast from Rupice through a wooded, unpopulated area. The route turns towards the south east and traverses through the village of Položac; at this point the closest sensitive receptor is 60m west of the road. From here the haul route traverses south east and continues around the northern edge of the historic Smreka iron ore pit before crossing the R444 south of Vareš town.

Baseline monitoring indicated high dust, particulate and gaseous pollutant levels at AQ3 located in the town of Vareš, probably associated with local industrial and domestic activity. Significant numbers of potential receptors reside in this location which is not subject to prevailing wind direction from either mine site or processing plant. Additionally, this location is situated over 280m from the haul road and over 2km from the processing plant.

There are less than 20 commercial, industrial and residential properties within 20m of the route to be used between Vareš and Mlakve (monitoring location AQN7). However, there are no residential properties near to the haul road through Mlakve. The haul route reaches the VPP via the western side, passing by rural settlements between Bijelo Borje and Tisovci (monitoring location AQN4). Along this stretch there is one residential property located 7m from the planned route. This is a holiday home used sporadically throughout the year. Several other residential properties are present, though located over 20m from the route.

The village of Tisovci has several residential properties, the closest of which are located 60-70m from the northwestern boundary of the VPP site. The dwellings are located approximately 215m from the crushing circuit at VPP, and 160m from processing areas. The settlement of Pržići to the north east of the processing plant has 10-20 residential dwellings, which are located 400-800m from the processing plant.

Other receptors sensitive to air pollution

The closest protected site for biodiversity to the Vares Processing Plant is the proposed buffer zone of the Zvijezda Mountain, 1.1km to the northeast. The most sensitive parts of the proposed designated site are located over 3km away with significant topographical barriers in between. The buffer zone separates the most sensitive parts of the proposed Zvijezda Mountain site from the project area, as is its purpose. The closest protected area to the Rupice project area is the Tajan Natural Monument (IUCN Category 3), at its closest point approximately 6km to the north of the Rupice concession boundary. It is not anticipated that the project will impact significantly on any protected site.

Habitats identified around the Project areas may be sensitive to air quality impacts, without mitigation. The Annex 1 listed habitats; Mountain hay meadows and hydrophilous tall herb fringe habitats which are both located within the path of, or adjacent to, the haul route, can be considered the most sensitive. This is due to their relative scarcity in the EAAA and that maintaining the botanical distinctiveness of these habitats relies on specific soil pH and low nutrient conditions (See Chapter 4.5 biodiversity baseline for more information). These can be affected by fugitive dust, particularly from materials alien to the locality that might alter the pH or nutrient conditions of surrounding vegetation/soils, as well as localised nutrient enrichment stemming from vehicular emissions.

5.5.4 Impacts associated with Fugitive Dust Emissions

5.5.4.1 Overview

Fugitive dust emissions are measured as Total Suspended Particulate matter (TSP). The size fraction of concern to human health in TSP consists of particles with a diameter of less than 10µm (PM_{10}) - these particles are small enough to be inhaled and assimilated into the respiratory system.

Fugitive dust and particulate material emissions were assessed using the widely recognised USEPA methodology[2],[3], to estimate the emission rates used for the prediction of dust emissions from mining, materials handling, and related activities. The emissions estimated using USEPA AP-42 are uncontrolled emissions, i.e. with no dust suppression applied. This approach was supplemented by

[2] AP-42 Fugitive Dust Emission Factors, USEPA (2006)
[3] Emission factors and emission estimation methods, USEPA

reference to the Australian Government's Emission Estimation Technique Manual[4] and suppression factors were used to refine the USEPA AP-42 estimates, based on wet and snow days and dust control measures effectiveness.

<u>Wet and Snow Days -</u> The days when total 24-hour rainfall exceeds >0.2mm are considered sufficiently wet to inhibit dust emissions, or if it is emitted, is assumed to rapidly fall as a result of the high humidity favouring agglomeration of fine particles into heavier, larger ones that will not be transported as far. Snow days are days where there is snow covering the ground at the fugitive dust emission points, thus preventing fugitive dust from being emitted and deposited on surfaces (in particular onto vegetation surfaces).

Analysis of the meteorological data from the two weather stations located at Vares and Rupice (see Chapter 4.2) indicate that on an annual average, 38% of days are considered "wet days" i.e., with recorded precipitation of >0.2mm. Snow groundcover data indicates that snow is present on the ground on 6% of the days considered. As these two conditions can occur on the same day, combining "wet days" and "snow days" data yields the result that approximately 40% of days during the year are wet and/or snow days.

Dust emission from mining operations will be deposited onto the surface of snow-covered areas during periods of the winter. Dust will become entrapped in the snow, thus meaning it will not be emitted to the atmosphere and will not make contact with vegetation or other sensitive receptors. During snow melt conditions, dust deposited on and within the snow cover will be transported in the melt waters that also contain elevated concentrations of suspended and dissolved solids, of which the dust associated with emissions from mining operations would form a proportion.

The dry days occur on average 60% of the year, recorded as <0.2mm of rain and with no snow cover. Dry days are further defined as those days when dust could be generated due to favourable atmospheric conditions. Since the mine will operate throughout the year, dry conditions will conservatively occur on average for 219 days per year.

<u>Dust control measures</u> and their relative effectiveness were applied as per the Control Technologies section of NPi EET Manual for Mining (2012)[4]:

- Watering of unpaved haul roads with bowsers to maintain a wet surface (or using salt during winter), is considered to reduce road dust by 50% (to give a controlled emission of 50% of the uncontrolled rate);
- Watering at crushing plant at key source points, considered to reduce dust by 50% (to give controlled emission of 50% of the uncontrolled rate);
- Water sprays, applied to material handling offloading locations, reduce dust emissions by 50% (to give a controlled emission of 50% of the uncontrolled rate).

[4] NPi EET Manual for Mining, 2012, National Pollution Inventory, Emission Estimation Technique Manual for Mining Version 3.1, Australian Government

Table 5.5.5 provides uncontrolled and controlled emission factors (adjusted for wet/snow days and dust suppression techniques). The emissions have been estimated considering the maximum ore and waste rock production during 2026 to represent a worst-case scenario.

Table 5.5.5: Dust Emissions associated with the construction and operation of project										
		Uncontrolled			**Wet and snow days**	**Dust Control Measures**	**Cumulative**	**Controlled**		
	Location	**TSP**	**PM10**	**PM2.5**				**TSP**	**PM10**	**PM2.5**
		kg/day						**kg/day**		
Material handling and Truck loading	Mine exit	0.208	0.156	0.023	0.6	0.5	0.7	0.062	0.047	0.007
Primary Crushing	Mine exit	31.152	12.461	1.869	0.6	0.5	0.43	9.35	3.115	0.561
Secondary Crushing (Grinding)	Processing plant	81.198	32.479	4.872	0.6	0.5	0.43	24.359	8.120	1.462
Tertiary Crushing	Processing plant	81.198	27.066	4.060	0.6	0.5	0.43	24.359	8.120	1.218
Material handling and transfer	Processing plant	13.533	5.413	0.812	0.6	0.5	0.7	4.060	1.624	0.244
Materials haul (unpaved road)	Ore haul road	2089.998	594.26	205.967	0.6	0.5	0.7	626.999	178.278	61.790
Total		2297.292	671.838	217.604				741.446	220.993	68.197

5.5.4.2 Local Weather Conditions

Site–specific meteorology data has been collected through the installation of two weather stations, one at each of the two sites (Vares Processing Plant and Rupice). The weather stations were installed in 2019 but following a review by WAI, the locations were moved in April 2020 and July 2020 for Vares Processing Plant and Rupice respectively, to allow smooth airflow and ensure sufficient distance from any obstruction. On-site weather data has been collected from June 2019 for22 months (and ongoing) for Vares Process Plant and from September 2019 for 19 months (and ongoing) for Rupice. Details of the weather and climate conditions are discussed in Chapter 4.2, Climate Baseline. The wind rose from the Vareš site can be seen below in Figure 5.5.1.

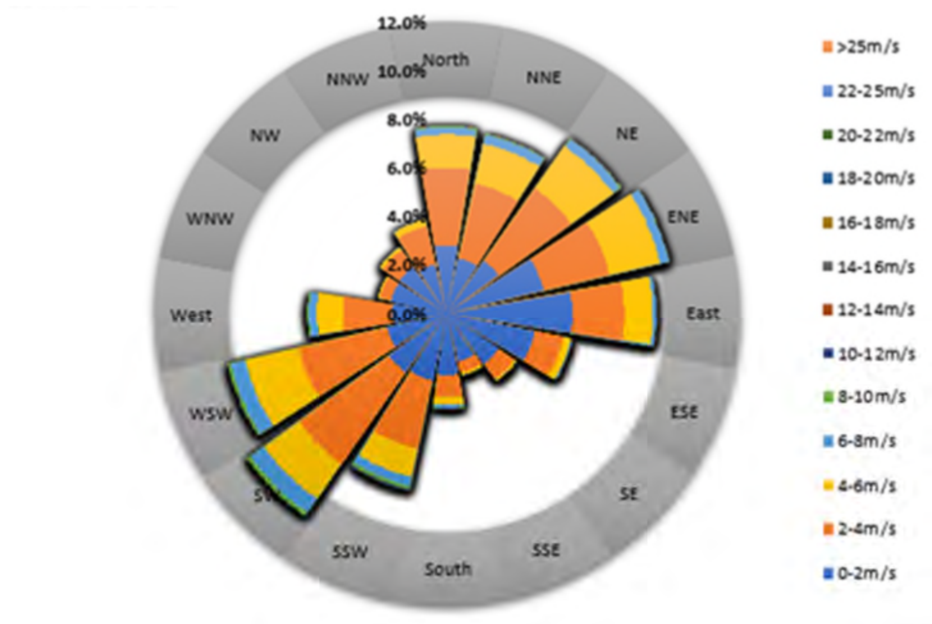


Figure 5.5.1: Wind rose from the Vares processing plant met site

The prevailing wind directions at the Process Plant and Rupice are southwest and south south-westerly respectively. Additionally, a high frequency of winds from the north-easterly quadrant occur at both. Generally, both Vares Process Plant and Rupice experience low wind speeds, with about 80% of the recorded winds at both sites being less than 4m/s.

5.5.4.3 Assessment of Dust in Prevailing Wind

Wind speeds of less than 1.0 metre per second (m/s) do not hold significant quantities of fugitive dust particles in suspension. Various figures are given for the threshold of wind speed at which dust particles begin to erode from an exposed ground surface. In dry conditions a wind speed of 5.5-6.0m/s (measured at the standard height of 10 metres above ground level) is required to raise some dust, but significant amounts of dust could only be raised by site activity. Much higher wind speeds of 17.0m/s are generally considered necessary to erode significant quantities of dust from soils, under field conditions, without other mechanical disturbance.

The climate data presented in Table 5.5.6 suggests that calm or low wind speeds (i.e. 2m/s or less) occur for 45% of the time. The majority of wind speeds recorded (i.e. >99%) are below 10m/s.

For a worst-case assessment, it is understood that the mine will operate continuously throughout the day for 365 days of the year. The number of working hours when site activities may, if not adequately controlled, raise dust which may then be emitted from the site, are shown in Table 5.5.6.

Table 5.5.6: Number of Working Hours per Year where Dust may be Emitted from the Site

Direction		**Speed Class (m/s)**				**Total (hours)**	**24 hour equivalent periods**
		0 - 2	**2 - 6**	**6 - 10**	**>10**		
N	348.25-11.25	236	386	29	2	417	17
NNE	11.25-33.75	195	407	36	1	444	19
NE	33.75-56.25	222	488	33	1	521	22
ENE	56.25-78.75	344	415	31	0	445	19
E	78.75-101.25	434	278	12	0	289	12
ESE	101.25-123.75	310	127	3	0	130	5
SE	123.75-146.25	217	74	0	0	74	3
SSE	146.25-168.75	172	49	1	0	50	2
S	168.75-191.25	215	105	13	0	118	5
SSW	191.25-213.75	240	342	41	5	388	16
SW	213.75-236.25	250	537	71	1	608	25
WSW	236.25-258.75	215	505	61	1	567	24
W	258.75-281.25	189	262	33	0	296	12
WNW	281.25-303.75	199	46	1	0	46	2
NW	303.75-326.25	200	82	1	0	83	3
NNW	326.25-348.75	176	159	1	0	160	7
		3813	4260	364	12	8449	352

5.5.4.4 Impact of Dust to Sensitive Receptors

Table 5.5.7 details the total number of working hours in an average year during which winds may blow dust towards sensitive locations. It should be emphasised that this does not equate to periods of time during which the receptors would receive nuisance dust. Due to the deposition of most dust within 250m of the source, operations carried out at distances greater than 250m from receptors would have a **negligible significance**.

Table 5.5.7: Total Number of Hours in an Average Year during which Wind May Blow Dust Towards Sensitive Receptor Locations within 1km of Vares Processing Plant						
Receptor Location	**Wind Sector (°)**	**Corresponding Wind Direction**	**Closest Distance from Areas of Working (m)**	**% Time of Wind Approaching from the Relevant Sector**	**Number of Working Hours in Which Wind Blows Over the Site to Receptor in an Average Year**	**24 hour** equivalent **periods**
Tisovci	281.25-303.75	WNW	20-90m	0.5	46	2
	303.75-326.25	NW	20-120m	1.0	83	3
	326.25-348.75	NNW	20-200m	1.9	160	7
Przici		NNE	400-800m	5.3	444	19
		NE		5.9	521	22

The small number of residential receptors in Tisovci are located less than 200m from the closest areas of working. It is therefore, predicted that a proportion of the medium and larger dust particles will not be deposited before reaching the sensitive receptors. However, it can be seen that very rarely will the wind direction come from the processing plant.

The assessment detailed in Table 5.5.7 has taken into account wind direction data from the Vareš weather station, in determining the proportion of time when the dust sensitive receptors may be located downwind of the processing facility. This is however considered to be a worst case approach, as it considers all wind speeds, including those periods with low wind speeds that would be unlikely to raise dust and carry it for significant distances.

A wind speed of 5.5-6.0m/s is required to raise some dust, but higher wind speeds would be required to raise significant volumes. The wind data in Chapter 4.2 and summarised in Table 5.5.6 suggests that approximately 95% of winds would be expected to be 6m/s or below in an average year. As a result, the number of working hours in which wind blows over the site towards the receptors in an average year (as detailed in Table 5.5.7) is considered to be an overestimate, as it includes lower windspeed data that cannot be isolated in this analysis.

Based on the distance from Project activities and prevailing wind conditions in the area, PM_{10} and $PM_{2.5}$ concentrations are not likely to exceed the guideline values shown in Chapter 2 and repeated below:

- PM10 20µg/m^3 (1yr average) 50µg/m^3 (24hr average); and
- PM2.5 10µg/m^3 (1yr average) 25µg/m^3 (24hr average).

The Air Quality Management Plan (AQMP) requires monitoring and reporting to audit the Project activities against these guidelines and will require action to be taken should the guidelines not be met during construction and operations.

Due to the increased distance from the source to the residential dwellings in Vareš and the other main settlements around the project, fugitive dust, including respirable dust concentration from the Project dust sources is expected to be low. The magnitude of change is considered to be low, and the impact significance from respirable dust will be a **minor, adverse impact**. This is considered to be an **insignificant effect**. However, small numbers of individual properties are located close to the haul route and could be subject to **moderate impacts** if haul road mitigation measures are not adequately implemented.

An approximate 2.4km section of the haul route traverses through or near to mountain hay meadow, and hydrophilous tall herb fringe habitats. This section runs from the Smreka iron ore pit, westward to Položac and then turns towards the north. This section of road will require mitigation to sufficiently reduce impacts from haul trucks during operation by preventing any fugitive dust from the road surface. Mitigation should be done through dust suppression during dry periods. Dust impacts during construction are likely to be temporary and sufficiently mitigated during rainfall or via artificial wetting, as necessary.

Dust could settle on nearby vegetation during construction and operation particularly during dry weather, in both the meadow and forested areas. Within forested areas at Rupice, edge trees may become covered in dust, acting as a buffer to dust deposition further into the retained forest. Dry periods where dust could be significant are minimal, and it is anticipated that rain fall would be sufficient to wash this dust away. Evidence of this is seen currently where no dust was observed on trees adjacent to tracks used by forestry vehicles. The impact to flora adjacent to the haul route will be **minor, adverse.**

5.5.5 Impacts associated with Combustion Emissions

5.5.5.1 Mobile Plant

The significance of vehicle exhaust gasses from vehicles operating within the Project footprint was considered with regard to the DMRB[5] screening methodology which examines potential air quality impacts of vehicle emissions. It has been used because it provides a relevant methodology for assessing the impact of Project related transportation on air quality.

The DMRB screening methodology was developed for use by the UK's Highways Agency, but is widely used as a tool for assessing the potential impacts as a result of an increase in vehicles movements to nearby existing sensitive receptors.

The DMRB methodology begins with a screening exercise. This establishes whether there is likely to be a significant impact on air quality, as a result of an increase in vehicles associated with a project. The first part of the screening exercise is to identify if there will be a daily increase of more than 1,000 vehicles or more than 200 trucks associated with the Project. In addition, all relevant existing sensitive

[5] Design Manual for Roads and Bridges LA 105 2019

human and ecological receptors need to be identified. DMRB states that only receptors within 200m of a route affected by a Project should be considered.

Should any of these criteria not be met, the potential air quality impact of the vehicles on the route is considered to be neutral and no further assessment is required.

For the Project the main vehicle traffic flow will be along the mine haul roads leading from the mine to the ore preparation facilities. The combustion/gas emission receptors closest to the haul road are located in the town of Tisovci and between Tisovci and Bijelo Borje, located approximately 20m and 7m away, respectively. In terms of the DMRB methodology, this receptor is located less than 200m from the road combustion source, however there are expected to be only 90 trucks per day. Therefore, the air quality impact on all receptors is considered neutral using the DMRB method.

Nutrient enrichment to sensitive habitats may occur as a result of transport emissions nearby. The forest habitat is considered the least sensitive due to its existing degraded state, with the open grassland and herbaceous vegetation potentially the most susceptible. With habitat management in the form of cutting and removal of arisings/grazing, the impact of any increase in nutrient deposition associated with the Project is expected to be negligible in the long term. This is fully defined in Chapter 5.4 biodiversity impact assessment.

Applying the ESIA impact assessment methodology described in Chapter 5.1 and refined by Table 5.4.1 and Table 5.4.2, receptor sensitivity is Medium, impact magnitude is Negligible, and **Impact significance is negligible**. The effect of mobile plant combustion emissions is therefore considered **insignificant**.

5.5.5.2 Stationary Combustion

The project will not have any diesel powered generators for onsite power generation, although there could be back-up facilities for use in an emergency.

5.5.6 Impacts associated with Nuisance Odours

Domestic wastewater and sewage are anticipated as being handled via septic tank systems at relevant areas in the mine area and via a package-design wastewater treatment plant. Sources of nuisance odours include vehicle and process emissions, but facilities with the most likelihood of causing significant nuisance odours, should appropriate operations not be maintained, include the sewage treatment systems and domestic waste storage ahead of disposal. Improper operation of these facilities has the potential to cause moderate short-term local impacts to aesthetic air quality, and therefore appropriate mitigation measures will be implemented as detailed in the following section.

5.5.7 Mitigation Measures for Air Quality Impacts

5.5.7.1 Fugitive Dust Mitigation Measures

To decrease potential impacts to air quality to the extent practical, substantial fugitive dust controls have been incorporated into the engineering design, which include:

- Use of water sprays at material stockpile/hopper loading points and other identified dust emission points, updated as required by the AQMP
- Dust raised from unpaved road surface during haulage has been identified as the most significant emission source (Table 5.5.5). In order to remove the risk of unacceptable impact, it will be necessary to provide and maintain sections of hard surfaced road near residential locations and near to particularly sensitive habitats.

Additional dust control measures will be systematically utilised by the Project during construction and operations, as set out in the AQMP; and include:

- **Road control programmes** – Appropriate dust suppression techniques will be undertaken, including spraying roads/vegetation with water and/or application of stabilising agents such as salt (winter), gravel, or environmentally inert chemicals, as appropriate. In addition, adequate equipment and personnel will be supplied to maintain road surfaces to control dust on the haul and access roads;
- **Speed and off-road restrictions** – Establishing and enforcing Project safety rules, including the posting and enforcement of speed limits on Project haul and access roads and restricting off-road travel to the maximum practical extent will limit the potential for additional fugitive dust emissions, as well as public safety hazards. Those employees whose jobs include driving as well as haulage contractors will be advised of the safety rules and that driving off established roadways is not allowed. Instruction on driving safety and observation of speed limits will be included in the new employee orientation and annual refresher training and in task training for specific job assignment. This aspect is developed in the Traffic Management Plan.

5.5.7.2 Combustion Mitigation Measures

Combustion emissions have been reduced for the Project in the following ways:

- Use of modern, energy efficient electrical equipment and mobile plant with fuel-efficient engines;
- Use of equipment exhaust controls. Exhaust controls on mobile equipment must be properly installed, positioned, maintained, and replaced as needed throughout the useful life of the equipment. Procurement of updated equipment with emissions controls and proper operation, care, and maintenance of the equipment will reduce

combustion emissions to acceptable levels for vehicles and generators, as well as allowing the equipment to run more efficiently and increasing its operational lifespan.

5.5.7.3 Nuisance Odour Mitigation Measures

To reduce impacts from nuisance odours sewage treatment facilities will be operated properly and monitored for operational performance, including nuisance odours.

- Project facilities will incorporate appropriate waste storage and handling procedures; and
- Sewage treatment facilities will be operated properly and monitored for operational performance, including nuisance odours.

5.5.8 Residual Impacts to Air Quality

Without appropriate mitigation, nuisance dust and fine particulates could have a **moderate adverse impact** upon on employees and sensitive receptors in the immediate vicinity of the site (humans residing close to the project haul roads and adjacent habitats). The AQMP will therefore be implemented to minimise nuisance dust emissions and control fine particulates. With appropriate mitigation measures it is considered that the impact on flora, employees and human receptors will be of **negligible to minor significance** in both the short term and the long term.

With appropriate management of sewage facilities, nuisance odour-related impacts are considered **negligible and not significant**, as little putrescible waste will be produced. With appropriate mitigation measures applied, the residual impact is considered negligible in both the short term and the long term for all sensitive receptors.

Table 5.5.8 presents a summary of the anticipated air quality impacts, relevant operational phase and planned mitigation measures.

Table 5.5.8: Summary of Air Quality Impacts

Impact	Mining Stage	Impact before mitigation	Key Mitigation	Residual Impacts
Fugitive Dust and PM10 emissions from earth works, loading, haulage, crushing	Construction	Minor	• Enforce speed limits for heavy equipment and general traffic on unpaved roads. • Restrict off-road travel unless absolutely necessary. • Limit number of trips with efficient loading procedures for material transport. • Apply stabilizing agents on high dust areas. • Top-wet truckloads of dusty material. • Spray water on unpaved roads and traffic areas. • Maintain gravel/laterite cover on unpaved roads and traffic areas. • Install dust suppression / control equipment at loading/unloading, storage, and material transfer points. • Dust suppression at the crusher through water sprayers.	Negligible
	Operation	Minor/Moderate	• All of the above mitigation measures. • Use employee personnel protective equipment where required and occupational medical monitoring. • Provide sections of hard surfaced road near residential locations and along the section of road within/near to the mountain hay meadow and hydrophilous tall herbaceous vegetation habitats.	Negligible
	Closure	Minor	• All of the above mitigation measures.	Negligible
Combustion emissions from Engine sources (mobile plant and other vehicles) Emissions	Construction Operation Closure	Minor	• Enforce speed limits for heavy equipment and general traffic on unpaved roads. • Train operators and drivers about maximum idling times. • Install appropriate emissions control equipment on vehicles. • Perform regular maintenance and inspection of vehicles and mobile equipment, including their emissions control systems.	Negligible
Nuisance Odours	Operations	Minor	• Practice appropriate waste reduction and recycling procedures to minimise waste. • Incorporate appropriate waste handling and storage procedures, as per the Waste Management Plan. • Operate sewage treatment facilities properly and monitor operational performance (including odours).	Negligible

Monitoring and Audit

The monitoring and audit planning required to validate the effectiveness of mitigation strategies have been identified.

Table 5.5.9: Air Quality Monitoring and Audit

Air quality, Monitoring and Audit programme and procedures			
Monitoring approach	Baseline	A programme of ambient air sampling has data available from 2020-2021 in order to establish baseline conditions at key locations within the Project licence area (see Chapter 4.7).	
Level 2 Management Plan	The AQMP provides the details of mitigation measures to control emissions of dust, particulates and combustion gases, associated with mobile plant		
Level 3 Standard Operating Procedures	The AQMP will be underpinned by five Standard Operating Procedures that will provide specific guidance on sampling locations and procedures during the construction, operational and closure phases. The level 3 procedures will include the following: • Visual inspection – routine visual monitoring to identify sources of dust emission, these inspection position will be determined to demonstrate coverage of identified sources of dust, including haul roads, crushing plant and load out points. • Meteorological stations – location, download procedures, analysis of results and persons responsible for data collection and dissemination. The maintenance requirements for the met stations will also be identified together with non-conformance procedures. • Location, collection, replacement and analysis of SO_2 and NO_2 samples, to include the procedures for the collection of active tubes (sample number, date, time and location reference), procedure to ensure that tubes are not contaminated between the sampling location and site offices, and procedures for shipment to accredited laboratory. Chain of custody documentation. • Location, collection and replacement of DustScan sticky pads, to follow similar procedures as those for SO_2 and NO_2 sampling. • Environmental sampling and maintenance procedures for periodic TSP, PM10, and PM2.5 monitoring. • The location of the monitoring instruments will be determined in a revision of the Level 2 AQMP. Dependent on suitable positions, this SOP will therefore be informed by an audit of the site at the onset of the operational phase, when the final details of the plan will be designed. The SOP will define the monitoring requirements and periods for the use of the equipment, which will be directed towards areas of the operation where the effectiveness of mitigation measures can be determined, thus providing feedback to the aims and objectives of the AQMP.		
Monitoring strategy			
Visual inspection	Environmental staff	Routine observations developed against a graded system for inspecting and determining whether dust suppression techniques are sufficient or require further action.	This dynamic audit would be undertaken through a schedule to be developed in the air quality management plan and will require the training of environmental staff, shift supervisors and mine management to develop a consistent approach to auditing dust emissions. A record to be made of any exceptional events that trigger additional dust management should be kept together with approach to mitigation.
NO_x and SO_x	Gradko tubes (or equipment with similar specifications for continuous monitoring)	Acrylic tubes designed for passive sampling of airborne gases. The tube contains an adsorbent material which can then be analysed by UV/Visible Spectrophotometry with reference to a UKAS (United Kingdom Accreditation Service) calibration	Recommended exposure length typically in the order of 4 weeks, after which time they are removed from their sampling location and returned to the manufacturer's accredited laboratory for analysis. Continuous use, reviewed annually.

Table 5.5.9: Air Quality Monitoring and Audit			
Air quality, Monitoring and Audit programme and procedures			
		curve, appropriate to this methodology.	
Dust	Using Frisbee dust deposit gauge and sticky pads.	Frisbee gauge consists of an upturned Frisbee with a loose-weave foam insert, mounted on a tube which feeds a 5 – 10 litre collection pot. The dust gets caught in the foam and washed through into the pot by precipitation. The contents of the collection pot are filtered, and the particulate on the filter used to determine monthly deposition. Monthly deposits should be stored and bulked quarterly to be tested for heavy metals at specified points.	%EAC is monitored over a period of 1 month after which the pads are returned to an accredited laboratory for analysis. The resultant measurement will be expressed as %EAC/day. Comparison of the monitoring data, compared to the baseline condition can be used to determine whether a soiling, or significant dust impact has occurred. Continuous use, reviewed annually.
Particulates	Mobile Sampling	Mobile sampling equipment designed to measure particulates using low volume sampling pumps, which can also recover SO_2, NO_x, CO, O_3, H_2S.	Periodic deployment of a mobile air quality monitoring station Quarterly, subject to review of results.

5.5.9 Conclusions

An impact assessment has been undertaken to assess the effects of construction, operation and closure of the Project with regard to sensitive air quality receptors. The findings of the impact assessment are summarised in Table 5.5.8 above.

The potential impact magnitude of air quality impacts generated by the Project has been assessed at identified sensitive receptors and appropriate mitigation measures recommended to minimise the significance of impacts.

To reduce the potential for air quality impacts at existing community receptor locations around the site and for employees working on the site, extensive mitigation measures and best practice methodology will be adopted by the Project to protect workers and off-site receptors. Chapter 5.4 on biodiversity further addresses impacts to ecological receptors.

With appropriate mitigation measures applied, the residual impact is considered minor to negligible in the short and long term.

5.6 Noise and Vibration

5.6.1 Introduction

This assessment has been undertaken to identify the potential impacts that the proposed Vares Project will have on the ambient noise levels in the areas surrounding the mine and related activities.

The methodology, described in detail below, is based on guidelines of the European Bank for Reconstruction and Development (EBRD), World Bank, International Finance Corporation (IFC) and the World health Organisation (WHO).

5.6.2 Assessment Methodology

5.6.2.1 Impact Significance Criteria

The significance of an environmental impact for noise and vibration is determined by the interaction of the magnitude of change in ambient noise level and the sensitivity of the receptor. The methodology for determining sensitivity of the receptor and the magnitude of impact with regard to noise are shown in Table 5.6.1 and Table 5.6.2, respectively.

Table 5.6.1: Methodology for Determining Sensitivity

Sensitivity	Methodology
High	Receptor/resource has little ability to absorb change without fundamentally altering its present character or is of international or national importance. For example, hospitals, residential care homes, and internationally and nationally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).
Medium	Receptors/resource has moderate capacity to absorb change without significantly altering its present character. For example, residential dwellings, offices, schools, and play areas. Locally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).
Low	Receptor/resource is tolerant of change without detriment to its character or is of low or local importance. For example, industrial estates.
Negligible	Receptor/ resource is not sensitive to noise.

Table 5.6.2: Methodology for Determining Magnitude of Noise Impact	
Impact	**Change compared with baseline or difference in predicted level compared to guideline level**
Large	Impact resulting in a considerable change in baseline environmental conditions predicted either to cause statutory objectives to be significantly exceeded or to result in severe undesirable/desirable consequences on the receiving environment.
Medium	Impact resulting in a discernible change in baseline environmental conditions predicted either to cause statutory objectives to be marginally exceeded or to result in undesirable/desirable consequences on the receiving environment.
Small	Impact resulting in a discernible change in baseline environmental conditions with undesirable/desirable conditions that can be tolerated
Negligible	No discernible change in the baseline environmental conditions, within margins of error of measurement

For the purposes of this noise assessment, the level of significance for noise effects will be determined by using the magnitude criteria detailed in Table 5.6.2 above, together with the sensitivity of the receptor shown in Table 5.6.1, as detailed above, using the significance matrix detailed in Table 5.6.3.

Table 5.6.3: Impact Significance Matrix				
Magnitude	**Sensitivity**			
	High	**Moderate**	**Low**	**Negligible**
Large	Very High	Major	Moderate	None
Medium	Major	Major	Moderate	None
Small	Moderate	Moderate	Slight	None
Negligible / Beneficial	None	None	None	None

The threshold between insignificant and significant impact lies between "Moderate" and "Major", shown on Table 5.6.3. Moderate impacts might be noticeable and intrusive but may cause a small change in behaviour. Major impacts might be noticeable and disruptive and might cause a material change in behaviour or attitude.

5.6.2.2 Regulatory Context

An assessment is required to consider any potentially noise sensitive areas in the vicinity of the mining operations. The potential effects of the future sources of noise on the existing sensitive receptors have been assessed with reference to the following guidance and local regulations.

- International Finance Corporation – Environmental, Health, and Safety Guidelines, Noise Management, April 2007 (IFC);
- Law on protection against noise "Official Gazette of F BiH" No 110/12
- Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise
- Directive 2000/14/EC Noise of Equipment for use outdoors
- World Health Organisation's Guidelines for Community Noise 1999 (WHO).

International Finance Corporation – Environmental, Health, and Safety Guidelines, Noise Management, April 2007 (IFC)

The guidance document sets out limits for noise impact at sensitive receptors within the vicinity of mining operations and states;

"Noise impacts should not exceed the levels presented in Table 1.7.1 or result in a maximum increase in background noise levels of 3 dB at the nearest receptor location off-site."

The Table 1.7.1 noise level guidelines are presented within Table 5.6.4;

Table 5.6.4: Noise Level Guidelines

Receptor	One Hour LAeq(dB)	
	Daytime 0700 - 2200	Night-time 2200 - 0700
Residential; Industrial; Educational	55	45
Industrial; Commercial	70	70
Guideline values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.		
For acceptable noise levels for residential, industrial and educational settings refer to WHO (1999).		

World Health Organisation's Guidelines for Community Noise 1999 (WHO)

The WHO Guidelines for Community Noise 1999 suggests guideline values for internal noise exposure which take into consideration the identified health effects and are set, based on the lowest effect levels for general populations. Guideline values for annoyance which relate to external noise exposure are set at 50 or 55 dB(A), representing daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed respectively.

The following guideline values are suggested by WHO:

- 35 dB $L_{Aeq(16\ hour)}$ during the day time in noise sensitive rooms;
- 30 dB $L_{Aeq(8\ hour)}$ during the night-time in bedrooms;
- 45 dB $L_{Amax(fast)}$ during the night-time in bedrooms;
- 50 dB $L_{Aeq(16\ hour)}$ to protect majority of population from becoming moderately annoyed; and
- 55 dB $L_{Aeq(16\ hour)}$ to protect majority of population from becoming seriously annoyed.

It should be noted that the WHO night-time internal guideline value for bedrooms is equivalent to 45dB L_{Aeq} outdoors, which is also quoted as the IFC night-time guidance level. The noise level criteria used in this assessment for comparison with outdoor construction and operational noise level predictions are, therefore;

- 55 dB L_{Aeq} Daytime; and
- 45 dB L_{Aeq} Night-time.

Law on protection against noise "Official Gazette of F BiH" No 110/12 - Table 2 Ref III"

In addition to international guidance, national guidance relating to permissible levels of noise exist. Noise standards in the Vareš municipality are presented in Table 5.6.5;

Table 5.6.5: ***Law on protection against noise "Official Gazette of F BiH" No 110/12 - Table 2 Ref III***

Type of Premises or Area	Time	LAeq dB(A)	LAmax dB(A)
External noise limits for residential, education and health institutions, public green space, and recreation areas.	07:00 -23:00	55($L_{Aeq,15\ min}$)	70
	23:00 – 07:00	45($L_{Aeq,15\ min}$)	

It should be noted that the national regulatory limits provided in Table 5.6.5 include maximum instantaneous noise impact limits. However, this assessment will be based on the average L_{Aeq} noise impact during the day and night-time periods and is therefore not comparable with the L_{max} limits presented in Table 5.6.5. Further, the L_{Aeq} average national regulatory limits correlate directly with the IFC EHS Guidelines as presented within Table 5.6.4, when considering general residential, industrial and educational receptors.

5.6.3 Existing Site Conditions

5.6.3.1 Baseline Summary

Baseline noise data has been captured by Zenica Institute. The monitoring consisted of two external baseline locations with measurements undertaken during the daytime and night-time. Noise surveys have been undertaken from 8th May to 11th June 2020 and from 15th to 23rd September 2020 and one night-time noise survey in December 2020. The measured noise levels include noise from existing noise sources such as road traffic. The noise monitoring has been undertaken to provide a baseline against which to determine the potential impact of noise at the receptors. A summary of the noise monitoring results is presented in Chapter 4.8.1 noise baseline.

All noise measurements were undertaken using Class 1 noise monitors and following the procedure included in BAS ISO 1996-1:2005; BAS ISO 1996-2:2008 – Noise description and measuring. All noise measurements were undertaken with the microphone between 1.2m and 2.0m from the ground and more than 3.0m from any other reflecting surface in accordance with the guidance stated in Law on Noise Protection ("Official Gazette of F BiH" No 110/12).

The baseline noise survey was undertaken early in project development process, since then the scope of the developments has changed and adapted to address potential impacts and to better suit the needs of the project. Therefore, not all of the monitoring locations are considered to be relevant to assessing the potential impact on the existing residential dwellings but allow for context of the surrounding area.

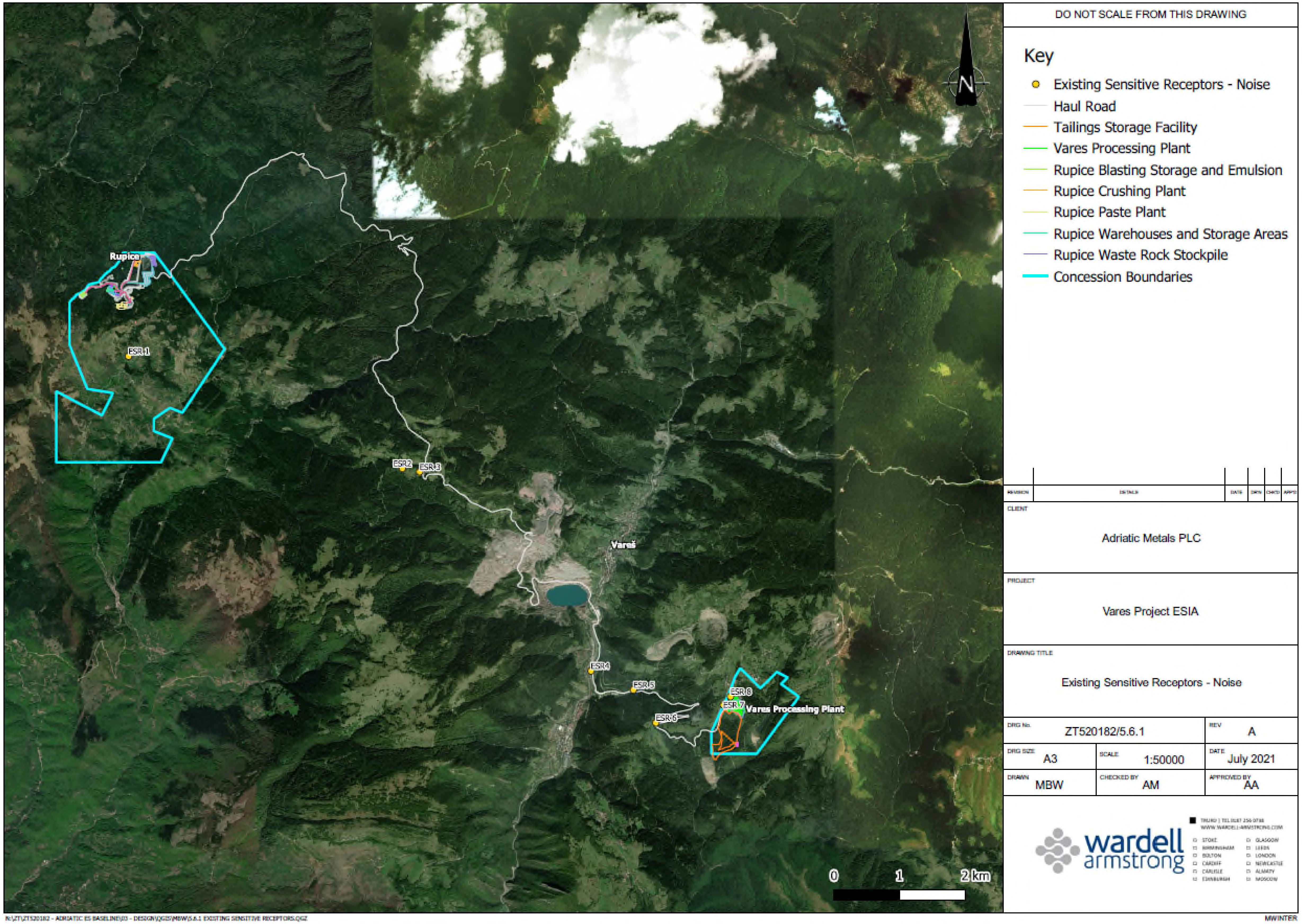
5.6.3.2 Sensitive Receptors

The locations considered to represent the nearest residential properties to the project area have been identified as Existing Sensitive Receptors (ESR), and their locations, as used in the assessment, are shown in Table 5.6.6.

All closest sensitive receptors, bar one, are residential properties, therefore, the sensitivity of each is considered medium (see Table 5.6.1). The one commercial property, the location of Vares municipality contractors, JKP Vares, has a low sensitivity.

Table 5.6.6: Existing Sensitive Receptors

Receptor	Receptor Type	Co-ordinates		Closest Project Area	Distance to Project (m)
		X	Y		
ESR 1	Residential	278637	4896957	Rupice Mine	441
ESR 2	Residential	283029	4894683	Haul Road	49
ESR 3	Residential	283299	4894617	Haul Road	69
ESR 4	Residential	285831	4891505	Haul Road	17
ESR 5	Commercial	286446	4891153	Haul Road	14
ESR 6	Residential	286786	4890652	Haul Road	7
ESR 7	Residential	287835	4890897	Processing Plant	64
ESR 8	Residential	287929	4891029	Processing Plant	33



Drawing 5.6.1: Existing Sensitive Receptors for Noise

5.6.4 Noise and Vibration Sources

5.6.4.1 Construction and Closure Generated Noise and vibration

During the construction and closure phase, any work carried out at the project is likely to generate noise and vibration that may propagate beyond the proposed development boundary. Activities on the site that could give rise to significant impacts, could include (but are not limited to) the following:

- Site preparation (e.g. ground excavation, levelling of ground, trenching, trench filling, unloading and levelling of hardcore and compacting filling);
- Construction of the buildings, including piling, fabrication processes (e.g. planning, sanding, routing, cutting, drilling and laying foundations);
- Installation of the processing plant;
- Underground blasting;
- Dismantling and removal of surface infrastructure at Rupice during closure; and
- Earthworks associated with landscaping activities at Rupice during closure.

The levels of noise experienced at the receptor closest to the proposed development will depend on the sound power levels of the machines used, the distance to the properties, the presence of screening or reflecting surfaces and the ability of the intervening ground or objects to absorb the propagating noise.

Noise and vibration generated by the construction and closure phases of the development may have a short-term, adverse impact at the above sensitive receptors. To minimise the potential levels of noise and ground borne vibrations generated by the construction, best working practices will be put in place as part of the construction noise and vibration management plan and will be carried through to the conceptual closure plan.

5.6.4.2 Operational Project Activities Generating Noise and Vibrations

During operations, potential activities that are likely to affect the ambient noise levels and have the potential to cause ground borne vibration, will result from operations including product extraction, waste extraction, stockpiling, crushing, hauling, stacking and loading activities. Exhaust and intake fans and fixed plant and infrastructure at both Rupice and the Vares Processing plant are additional potential sources of noise. Mining, processing and haulage will occur 24 hours a day, for approximately 365 days per year, resulting in the potential for increased noise levels during both day and night-time periods. Upon closure no residual noise sources are expected to remain.

There are several haul routes with different purposes for the Project: between the Rupice site and the Vares Processing Plant, Vares Processing Plant to Droskovac Rail Loadout, and the Vares Processing Plant to the TSF. Haul trucks with a carrying capacity of up to 30 tonnes will transport the ore and waste material between the processing plant and Rupice Mine area.

Mobile equipment operations, which are predicted to increase the ambient noise levels in the project area, include:

- Light vehicles – supply vehicles used for the transportation of tools and staff;
- Haul trucks – transportation of materials i.e. material ore and tailings material;
- Heavy mobile equipment – drill rig, excavators, dozers, wheeled loaders etc; and
- Reversing alarms.

Noise and vibrations resulting from supply trucks associated with the development, in the form of traffic on public roads, may also affect ambient noise and vibration levels in the vicinity of existing receptors.

Heavy plant and haul trucks will access the site via the public road traffic network, they will stay within the site area for the lifetime of the project. Any subsequent effects on ambient noise levels in the vicinity of the public road network will occur over a short period of time during the setup and decommissioning of the mine. The movement of such vehicles when off the site is considered to be negligible at receptors. Therefore, this effect has not been considered further within this assessment.

It is assumed that the movement of light vehicles, used for the transportation of supplies and site staff along public roads will be restricted to daytime hours for safety reasons. The traffic movements themselves will be of low number and therefore have a negligible impact on any noise sensitive receptors. Therefore, this potential noise source has not been considered further within this assessment.

5.6.4.3 Operational Noise and vibration Sources

The primary noise sources on the surface, the quantity of sources and their sound power levels which are used in the assessment are shown in Table 5.6.7 below. The plant that will be installed below ground has not been considered within this assessment as noise from this plant will not be audible above surface. Noise data has been sourced from WAI archives, together with manufacturer specification sheets and noise levels for standard construction vehicles detailed within BS5228-1:2009 + A1:2014 *'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'* (BS5228-1).

Table 5.6.7: Proposed Plant Operational Phase – Source Sound Power Levels		
Source	**Sound Power Level LW(dB)**	**Quantity of Sources**
Rupice Mine		
Jaw Crusher	124	1
Cone Crusher	124	2
Stationary Screen	109	1
Grader	114	1
Häggloader	122	1
Front Loading Shovel	110	1
Haul Road		
Haul Road Movements	108	4 Movements per Hour
Vares Processing Plant		
Ball Mill	115	2
SAG Mill	115	1
Pump	75	9
Gantry Crane Engine	73	1
Loader 22t	100	1
Loader 30t	97	1
Telehandler 35t	87	1
Forklift 10t	91	1
Forklift 5t	99	1
Forklift 2.5t	90	1

*Denotes sound power levels derived from example noise data of construction vehicles included in BS5228-1

Although there are additional noise sources at the site not included in Table 5.6.7 above, their associated noise levels are considered to be of a lesser magnitude and constitute a negligible contribution to the overall noise levels at the site. This includes plant located underground, staff transport vehicles and material transport trucks. Staff will be transported to and from the project using a minibus, which will travel the haul road four times per day between shift changes and will not significantly impact the noise levels at the existing residential dwellings.

Whilst ventilation fans at the Rupice mine are considered to be a noise source, the emission will be dominated by the crusher and mobile plant on site. Therefore, these have not been considered to be a significant noise source.

The façade of the processing building has been modelled using Kingspan KS1000 RW/ 40 + I + L which provides a Sound Reduction of 39dB Rw[1]. While it is not required that this specific product is used, a similar product which provides the same or better sound insulation performance should be used.

Details of façade product used in the noise model has been detailed in Table 5.6.8 below.

[1] Rw is the weighted sound reduction index typically used to measure the sound insulation provided by windows, ventilation systems or walls.

Table 5.6.8: Distance from Project to Existing Receptors								
Façade	Rw	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
Kingspan KS1000 RW/40 + I + L	39	12	16	30	40	44	51	64

5.6.4.4 Operational Assumptions

The potential impact of operational noise has been predicted by assuming one robust operational phase. This method assumes the worst-case location of the plant undertaking the loudest operation. This approach provides a 'worst-case' noise prediction. This one operational scenario represents the mining phase with the most works scheduled, i.e. years 5-6, and the processing plant operating at full capacity.

The following assumptions have been made through the noise prediction process to ensure 'worst-case' assessments of each scenario are maintained:

- During the operational phases, each item of plant is situated at the nearest possible operating location to the noise sensitive receptors; and
- During the operational phases, all items of plant are assumed to be operating 100% of the daytime and night-time periods.

5.6.5 Noise Predictions

5.6.5.1 Methodology and Assumptions

Calculations have been carried out using SoundPLAN 8.2 environmental noise prediction software which calculates noise propagation to the methodologies contained within ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'. This outlines many attenuation factors that can be used in noise propagation calculations, including, but not limited to, geometrical divergence, atmospheric absorption, ground effect, and screening.

The main factor affecting source noise propagation is the distance between noise source and receptor. Air and ground absorption also influence the transmission of noise, therefore these effects have been predicted using the noise model which conforms to ISO9613. It has been assumed that noise emanating from the Project will remain relatively consistent throughout the year.

The prediction factors outlined above have been used in the model. Details of noise predictions pre- and post-mitigation are found in Appendix 5.6.1.

The following assumptions were made in the prediction of site noise at each of the identified receptors:

- Atmospheric absorption is the attenuation of noise as a result of the atmosphere. Noise propagation through the atmosphere depends on two factors: temperature and relative humidity. In all cases, as stated previously, no specific additional attenuation was used in the predictions;
- Attenuation due to ground effect is mainly the result of the ground surface interfering with the sound propagating directly from source to receiver. Given that the land between the Project and the noise-sensitive receptors is predominantly covered by rock and earth, the ground factor has been set at a conservative 0.5 in accordance with the guidance given in Section 7.3.1 of ISO9613-2:1996; and
- It is assumed that a 5.12m high close boarded acoustic barrier is located between the processing plant and the existing residential properties; the location of this fence is shown in Appendix 5.6.1.

5.6.5.2 Noise Predictions at Existing Sensitive Receptors (ESRs)

Due to the scale of the Project, multiple ESRs have been identified as having the potential to be adversely impacted by the various operations (Table 5.6.6 and Drawing 5.6.1). ESR8 has been identified as the location most likely to be affected by the noise emissions from the Vares Processing Plant. ESR4, ESR5 and ESR6 are the closest receptors to the proposed haul road and are the most likely to be affected by noise emissions associated with vehicle movements on this road. ESR1 is the closest existing residential dwelling to the Rupice Mine and is most likely to be impacted by the mining operations. Therefore, these locations will be investigated in detail.

Predictions of noise from peak operations at the Project site are detailed in Table 5.6.9. A comparison to the existing background noise level has been undertaken in Table 5.6.10, however it should be noted that background noise levels surrounding the project are exceptionally low, especially during the night-time period, measuring as low as 18.8dB L_{90}. It is generally accepted that the typical limit for human hearing is 20dB anything below this would likely be inaudible. Therefore, any movements on the haul road would exceed the background noise level by more than 3dB. Therefore, it is considered to be unreasonable to use a noise limit based on an increase of 3dB above background.

Table 5.6.9: Noise Predictions Compared to IFC Guideline Noise Levels						
Receiver	**Daytime dB LAeq,16hour**	**IFC Daytime Noise Limit**	**Daytime Exceedance of IFC noise limit**	**Night - time dB LAeq, 8 hour**	**IFC Night-time Noise Limit**	**Night- time Exceedance of IFC noise limit**
ESR1	37.7	55	-17.3	37.7	45	-7.3
ESR2	40.5	55	-14.5	40.5	45	-4.5
ESR3	37.5	55	-17.5	37.5	45	-7.5
ESR4	49.6	55	-5.4	49.6	45	4.6
ESR5	49.8	70	-20.2	49.8	70	-20.2
ESR6	55.0	55	0.0	55.1	45	10.1
ESR7	42.4	55	-12.6	42.4	45	-2.6
ESR8	43.8	55	-11.2	43.7	45	-1.3

Table 5.6.10: Predicted Noise Impact Compared to Baseline Noise Survey						
Baseline Survey	**Lowest Measured Daytime Level**	**Predicted Daytime Noise Level**	**Lowest Measured Night-time Level**	**Predicted Night-time Noise Level**	**Daytime Exceedance**	**Night-time Exceedance**
N4	20.4	49.6	N/A	49.6	29.2	N/A
N5	42.4	42.4	18.8	42.4	0	23.6
AQN7	36.2	49.6	N/A	49.6	13.4	N/A
AQN9	32.4	37.7	N/A	37.7	5.3	N/A

The predicted noise level from the proposed operations at the existing sensitive receptors, due to peak operational activity, will be equal to or below the recommended daytime noise levels detailed within IFC, WHO and "Official Gazette of F BiH" No 110/12 at all ESRs. It should be noted that these predictions represent a "worst-case" scenario and that for the majority of the operational phases the noise impact at sensitive receptors is likely to be less.

However, during the night-time period the dwellings at ESR 4 and 6 will exceed the recommended night-time noise levels detailed within IFC, WHO and "Official Gazette of F BiH" No 110/12.

Therefore, to consider the potential exceedance in more detail the internal noise level detailed in WHO has been calculated. It is generally agreed that a partially open window, when used for ventilation, provides approximately 13dB of attenuation. Therefore, the internal noise level during the night-time has been calculated and compared to the internal guideline noise levels in accordance with WHO. The results are detailed in Table 5.6.11.

Table 5.6.11: Internal Noise Level					
Receiver	Night - time dB LAeq, 8 hour	Glazing Attenuation	Internal Level	WHO Noise Limit	Exceedance
ESR4	49.6	13	36.6	30	6.6
ESR6	55.1	13	42.1	30	12.1

As shown in Table 5.6.11 the internal noise level at ESR 4 and 6 will exceed internal noise levels with an open window. Therefore, it is recommended that mitigation measures are installed at the residential dwellings on a plot-by-plot basis. Details of the mitigation measure required have been set out in section 5.6.6 below.

When comparing the predicted specific noise levels associated with the Project at ESRs with the IFC guidelines, the magnitude of the noise impact of operational phase is considered to be **negligible** at the majority of the existing sensitive receptors with the exception of ESR 4 and 6. Without the installation of the correct mitigation measure the impact is considered to be **major;** however, with the correct mitigation measures in place the noise impact at ESR4 and 6 can be reduced to a lower impact. The significance of this impact is **moderate**, when compared to the sensitivity of the receptor using Table 5.6.3.

Standard noise mitigation and best practices for worker exposure will be adopted from the health and safety management plan.

5.6.5.1 Noise Predictions at Existing Sensitive Receptors (ESRs)

Human perception of vibration is extremely sensitive. People can detect and be annoyed by vibration before there is any risk of structural damage. Cases where damage to a building have been attributed to the effects of vibration alone are extremely rare; even when vibration has been considered to be intolerable by the occupants.

It is not possible to establish exact vibration damage thresholds that may be applied in all situations. The likelihood of vibration induced damage or nuisance will depend upon the nature of the source, the characteristics of the intervening solid and drift geology and the response pattern of the structures around the site. Most of these variables are too complex to quantify accurately and thresholds of damage or nuisance are, therefore, conservative estimates based on a knowledge of engineering.

Where ground vibration is of a relatively continuous nature, there is a greater likelihood of structural damage occurring, compared to transient vibration. For example, that caused by transiting vehicles. BS5228-2 suggests that the onset of cosmetic damage is 15 mm/sec (15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz for residential or light commercial type buildings).

Wardell Armstrong International's (WAI) archives contain field trial measurements of ground vibration associated with types of machinery likely to be used during the construction of the proposed development. The representative measured levels made by WAI using a Vibrock B801 Digital Seismograph are set out in Table 7.9.

Table 5.6.12: Measured vibration levels of plant under normal operating conditions			
Plant Type	**Distance from Source**		
	10 m (mm/s)	**20 m (mm/s)**	**30 m (mm/s)**
25-30 tonne excavator	0.175	0.075	Background
25 tonne dumptruck (Volvo A25) Loaded Empty	 1.000 0.225	 0.150 0.050	 Background Background
Dozer	1.050	0.400	Background
Vibrating roller Drum Vibrator on Vibrator off	 4.470 0.500	 3.270 0.150	 2.350 0.050
Loading shovel	1.025	0.150	Background

Owing to the distances between the Rupice mine and the existing residential dwellings it is considered unlikely that the mining activities will generate vibration levels greater than the background.

The haul road movements are highly unlikely to cause an adverse impact at the existing residential dwellings due to the infrequency of the vehicle movements. It is likely significantly lower than the level required for structural damage to occur. However, best practice measure should be implemented where possible and the space between the haul road and residential dwelling maximised as far as practicable.

Underground blasting at the Rupice mine has the potential to cause a vibration impact due to ground borne vibration, however the closest existing sensitive receptor lies approximately 441m from proposed mine it is highly unlikely exceed the background level at the existing sensitive receptors.

The affected sensitive receptor is medium sensitivity, and it is considered that the magnitude will be Negligible due to the distance of sensitive receptor. To minimise the potential levels of vibration generated by the construction works, however, best working practice will be put in place.

5.6.6 Mitigation Measures

5.6.6.1 General Mitigation Measures

General mitigation measures, applicable to all noise sources, which will be implemented to address identified impacts for the construction and operational phases of the Project are summarized as follows:

Design Mitigation

- Designed mitigation measures prior to start upshould be in place before tests on the crushing plant are commenced. Soil mounds constructed adjacent to haul roads could be located to provide additional attenuation between the haul trucks and the nearest community;

- During the detailed design stage, the use of noise barriers, baffles, or enclosures to provide abatement for noisy equipment such as generators, compressor, pumps and gearboxes should be considered;
- Adequate distance between the stationary noise sources and the nearby communities should be maintained; and
- The façade of the proposed processing building should provide a minimum of 39dB Rw.

Operational Plant Mitigation

- All mobile plant should undergo regular inspection and maintenance to ensure that the installed mufflers are performing to an adequate standard and that worn parts are replaced;
- Hard surface roads will be installed and maintained to reduce road noise and dust;
- Design of the haul road should minimise excess revving;
- A speed limit should be imposed to minimise aerodynamic noise.

During operations, the following noise abatement best practice measures will be implemented:

- Workers will be trained in noise abatement best practices, including avoiding unnecessary revving of engines and switching off equipment when it is not required;
- Haul routes will be well maintained and where steep gradients are required operatives will be trained to minimize engine noise through avoiding unnecessary revving etc;
- Drop height for materials will be minimised;
- Vehicle and plant start-ups will be sequenced to avoid simultaneous noise bursts;
- All vehicles will be fitted with reversing alarms set at lowest level subject to health and safety considerations;
- Provide an air inlet silencer and exhaust silencers for stationary combustion engines and other units (for example generators);
- Perform regular inspection and maintenance of material handling vehicles and equipment to ensure that they have quality mufflers installed, worn parts are replaced, and lubricants are applied so that the design noise-output specifications continue to be met;
- When plant equipment has to be replaced, the selected plant will have a sound power level equal to or less than the plant that it is replacing;
- Employees and contractors involved in mining and blasting operations will be issued with and wear appropriate hearing protection in high-noise areas. Such areas will be designated by signage in the appropriate language, and employees and contractors will be trained in hearing protection procedures;
- The static plant located in the processing areas will be housed within a building, and breakout points in the facade of these buildings (i.e. doors, windows etc.) will be minimised, as well as minimising the reverberant noise inside the buildings, which will be controlled through sound absorptive material;
- Complaints related to noise associated with any of the project activities will be monitored through the stakeholder engagement activities and the Project's complaints and grievance process, including the use of drop boxes to encourage comments on performance;

- Noise monitoring will be undertaken in accordance with the Noise Management Plan and following any complaints from within the affected community receptors;
- If possible, vehicle movements should be limited during the weekend and night time periods to reduce the noise impact during the quieter periods.
- Noise monitoring should be undertaken and investigated in the event of a complaint, and
- All measured data will be logged and maintained as a record for the site EMS, which should be available on request and published annually for the duration of the Project.

The following general measures will be implemented to minimize transportation-related noise impacts associated with the Project:

- Enforce speed limits in relation to road conditions and location of sensitive receptors such as populated areas;
- Maintain access road surfaces in good repair to reduce tyre noise; and
- Ensure continuous traffic flow to avoid prolonged idling.

5.6.6.2 Residential Mitigation Measures

As detailed in Section 5.6.5, mitigation measures are required to meet noise guideline levels within the dwellings at ESR 4 and 6. Two alternative forms of mitigation will reduce the significance of the impact sufficiently.

It is recommended that a 2.5m high acoustics barrier is installed between the haul road and ESR4, as residential buildings are present at this location, assuming adequate space to install an acoustic barrier. The choice may be given to the residents to whether an acoustic barrier is installed, or an alternative glazing and ventilation scheme is installed. The residential dwelling (holiday property) at ESR6 will require the installation of the glazing and ventilation scheme.

The acoustic barrier can consist of either an earthen bund or close boarded acoustic fencing. If an alternative glazing and ventilation scheme is used to mitigate the noise impact on these properties, the exact glazing requirements will be identified on a plot-by-plot basis. The glazing scheme required will depend on the construction of the building, existing ventilation system and internal room dimension. The attenuation specification of an approximate glazing scheme is detailed in Table 5.6.12 below. The specifications below show the attenuation across the frequency spectrum provided by the glazing schemes. These levels can be compared to the acoustic attenuation in the glazing specification documents. It may be that the existing glazing achieves these specifications however this cannot be confirmed at the time of writing.

The exact glazing scheme required can be calculated by taking into consideration the building composition, dimensions of the noise sensitive rooms and floor layout. The glazing scheme detailed below is based on a standard double-glazing window consisting of two sheets of 4mm glazing separated by a 12mm air gap also known as 4/12/4. The alternative ventilation system should be installed to allow for adequate airflow to the building without requiring windows to remain open.

Most forms of trickle ventilation allow for the windows to be opened when purge ventilation is required. The glazing scheme installed should be equal to or greater than the level shown in Table 5.6.12.

Table 5.6.12: Proposed Glazing Scheme

	Rw	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz
Glazing Scheme	26	12	18	24	20	25	23	29	35	35
Ventilation	39	26	32	39	38	29	47	43	40	40

5.6.7 Monitoring and Audit

The monitoring and audit planning required to validate the effectiveness of the mitigation strategies have been identified in **Error! Reference source not found.**.

<table>
<tr><th colspan="3">Table 5.6.13: Noise Monitoring and Audit</th></tr>
<tr><td colspan="3">Noise - Monitoring Approach</td></tr>
<tr><td>Standard Operating Procedures</td><td colspan="2">The noise assessment detailed in the ESIA will be underpinned by a monitoring plan that will provide specific guidance on monitoring locations and procedures during the operational and closure phases. The plan will include the following:
• Suitable Monitoring Equipment – Class 1 noise meters with environmental monitoring kits will be used for noise monitoring and suitable maintenance requirements and non-conformance events or activities will be identified. Chain of custody documentation will be required if equipment is hired in. The equipment will be calibrated before use and periodically sent to the manufacturer for laboratory recalibration.
• Noise Monitoring Procedures - The noise assessment will define the monitoring requirements and periods for the use of the equipment, which will be directed towards areas of the operation where the effectiveness of mitigation measures can be determined. The procedure will ensure that representative data is collected and suitable records retained throughout the duration of the Project and will include details of:
- suitable monitoring locations;
- duration of monitoring to be undertaken at each location for each identified stage of works; and
- recording of all required noise data including noise level (L_{Aeq}), date, time, weather conditions and any other relevant information.
- guideline noise levels
- action to be undertaken in the event that guideline noise levels are exceeded at identified receptors.
Complaints Procedure –The procedure will detail actions to be undertaken in the event that noise specific complaints are received by the operator either directly or through the dedicated liaison mechanisms implemented as part of the project</td></tr>
<tr><td>Monitoring strategy</td><td>Equipment</td><td>Procedure</td></tr>
<tr><td>Noise</td><td>Class 1 noise meters with environmental monitoring kits will be retained on site and maintained throughout the duration of the Project.</td><td>Noise monitoring will be undertaken at locations considered representative of sensitive receptors closest to the Project periodically through each stage of the proposed Project. Additional monitoring will be undertaken in response to noise complaints at suitable locations.</td></tr>
<tr><td colspan="3">Vibration - Monitoring Approach</td></tr>
</table>

Standard Operation Procedures	The vibration assessment detailed in the ESIA will be underpinned by a monitoring plan that will provide specific guidance on the monitoring locations and procedures during the operational and closure phases. The plan will include the following: • Suitable Monitoring Equipment - seismograph will be used for vibration monitoring at the existing sensitive receptors and suitable maintenance requirements and non-conformance events or activities will be identified. Chain of custody documentation will be required if equipment is hired in. The equipment will be calibrated before use and periodically sent to the manufacturer for laboratory recalibration • Vibration Monitoring Procedures - The procedure will ensure that representative data is collected, and suitable records retained throughout the duration of the Project and will include details of: - suitable monitoring locations; - duration of monitoring to be undertaken at each location for each identified stage of works; and - action to be undertaken in the event that guideline vibration levels are exceeded at identified receptors. Complaints Procedure – The procedure will detail actions to be undertaken in the event that noise specific complaints are received by the operator either directly or through the dedicated liaison mechanisms implemented as part of the project.	
Monitoring strategy	**Equipment**	**Procedure**
Vibration	Vibration meters of a suitable standard and level of maintenance will be used as required. Vibration monitoring will be undertaken in response to vibration complaints at suitable representative locations.	Vibration meters of a suitable standard and level of maintenance will be used as required. Vibration monitoring will be undertaken in response to vibration complaints at suitable locations.

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5.6.8 Residual Impacts

Standard noise mitigation and best practices will be adopted by the Project to protect workers and community receptors.

During the early stages of operation, it is good practice to monitor noise at the nearest sensitive receptors to ensure the predicted noise impact is being experienced within the sensitive areas. This will be done in accordance with the Noise Monitoring and Management Plan.

Additionally, the effectiveness of mitigated noise activities will be monitored via the Project's complaints and grievances mechanism. The summary of residual impacts has been defined in Table 5.6.14.

Table 5.6.14: Impact Summary

Impact	Mining Stage	Impact before mitigation	Key Mitigations	Residual Impacts
Noise on existing community receptors	Construction and Operations	Minor (low)	Perform Regular maintenance and inspection of vehicles and mobile equipment, including mufflers. Enforce speed limits for heavy equipment and general traffic on all roads and maintain roads. Install noise attenuation devices on construction equipment and use temporary barriers where possible to reduce noise propagation. Position stationary noise sources away from residents. Installation of noise insulation should be installed to the main processing building as detailed in Table 5.6.9 Implement Noise Management Plan.	Minor (low)
	Haul Road	Major	Engage with occupants of ESR 4 and 6 to develop appropriate noise mitigation measures, such as installing an acoustic barrier between the haul road and the residential dwellings or an improved glazing and ventilation system at ESR 4 and install additional glazing and ventilation (air conditioning) for ESR6 as detailed in Section 5.6.6.	Moderate
Vibration on existing community receptors	Vehicles, Heavy Equipment	Negligible	Schedule high vibration-generating activities to daytime hours. Perform regular maintenance and inspection of equipment in accordance with the Air Quality and Vibration Management Plan. Monitor vibration-related complaints through the Complaints and Grievances Process.	Negligible
	General Project Operations	Negligible	Schedule high vibration-generating activities to daytime hours. Perform regular maintenance and inspection of equipment. Monitor vibration-related complaints through the Complaints and Grievances Process.	Negligible

5.6.9 Conclusions

An impact assessment has been undertaken to assess the effects of the construction, operational and closure phases of the Project with regard to noise and vibration sensitive receptors. The findings of the impact assessment are summarised in Table 5.6. above.

- Noise and vibration associated with the construction operations will be minimised using best working practices which will be put in place as part of the construction noise management plan.
- Noise levels associated with peak operations of the Project are predicted to be below noise levels recommended by IFC, WHO and Official Gazette of F BiH" No 110/12 - Table 2 Ref III, with the inclusion of the proposed mitigation measures which include a 5.12m high acoustic barrier located between the processing are and the existing sensitive receptors. A 2.5m high acoustics barrier located between the haul road and residential properties or an improved glazing and ventilation scheme in properties located at ESR4. Residential dwellings at ESR 6 will require the installation of the glazing and ventilation scheme as detailed in section 5.6.6.1. The specification for the glazing scheme should be identified on a plot-by-plot basis.
- Vibration associated with the operational phase of the project will likely be negligible and should be monitored using a seismograph if any complaints are received.
- No residual noise impact should occur once the project is completed.

To further reduce the potential for noise and vibration impacts at existing receptor locations, standard mitigation measures and best practices will be adopted by the Project as per a Noise and Vibration Management Plan, to protect community receptors. Additionally, the effectiveness of mitigated noise activities will be monitored via the Project's grievance mechanism.

5.7 Hydrology and Hydrogeology

5.7.1 Introduction

This section assesses the potential water resource impacts resulting from the construction, operation, and closure of the Vares Polymetallic Project. For the purposes of the assessment, the project is separated into three components: the Rupice mine site, the Vares Processing Plant (VPP) site, and the Haul Route connecting the two sites. Impacts have primarily been assessed at the Rupice and VPP sites where the main potential permanent catchment changes take place; along the Haul Route the majority of potential water related impacts are addressed through construction and environment management plans.

5.7.2 Methodology

5.7.2.1 General approach

The general methodological approach to the impact assessment is outlined in Section 5.1 and is based on principles, standards and guidelines of prominent International Finance Institutions (IFIs) including the European Bank for Recovery and Development (EBRD), the International Finance Corporation (IFC) and the World Bank (WB). The categories used in Section 5.1 for receptor sensitivity, magnitude of change and impact significance have been adapted for Hydrology and Hydrogeology.

Hydrological effects associated with a development can relate to changes in water quality, quantity and a combination of both. Physical and chemical alterations to a water resource may limit, constrain or prevent its useability by virtue of changes in quality, changes in storage, flow rates and hydrographic disruption such that flooding and low flow conditions are exacerbated. Hydrological systems that are maintained in good status in terms of flow, quality and ecological function can support a range of environmental and ecosystem services including helping regulate soil moisture, habitat integrity, biodiversity, minimising erosion and sedimentation. Existing water users may have formal and informal rights to water resources. Impacts may be latent, i.e. occurring over extended time periods and cumulative when pressure on water supplies is compounded with deterioration of water quality status.

An outline of key general water good practice measures and standards is listed in Table 5.7.1.

Table 5.7.1: Water in the IFC PSs, EBRD PRs and Equator Principles
IFC Performance Standards The original 2012 IFC Performance Standards referred to water as a cross-cutting issue affecting environmental and social risks and impacts. Subsequently, the 2018 revision to the World Bank standards: the *Environmental and Social Framework* has gone further in explicitly identifying expected water requirements for projects in a revised series of **Environmental and Social Standards (ESS)**. In conjunction with the ESS, the 2019 World Bank Group Environmental, Health and Safety Guidelines (**EHS Guidelines**) provide general and sector-specific technical references which the IFC uses during project appraisal. The EHS Sector Guideline for Mining states that mining projects should focus on establishing a water balance to inform infrastructure design, implement circular water management (reuse), avoid over-abstraction, consult with affected communities and implement measures such as stormwater harvesting. Additional good practice measures include segregating clean and contact-water to reduce sediment-laden run-off and improve water resource efficiency. The guidelines emphasise the need for mining operations to treat mine effluent streams to ensure discharges do not result in contaminant concentrations in excess of local ambient water quality criteria. The guidelines require operators to be able to manage storm water flows and ensure drainage and dams are appropriately designed to meet the full hydraulic load contribution from upstream catchments and meet appropriate design criteria for 100-year/24-hour recurrence periods (permanent) and 1 in 25-year recurrence periods (temporary) facilities. Note that the Mining, Water and Waste EHS Guidelines are either pending or undergoing revision to update the guidelines (a process started in 2018) to reflect more up-to-date consultation views. The aspects of the ESS relating to water are summarised below.
ESS1 emphasises that a project needs to understand environmental and social risks and impacts of the project's area of influence and in particular affected watershed.
ESS3 is the main document related to water in terms of it being both a valued resource (used by others) and requiring protection from pollution. ESS3 requires a project-level approach to water resource efficiency and pollution prevention and control. Water Consumption is specifically referenced to by PS3 for projects that are potentially significant consumers of water that may have significant adverse effects on others. In such instances ESS3 requires projects to develop a detailed water balance, identify opportunities for efficiency improvement, measure and benchmark water use against available industry standards (for example per ICMM, GRI and CPD Water Reporting Standards).
ESS3 also requires a project to avoid and/or minimise/ control the release of pollutants to water from routine and non-routine circumstances that may affect local and regional scale water resources. Projects are required to address potential adverse impacts by considering natural baseline conditions, assimilative capacity and cumulative impacts of water use upon communities, other users and the environment.
ESS4 identifies that diminution or degradation of water resources (quality, quantity) may result in health-related risks and impacts to communities through direct and indirect mechanisms including effects on ecosystem systems on which people may be reliant. PS4 recognises that projects need to take consideration of locations where impacts may exacerbate already water-stressed locations affected by climate change.
EBRD Performance Requirements The EBRD Environmental and Social Policy April 2019 states the following in relation to the water environment: • All technically and financially feasible and cost-effective opportunities for water minimisation and recovery in accordance with GIIP will be identified and considered as part of the project design. Where a project specific water supply needs to be developed, the client will seek, where feasible, to utilise water for technical purposes that is not fit for human consumption. • The client will, as part of its environmental and social assessment process, consider the potential cumulative impacts of water abstraction upon third party users and local ecosystems. This assessment will also consider the potential effects of climate change. Where adverse risks and impacts are identified, the client will implement appropriate mitigation measures to mitigate such risks and impacts in accordance with the mitigation hierarchy approach and GIIP.
The Equator Principles recommend in relevant circumstances that ESIA documentation should include water usage, water intensity and water sourcing. The 2019 revision to the Equator Principles has placed increased emphasis on the

Table 5.7.1: Water in the IFC PSs, EBRD PRs and Equator Principles
need to consider and explicitly reference where appropriate climate change risks in terms of physical effects (i.e. increased rainfall intensity and drought) and transitional effects such as restrictions in water use, competition and shifts in supply and demand.
There are numerous Good International Industry Practice (GIIP) guidelines on water management related to extractive industries including the Water Stewardship Framework from ICMM (2020), the IPIECA (2016) Good Practice Guidelines and related materials, and the Australian Govt. (2011- 2016) leading practice handbook series amongst others. As well as reinforcing and providing practical measures to implement the ESS, the GIIP guidelines place emphasis on: • GIIP 1: Water stewardship. Companies and project proponents must act as stewards of the water environment respecting that water is a shared resource and applying their own competency, resources and expertise to ensure equitable water use and rights. • GIIP 2: Technically defensible modelling and assessment. Systematic water risk management needs to develop from understanding detailed, location -specific hydrological behaviour and variability in catchment systems and from this development of technically assured assessments of the interaction a project(s) with its respective catchment(s).

Thresholds and Criteria

The adopted water criteria for the project address BiH regulatory standards and also align with EU water framework directive (WFD) approaches, as defined in Chapter 2. The prescriptive thresholds for Class I and Class II water sources in Bosnia set water quality criteria that should not be exceeded in stream and rivers. Bosnian regulations specify the calculation by which minimum environmental flows must be set for different water courses. Bosnian source protection zone regulations prevent certain activities occurring within defined groundwater catchment zones of public water supplies. In conjunction with this, the EU WFD seeks to establish good catchment management principles across river basins and requires government agencies to set up 5-yearly catchment plans and improve water quality and resource value by site-specific continual improvement targets and programmes of measures. Activities that could cause derogation of the status objectives (quality, quantity and aquatic health) would therefore contravene the EU WFD standards. The numerical criteria that form these standards for individual chemical parameters are listed in Chapter 4.9 Hydrology and Hydrogeology Baseline.

Study Area

The hydrology and hydrogeology assessment considers the surface and sub-surface footprint of the underground Rupice Mine and similarly the VPP, both with associated infrastructure and the Haul Route connecting these two project areas. The study area encompasses an area within an 8km radius of the Rupice Mine, and within a 3km radius of the VPP. The assessment has been carried out by means of initial desk-top review of hydrology and meteorological characteristics, initial data collection followed by a formal scoping stage to identify the important catchment features and processes, for example the interaction between stream baseflow, spring discharges and groundwater recharge in a karstic setting. Thereafter the initial data acquisition programme was expanded into an extensive baseline data collection programme comprising new instrumented monitoring points (weirs and groundwater wells), quality assured sampling and analysis, some dynamic programme adaptation, manual and automated instrumentation, modelling, further site survey and analysis of the study area.

5.7.2.2 Methodology for the assessment of hydrology effects

The significance of hydrological effect is determined by a consideration of the sensitivity of the receptor(s) and the magnitude of the effect. Receptor sensitivity scales are provided in Table 5.7.2. The receptor sensitivity scale categories of different surface and groundwater resources, from minor to very high, used in the impact assessment are shown in Table 5.7.2.

Table 5.7.2: Receptor Sensitivity Scale

	Sensitivity of receptor	Surface Water	Groundwater
1	Minor	The water resource is not essential to supporting flora and fauna. The water resource has little or no role in terms of providing services for the Local Community	A non-aquifer or saline or unusable groundwater resource providing insufficient yield for productive purposes and requiring extensive treatment i.e., desalination or equivalent before water can be safely used for any beneficial use.
2	Medium	The water resource supports populations of flora and fauna. Local importance in terms of providing services, but there is ample capacity and/or adequate opportunity for alternative sources.	Either a shallow unconfined aquifer generally considered a minor or secondary resource or a confined aquifer, capable of localised moderate yields (i.e., approximately 1l/sec). Results of water quality samples suggest water is safe for use for domestic and irrigation purposes however treatment is required prior to human consumption.
3	High	A water resource supports significant protected or large populations of flora and fauna. Is relied upon locally without options for alternatives.	Either a shallow unconfined aquifer generally considered a principal resource or a confined aquifer of regional significance. Both aquifers may provide significant baseflow contribution to local springs and surface water and may be used for occasional or local direct abstraction for drinking and domestic use as well as agriculture, stock watering, ecological services. Water quality is generally good and requires minimal treatment.
4	Very High	A water resource which makes up the qualifying feature of a protected area. The water resource supports important (e.g., protected, large populations) of flora and fauna. Highly important water resource, relied upon locally, or is important at a regional or transboundary level for providing services.	An aquifer that supports high yields of good quality water that is already deployed for public water supply. Source protection zones 1 and 2

The methodology adopted for assessing the impact upon the groundwater resource is consistent with the other environmental disciplines examined in the ESIA. The impact assessment is based on the receptor sensitivity (as defined in Table 5.7.2 and the potential magnitude of change. The magnitude and change scale used specifically for water resources in this ESIA is described below (Table 5.7.3) which is consistent with current best practice for water assessment. The magnitude is assessed in terms of the size, scale, duration and reversibility of impact. Table 5.7.3 explains how these criteria are applied to determine the magnitude of change.

Table 5.7.3: Magnitude and Change Scale

Magnitude of Change	General Description of change	Specific to Surface Water	Specific to Groundwater
Negligible	No significant changes distinguishable from natural variability.		
Low	Water quality and quantity will recover rapidly through natural processes and the duration of impact is short (months).	Affects limited stretch / area of watercourse	Results in temporary impact on localised groundwater.
Moderate	Water quality, quantity and the condition of the watercourse is likely to recover through natural processes and the impact is predicted to be medium term (a year).	May affect multiple stretches / areas of a watercourse.	Results in loss of integrity of part of the aquifer and constraints to use by receptors.
High	Potential for water quality and/ or quantity to be permanently impacted.	An entire watercourse may be affected.	Results in loss of integrity of part of the aquifer and prevention of use by receptors.

Once both receptor sensitivity and change criteria have been defined in specific terms that relate to water resources, the two criteria can be combined to provide an assessment of the potential level of impact on receptors (Table 5.7.4) which in turn is used to assess the significance scale (Table 5.7.5). Impact is therefore defined as the combination of the magnitude of change and the receptor sensitivity.

Table 5.7.4: Hydrology Impact Significance Matrix

Receptor Sensitivity	Magnitude of Change			
	Negligible	Low	Moderate	High
Minor	Negligible	Negligible	Minor	Moderate
Medium	Negligible	Minor	Minor	Moderate
High	Negligible	Minor	Moderate	Major
Very High	Minor	Moderate	Major	Very High

For the purposes of the current assessment, and in line with the general methodology outlined in Chapter 5.1, negligible and minor significance will be considered as 'insignificant' impacts and will not require additional mitigation measures. Moderate and major significance will be considered 'significant' impacts and will be subjected to specific mitigation measures to reduce them to acceptable levels.

Potential impacts are considered pre- and post-mitigation. Mitigation measures will be implemented during construction, operational and closure protecting the water environment. Selected aspects of the mitigation measures to implement over time will be included in the Water Management Plan.

5.7.3 Assessment of hydrological effects

5.7.3.1 Overview of effects

The nature of the effects from the project on the surrounding catchments will vary during the construction and operation of the Project. Table 5.7.5 describes in high level (outline form) the aspects of the operations that have potential to affect water resources.

Table 5.7.5: Summary of potential changes relating to different aspects of the development (without mitigation)

Aspect of development	Potential Change
Vares Processing Plant	
Construction	Regulated release of water stored in the existing thickeners (circular open tanks on site) to the Mala river.
	Release of sedimented runoff from construction affecting the water courses in the western river valleys joining the Mala river
Operation	Release of effluents from the VPP affecting Mala river water quality
	Release of acidified / metalliferous drainage from stockpiles affecting Mala river water quality
	Contamination to groundwater
Closure	Continued release of contaminants to ground or surface water
	Flooding risk from the site to local inhabitants or critical infrastructure i.e., the dry stack TSF river valley
Rupice Underground Mine	
Construction	Release of sedimented water and run-off from the site groundworks and reprofiling to the Hot Stream.
	Contamination to groundwater from stores of fuels, oils, plant machinery
Operation	Sedimented water runoff from site (non-contact water) to the Hot Stream
	ARD release to ground (through base of stockpiles) and to surface water (Hot Stream) from uncontrolled event
	Abstraction of water from Bukovica River changing the baseflow levels and flow rates
	Mine dewatering and subsurface groundwater quality changes affecting aquifer and groundwater users and reducing baseflow in streams and springs
Closure	Mine water rebound and subsurface acidification
	Continued run-off from closed site
Haul Route	
Construction	Sedimented water runoff from road construction affecting Zagarski Potok, potentially culverted.
	Sedimented water runoff from road construction affecting Borovicki river and Bucovica Potok
Operation	Spillage of product, oil during haulage operations affecting water course
Closure	None expected

It is noted that the Mala River within the VPP catchment area has been deemed as a high sensitivity receptor due to the presence of white clawed crayfish which inhabit the stream. These Crayfish are IUCN Endangered, FBiH endangered and an Annex II species. Impacts specifically relating to the white clawed crayfish are assessed in Chapter 5.4.

5.7.3.2 Vares Processing Plant

The brownfield redevelopment of the VPP site includes rehabilitation of the existing thickener tanks. Bottom sediment and supernatant water in the tanks is being managed under a demolition permit which requires Adriatic Metals to dispose of sediment to a temporary managed waste facility before either permanent waste disposal or entraining the material into the project process facility. The supernatant water is consented under the demolition permit to be released at low rates blended with excess storm water flow as site runoff to the western valleys of the Mala river. The volume of water stored in the existing thickeners (circular open tanks on site) is approximately 7500m^3 and has been subject to analytical testing and verification to determine the appropriate blending rates for return of the water. The effect of the managed supernatant water disposal is expected to be **Minor** (High Receptor Sensitivity: the Mala River, Low Magnitude of Change).

Process effluents from the VPP are expected to start being generated after the first 270 days of operations (based on MineSAT™ software modelling) which indicates this is the threshold when ionic concentration build-up from reagent addition start to approach potential saturation limits and hence scale-risk begins to emerge. Although the Vares Process Plant will nominally operate as a zero discharge facility, i.e. the metallurgical water balance is net negative, modelling indicates there could be occasions when reagent waters will need to be refreshed because the ionic concentration of the process water inventory will build up. Anti-scalant will be added periodically. No discharge is proposed at the site. The effect of VPP effluents on the surrounding water environment is expected to be **Minor** (High Receptor Sensitivity: the Mala River, Low (or zero) Magnitude of Change).

During construction, sedimented run-off from site clearance and earthworks will drain to the two valleys located to the west of Tisovci and the TSF valley. Both valleys are currently heavily wooded and steeply sloped with a narrow (<1.5m wide) rocky stream channel along the base. The un-named streams are ephemeral and drain either to the old TSF or direct to the Mala river. The TSF valley is undergoing clearance and groundworks in preparation for the new TSF which includes stream diversion channel designed to keep the new TSF dry. The effect of the construction works site run-off is expected to be **Minor** (Minor Receptor Sensitivity: the ephemeral side valleys, High Secondary Receptor Sensitivity: Mala River Low Magnitude of Change). Due to the sensitivity of the white clawed crayfish and Priority Biodiversity Feature (PBF) of the Mala River, a sediment trap or sedimentation/attenuation pond is required, prior to discharge within the Mala River Catchment.

At the VPP, coarse ore will be brought in by trucks over a site weighbridge accessed from the Vares haul road that runs along the Zagarski stream before it traverses through forested land and minor built up areas to the VPP. Once on the site, the ROM Ore material is placed in two day steel bins (for two days storage). There is a 12 hour emergency stockpile with a concrete bund. No separate storage of tailings will occur except on the concrete floor of the tailings filter building before being loaded into trucks before return to PBF or TSF. There is capacity for 12 hours tailings storage in the building. The coarse stockpiled ore is collected into an ore hopper and then passed through bins and conveyors to the ball mill and from there on into the processing plant. The tailings and ore material within the site curtilage creates a possible risk of acidic and metalliferous leaching discharging with site drainage and runoff into the Mala river. The mitigations built into the project include segregation of contact and non-contact drainage systems and recirculation of sump collected water back into the process water inventory. The ore and tailings material will not be exposed on site and will not exceed two day's material turnover. Retention time on site will therefore be minimal given the turnover of ore material upon arrival. The effect of acidified / metalliferous drainage from stockpiles affecting Mala river water quality is expected to be **Minor** (High Receptor Sensitivity: the Mala River, Low Magnitude of Change).

At the VPP the process and potable water demand will be met by the existing JKP d.o.o. Vares[1] reticulated supply. The VPP site has its own dedicated receiving tank and pipeline supply which has been operating and providing water for the exploration team on-site since 2018 to present. The water is provided by the JKP network of rural waterworks and springs and arrives on site at constant pressure and potable standard and the existing supply pipe is sized up to 9l/s. The expected water demand for the facility is 5.4 l/s. The water originates from the Lalića Mlin spring which has a reported capacity of between 6 to 15 l/s which also supplies water to the neighbouring villages of Pržiće, Tisovici, Bijelo Broje, Mir and Stupni Do. The supply is part of a distribution network with overall excess capacity in the order of 40 to 60 l/s across the Vares municipality and individually in many villages. Additional water can therefore be redistributed and deployed where necessary (Vareš Municipality Development Strategy, 2017–2026). Stupni Do is connected to the Sedra spring source which is operated in conjunction with Crna vrela water supply which is also reported to have excess capacity and yields in the range 6-15 l/s. There will be **no effect** associated to the JKP water supply to VPP. Pipework is already in place, and due to excess water availability, no supply will be taken from other sources.

The project water demand at VPP is almost entirely consumptive i.e. a net negative water demand as water is used along with flotation reagents in the processing plant and continuously lost in entrained moisture content in concentrate product and tailings leaving the plant. The VPP water demand, including operational and unaccounted for losses, is expected to be in the order of 5.4 l/s which appears well within the network capacity. Water will be provided under licence or contract with JKP to ensure an assured reliable supply with minimal change to the existing utility footprint.

The VPP site hydrogeology has been assessed and a relatively deep unsaturated zone is present beneath the site i.e. no water table was encountered to depths of 40m drilling through competent basement rock. The aquifer formation that is nominally present in the environs of the VPP is a low permeability Jurassic-Cretaceous formation with no nearby groundwater receptors. The impact of any potential groundwater contamination from the site is expected to be **Negligible** (Minor Receptor Sensitivity: an unused, low permeability, deep water bearing zone, Low Magnitude of Change).

At cessation of operations at VPP, the plant infrastructure, process and utilities will be decommissioned and removed. The TSF will undergo progressive closure with only the final lift requiring rehabilitation at the end of mine life. The plant site is constructed on an engineered concrete platform with a stormwater tank and drainage that is gravity fed. At the closure and post-closure stage the main feature that could potentially cause contamination to groundwater and or surface

[1] Local water utility company

water is assessed to be leaching from the dry-stack TSF. Initial geochemical test work has indicated that the tailings are potentially acid generating with potential to leach metals from the tailings. Mitigation in design that is being included (WAI, June 2021, Report ST18587 BoD) comprises: i) isolation of tailings from the centre-line small stream running down the valley by construction of an underdrainage system to convey surface water beneath the TSF, ii) a low permeability mineral lining system placed above the underdrainage (synthetic HDPE liner is not suitable for this setting), ii) TSF phases will be closed by blinding over with a 1m thick layer of low permeability soils, encasement of the valley sides with a 2m layer of (carbonate) waste rock and a 0.5m thick waste rock layer on the lift surface. Considering these mitigations in design, the resultant impact from the TSF is expected to be **Minor** (High Receptor Sensitivity: the Mala River, Low Magnitude of Change).

The VPP site elevation creates a ground surface fall away from the nearby Tisovici settlements. Stormwater and runoff is collected by onsite and perimeter drains which outflow to the Mala river. A sediment trap or sediment attenuation pond will be required to mitigate impacts to the PBF of the Mala River. The potential for an intense thunderstorm event to overwhelm the site drainage is low as the drainage has been designed for a 1 in 100 year recurrence interval of a 24hr storm event. The flood risk impact to nearby inhabitants and critical infrastructure is **Minor** (High Receptor Sensitivity: the Mala River and TSF, Low Magnitude of Change).

5.7.3.3 Rupice Underground Mine complex

During construction, sedimented run-off from site clearance and earthworks will drain to settlement ponds with decant to the Vruci Potok (Hot Stream) valley. Surface infrastructure and groundworks are all located on the western side of the Kiprovac ridge, below the ridge line and therefore no expected overland flow routes are present connecting to the Borovicki river. The Vruci Potok is currently subject to frequent heavy sedimentation and turbidity from non-project related forestry activities. One of the first scheduled construction activities will be the excavation and lining of the non-contact water settlement pond which is located at the foot of the site and within a natural drainage line that collects from the site footprint. The settlement pond is designed to retain two days residence water collected from the site and has sufficient capacity to hold a design stormwater flow. The effect of the construction works site run-off is expected therefore to be **Negligible** (Minor Receptor Sensitivity: the Hot Stream (Bosnian Class II stream), Low Magnitude of Change).

The accidental release of anthropogenic contaminants such as oil spills, fuels and other liquids from plant operations during construction will be minimised as far as possible by the development and implementation of construction EMP's. However as the site will be in development and there will be limited hard standing and impervious surfacing, any release will likely infiltrate to ground (a large spill would drain to the settlement pond described above and the incident could be managed by emergency response procedures including sampling during the 2 day residence period, assessing dilution and appropriate actions thereafter including, if necessary, pumping out and tankering). For infiltrating contaminants, the aquifer is confined and therefore protected by overlying low permeability cherts of the Triassic and Jurassic sequences. Groundwater levels beneath the Rupice site have been measured in wells and piezometers at depths between 16.46m (REW1) to 66.3m (BRP3) with an average across all locations (and all rounds) of 43.9m, however the water bearing zone of the aquifer (the 'Anisian upper block T^1_2' unit) is located approximately 120m below ground level. The effect of the accidental spillage of contaminants during construction works impacting the aquifer is expected therefore to be **Negligible** (Minor Receptor Sensitivity: given the intermediate 120m unsaturated zone and aquitard, Low Magnitude of Change).

In terms of operational site drainage and sedimented runoff, the overall site perimeter will be bunded and bermed and no run-off from the flanks of the hillside should interact with the site apart from a central small depression that will either be culverted or comprise rock drain to isolate the occasional ephemeral overland flow expected during major thunderstorms. During operations, sedimented run-off and non-contact water from site drainage will drain to settlement ponds with decant to the Vruci Potok (Hot Stream) valley. The settlement pond is designed to retain two days residence water collected from the site and has sufficient capacity to hold a design stormwater flow. If water is taking longer to settle, it may be necessary to add a flocculant to clarify the water prior to discharge. The effect of the operation's run-off is expected therefore to be **Negligible** (Minor Receptor Sensitivity: the Hot Stream, Low Magnitude of Change).

High grade and medium grade ore is expected to be acid generating with elevated metal content in 'contact water' that may shed from the stockpile facilities as run-off or seepage and collect in a purpose built drainage, storage and treatment system. Low grade ore and waste rock is not expected to be acid generating or have high leachable metals as the mineralisation in the ore is associated with a dolomite host rock that buffers reaction. All stockpiles are 'temporary' with no residual waste rock left after operations as this material will be used for paste backfill. Further detail on potential surface impacts from contaminated ARD and/or metal-rich water from PAF, waste rock and ore sources draining through runoff and seepage at Rupice is described in the Geochemistry section along with mitigations which are further developed in the Mine Wate Management Plan. The key outline mitigations referenced in the Geochemistry section that relate to Hydrology and Hydrogeology are 'Control, contain and manage water seepage and runoff from the facilities; and Prevent migration of metal leachate or ARD to surface water, groundwater and soils.' These are addressed below.

The ore will be recovered from the ROM stockpiles for processing. The waste stockpile and low grade will be present for 8 and 12 years (respectively) before being depleted to zero. These features in terms of drainage design are regarded as temporary and the drainage design criteria is based on meeting a peak flow for recurrence periods of at least a 25-year/24-hour event.

In contrast the rest of the surface drainage and facilities on site are sized for permanent drainage installations and designed for a 100-year/24-hour recurrence period.

The stockpiles are placed on an impermeable pad, raised and bunded above natural ground elevation with an external mechanically stabilised earth (MSE) wall, engineered granular sub-base material and HDPE liner beneath graded locally site-won calcareous gravel dressing 150mm thick. The pad will have a 2˚ moderate fall / grade to the west limiting the potential for ponding and retention/reaction time whilst on the pad. Sub-base drainage and the collector system will comprise perforated and non-perforated drainage pipes embedded into the MSE wall and draining down to the second settlement pond located in the Hot Stream Valley near the lower portal entrance.

The runoff and drainage collected from this contact water system is held in the second settlement pond (with 2 days design storm capacity). The pond is partitioned with a basin for the high and medium grade effluent and another for the low grade and waste rock effluent. The high grade effluent is then pumped to an onsite treatment plant where pH is adjusted and metals fixed by a ferric oxide precipitation process onto an activated lime sludge which is then managed as a semi-solid waste stream and disposed offsite. The sludge quantities are relatively small as the overall average annual run-off flow from the high grade and medium stockpile pad is 1.8l/s[1].

The treated outflow from the treatment plant will then be diverted back to the waste rock pond partition, or if this is dry, the non-contact water settlement pond, for further blending and amelioration with alkaline water before discharge.

As an added contingency, an emergency overspill pond is present where water can be diverted and held if necessary. The effect of the operation's ARD drainage is expected therefore to be **Minor** (Minor Receptor Sensitivity: the Hot Stream, Moderate Magnitude of Change).

The process water requirements for the Rupice site are met by withdrawing 7.6 l/s (655 m^3/d) from a water source that draws from the headwater springs of the Bukovica stream. This asset is owned by JKP Vares (the local water utility) and is located 5km east of the Rupice site and the water will be supplied under a contract arrangement with JKP. The impact (if any) from this arrangement is treated as an Associated Facility issue in the ESIA with JKP responsible for permitting and ensuring environmental compliance. As part of due-diligence however, it appears that the withdrawal of water from this point will not impede upon system capacity (the maximum flow rate is expected to be 15 l/s), other users or downstream receptors. However, further study work is required to confirm this, and will be part of ongoing environmental monitoring and assessment in conjunction with data to be provided by JKP. It is noted there are also two other project water pipelines which are already extant that draw water from the Borovicki (the Sastavce tank) and the Hot Spring (the K1-4 network) that will be retained. Currently these pump and pipeline systems are sized to provide a maximum of 4 l/s intermittently and 0.4 l/s continuously to provide service water exploration drilling activities. Due to problems encountered in 2020 with the Borovicki stream experiencing low flow, these sources can only be used selectively. The effect of water withdrawals on the Bukovica stream river is expected to be **Minor** (Medium Receptor Sensitivity: (for now the Bucovica, nominally part of SPZ 2 of the Bukovica PWS is treated as a Bosnian Class I river), Low Magnitude of Change).

During mining operations, low rates of groundwater are expected to interact with open 'capital' mining sections i.e. the ore winning stopes which are open for a limited period of time before being backfilled with low permeability paste (expected to not exceed 1-3 months of open period). The mine schedule, geotechnics and material management system (wastes and tailings) are optimised for as short a period of time as possible for leaving open the capital sections, whereas the 'development' sections or infrastructure (the decline, services tunnels, ventilation shaft and drives) will be shotcreted and effectively sealed soon after their opening (within 12-48 hours). The overall net inflow rate of

[1] Caveat: Assuming no loses (representing a worst case scenario). This flow rate is based on average rainfall data from Sarajevo, therefore should be taken as a high level estimate.

groundwater into the mine has been assessed analytically based on site-specific tests as between 75 -125 m^3/d water. This is relatively low and represents a near dry mine condition. However, the hydrogeological baseline work also indicates some sections of the underground mine could encounter localised moderate to high inflow rates because a) there are areas of karstic Jurassic limestone nearby that provide a rapid recharge system, and b) there is an extensive fault and gouge zone network that could convey the recharge pulses below the confining geology.

The effect of dewatering upon groundwater supply to other users is expected to be negligible as the zone affected by drainage of these low, passive inflow rates will be localised to the immediate vicinity of the mine. Groundwater flows northward away from known other users such as the residents of Borovica Gonja (public springs) , the Kings Mill bottled water plant (several kilometres hydraulically up-gradient) and the Bukovica Municipal Public water supply located 8 km south and sourced from a large karstic groundwater and streamflow catchment. To formally assess risk however, a numerical groundwater model is being undertaken which will model the radius of influence of the mine drainage and through zone water balances in the model demonstrate where the contributing recharge to the drainage is derived from. The model is based on site-specific piezometry and aquifer parameters all of which indicate no likely interference effect with other receptors by virtue of either flow direction away from water users or low rates of permeability. The groundwater model layering, conceptualisation and parameters have been constructed and model simulations will be undertaken before early construction activities commence. One key mitigating factor is the use of low permeability paste backfill during the course of mining and shot-creting which will limit persistent inflow and keep inflow rates on the whole to a minimum. The rate of groundwater inflow to the mine is capable of being supplied by recharge from outcropping limestone in the immediate vicinity of the mine without recourse to wider drainage or modification of the local regional flow patterns.

This overall model of inflow behaviour has been assessed numerically to inform the mine feasibility studies. The groundwater model also helps illustrate groundwater flow patterns, areas of discharge and the potential fate and transport of groundwater that has undergone water chemistry alteration by the mine. The potential impacts of the underground mine on groundwater receptors is summarised in Table 5.7.6 below and in graphical form in Figure 5.7.1.

Table 5.7.6: Potential impacts of the underground mine to groundwater

Potential Impacts Posed by Mine Development	Source	Pathway	Receptor	Linkage Complete
Disruption to normal groundwater flow paths due to mine dewatering. Could lead to a reduction of source supply to Borovicki public and private water supplies (collectively termed PPWS).	Pumping UG Mine	Diversion of T^1_2 groundwater	Kings Spring, Bukovica Public Water Supply (PPWS) and SPZ	Possible though unlikely as groundwater at the mine discharges into the Trstionica basin (northwards) to be assessed by modelling.
Disruption to normal groundwater flow paths due to mine dewatering. Could lead to a reduction of source supply to neighbouring settlements.	Pumping UG Mine	Diversion of T^1_2 groundwater	Residential Springs	Unlikely as Springs are at higher elevation

Table 5.7.6: Potential impacts of the underground mine to groundwater				
Potential Impacts Posed by Mine Development	**Source**	**Pathway**	**Receptor**	**Linkage Complete**
Groundwater flow disruption from low permeability paste backfill within mined out void. Could lead to a reduction of source supply to neighbouring settlements.	Paste Backfill	Diversion of T^1_2 groundwater	Residential Springs	Unlikely as groundwater would re-equilibrate around paste grouting
Increasing conductivity of the groundwater system through stopes, drives and shafts connecting potentially previously isolated aquifer blocks.	Underground mine	Diversion of T^1_2 groundwater	Springs and PWS	Unlikely as paste backfill will seal sections
Disruption to groundwater system, associated with reduction in recharge as a result of low permeability mine infrastructure at the surface.	Site Infrastructure	Infiltration	Springs and PWS	Unlikely as the site is confined and recharge occurs offsite
Infiltration of potential spills, ARD or discharges of chemicals into groundwater.	Site Infrastructure	Unsaturated zone, preferential pathways etc.	Springs and PWS	Unlikely as the site is confined and 120m unsaturated zone
Groundwater contamination from oxidisation of heavy metals during mine dewatering, during mine water rebound.	Pumping UG Mine	T^1_2 groundwater	Aquifer	Possible, although the abundance of alkaline groundwater may attenuate this. To be assessed by modelling

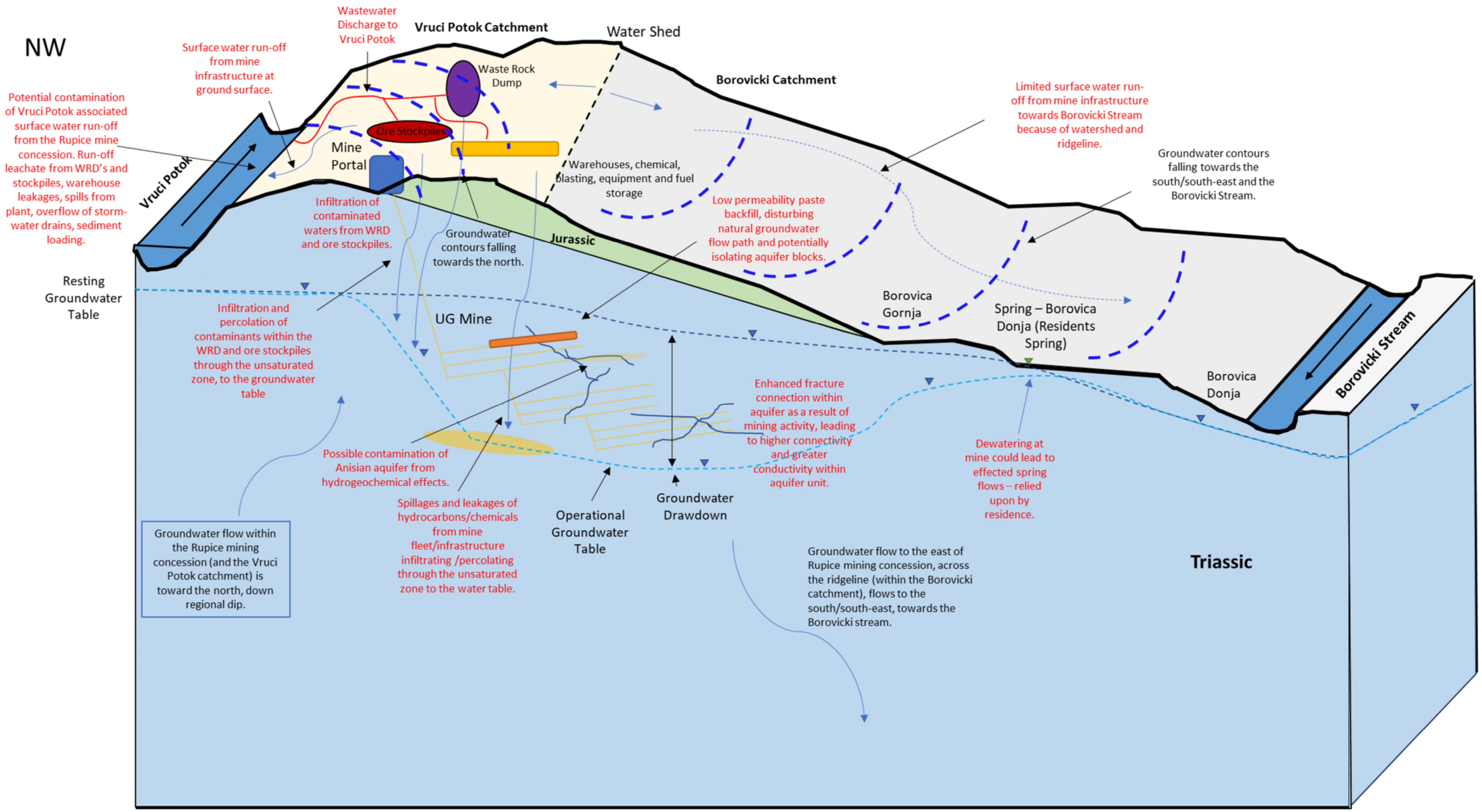

Figure 5.7.1: Conceptual Site Model of Underground Mine impacts

The potential impact from the mine on groundwater is therefore:

i) disruption to the source works located in the Borovicki valley for which the SPZ boundary 3 is used as the compliance point for modelling, and
ii) possible groundwater contamination of the Anisian aquifer from hydrogeochemical effects.

Groundwater numerical modelling is being undertaken to evaluate the plausibility of these scenarios. Results from this numerical modelling will be made available later in 2021, following model refinement and calibration. In addition, extensive geochemical testwork has been undertaken including two physical test models which saturated and semi-saturated ore material in locally derived spring water to emulate the groundwater geochemical contamination scenario. The results from these tests indicated significant subsurface neutralisation is likely. The effect of underground mining on groundwater receptors is expected to be **Minor** (High Receptor Sensitivity: the Aquifer, SPZ Boundary III, Low Magnitude of Change).

The geochemistry assessment has identified that high-sulphide Rupice ore is likely to be acid-generating with metal leaching resulting in effluents draining from the stockpiles with high metal content leachate, particularly Cd, Cu, Fe, Zn, Pb, Mn, Al, Ni and As. The geochemical impact is assessed as moderate to high, which without mitigation, is significant. Consequently, the project will include an onsite ARD treatment plant where pH is adjusted and metals fixed by a ferric oxide precipitation process onto an activated lime sludge as well as the drainage and containment strategies outlined above.

In addition to the elevated base and heavy metals observed from field leachate trials on the ore, thallium was also observed at elevated concentrations in all the leachate samples with a tendency for highest concentrations of between 60 -70 µg/l in the samples from the hanging wall sediments (dolomitic and non-carbonate, codes HWSED, HWSEDNLI respectively), the Fault Zone between Jurassic and Triassic geology (FLTZN) and Jurassic Limestone-Chert formation (LSTCHRT). These named geological units are non-target lithologies for mining and suggest the thallium deportment is not particularly associated with the mineralisation. That the thallium is not related to the ore-forming hydrothermal events, suggests it is a background feature of the geology. The experiments may have enhanced the leaching effects compared to in-situ rock, on account of the rock being broken up with a higher surface area. The results from the groundwater, springs, surface water baseline sampling indicate thallium in the Rupice area is between 7 -23 µg/l and at Veovaca in groundwater we see 7 µg/l. Thallium was reported in surface water at VPP (monitoring point PPV-6) at concentrations between 12-21 µg/l. Studies have shown that when lead-zinc ores are processed via flotation, the total concentration of thallium increases within the process water[2]. Escapes, spills and accidental discharge of untreated, thallium enriched, process waste waters has the potential to contaminate the underlying groundwater as well as surface watercourses. Given the geochemical presence but no clear indication of enrichment in the ore body the effect on groundwater and surface water receptors from

[2] Karbowska, B., et al., 2014. Translocation and mobility of thallium from zinc–lead ores. *Journal of Geochemical Exploration*, 143, pp.127-135.

thallium contamination is expected to be **Minor** (High Receptor Sensitivity: the Aquifer and surface water receptors, Low Magnitude of Change).

At closure stage the remaining open void (that has not been paste backfilled) may flood. The combination of low permeability seals in the mine and the reflooding by alkaline carbonate groundwaters means the effect on groundwater receptors is expected to be **Minor** (High Receptor Sensitivity: the Aquifer, SPZ Boundary III, Low Magnitude of Change).

At cessation of operations at Rupice, the plant infrastructure, process and utilities will be decommissioned and the most significant remaining features will comprise the now depleted and empty stockpile pads. No contaminative material is expected to remain. The resultant impact from the stockpiles is expected to be **Negligible** (Minor Receptor Sensitivity: the Hot Stream, Low Magnitude of Change).

5.7.3.4 Haul Route

During construction, operations and closure of the haul routes, given the inbuilt environmental management mitigations that will be in place including silt traps and construction material control, no significant hydrological change is expected to occur to the associated water courses. Potential effects on aquatic ecology associated with the haul route (Zagarski Potok) are assessed in the biodiversity section. No hazardous materials are expected to be transported along the routes, except fuel for vehicles which will require associated spill kits. Process effluents from the VPP may periodically need to be tankered and co-mingled into the Rupice ARD treatment system to stop scale risk from high concentrations of salts building up in the VPP (i.e. to refresh the process inventory with new water and displace the old water). The tankered effluent constituents are moderate to high concentrations (i.e. over the saturation index) for dissolved calcium, sulphate, zinc and copper (Libertas Metallurgy July 2021). However these do not represent hazardous compounds *per se* and would not constitute a major emergency event if spilled. The resultant impact from the project is expected to be **Negligible** (Minor Receptor Sensitivity, Low Magnitude of Change).

5.7.3.5 Summary

Table 5.7.7 summarises the impact assessment for both Rupice and VPP concessions.

Table 5.7.7. Summary of Impact Assessment for Rupice and VPP

Activity	Potential Effect	Receptor	Sensitivity of Receptor	Magnitude of Change	Impact Significance*	Significant Effect**
VPP						
Brownfield redevelopment of VPP site	Disposal of supernatant water via blending with excess storm water flow as site runoff to the western valleys of the Mala river.	Mala River	High	Low	Minor	No
VPP Operations	Effluent disposal to the Mala River.	Mala River	High	Low	Minor	No
Construction works	Site run-off associated to construction.	Ephemeral side valleys, Mala River	High	Low	Minor	No
Drainage from Stockpiles	Acidified / metalliferous drainage from stockpiles affecting Mala river water quality	Mala River	High	Low	Minor	No
Water Supply	No Effect					
VPP Operations	Potential groundwater contamination from the site .	Groundwater within low permeability, deep water bearing zone.	Minor	Low	Negligible	No
TSF	Impact from the TSF.		High	Low	Minor	No
Flood risk associated to VPP Operations	flood risk impact to nearby inhabitants and critical infrastructure		High	Low	Minor	No
Rupice						
Construction works	Site run-off associated to construction.	Vruci Potok	Minor	Low	Negligible	No
Construction works spillage of fuels, oils, chemicals etc.	accidental spillage of contaminants during construction works impacting the aquifer	Anisian upper block T^1_2' unit Aquifer	Minor	Low	Negligible	No
Run-off	Operational sediment run-off from site.	Vruci Potok	Minor	Low	Negligible	No
ARD	Operational ARD drainage.	Vruci Potok	Minor	Moderate	Minor	No
Water Supply	Water withdrawals on the Bukovica stream	Bukovica Stream	Medium	Low	Minor	No
Underground mining	Groundwater contamination.	Anisian upper block	High	Low	Minor	No

		$T^1{}_2$' unit Aquifer				
Underground mining, WRD and Stockpiling	Thallium contamination to groundwater and surface water receptors	Vruci Potok, Borovicki and Anisian upper block T12' unit Aquifer	High	Low	Minor	No
Mine closure	Underground mine flooding.	Anisian upper block $T^1{}_2$' unit Aquifer	High	Low	Minor	No
Mine closure	Effect associated to stockpiles and ARD.	Vruci Potok	Minor	Low	Negligible	No
Haul Road						
Construction and Operation of Haul Road	Impact of haul road on surrounding environment	surface water courses	Minor	Low	Negligible	No
* Refer to Table 5.7.4: Hydrology Impact Significance Matrix ** Moderate and major significance will be considered 'significant' impacts						

5.7.4 Mitigation Measures

The mitigation hierarchy requires that measures are structured to avoid or prevent, then reduce, isolate and control potential impacts. With regards to protecting water resources, the project will comply with EBRD and EU Water Framework Directive (WFD) policies to ensure all measures are taken to prevent adverse impacts or deterioration.

The WFD is designed to enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands, to promote sustainable water use, to reduce pollution of water and to ensure a progressive reduction in groundwater pollution. The WFD considers protection for all waters, surface water and groundwater, in a single system of water management which is defined by river basins. In summary, the WFD objectives focus on achieving and maintaining good waterbody status for both water quantity and water quality. For good status to be achieved, both the sustainable flow and recharge as well as the absence of pollution is required.

The mine site and all infrastructure/facilities has been/will be designed and will be constructed to avoid impacts to the water environment and to follow and support EBRD principles and WFD objectives. Incorporated design mitigation includes, but is not limited to, the following:

- At VPP and Rupice, non-contact water is drained in trapezoid channels around site, culverted where appropriate and joining natural drainage lines before entering local water courses to minimise catchment size and maintain, as much as much as possible, a natural catchment drainage system;
- Contact water comprising ARD runoff from the Rupice rock dump and ROM stockpiles requires treatment to achieve compliance with the adopted water quality standards

for: pH, suspended solids, heavy metals, sulphate, conductivity and ammoniacal nitrogen. As the water quality objectives are (with the exception of iron) based on total concentration, the water treatment plant will need to be designed to minimise the dissolved metal concentrations;

- There will be no discharge effluent from VPP. The VPP will nominally operate as a zero discharge facility, i.e. the metallurgical water balance is net negative. The process water quality may however need management from reagent addition which results in significant input of calcium, sulphate, zinc and copper. The process designers have therefore recommended implementation of chemical anti-scalant programs to inhibit the scale formation and reduce or eliminate operational issues;
- Sanitary effluent from VPP will be discharged into the existing sewerage infrastructure operated by JKP. Sanitary effluent from Rupice will require treatment using a package wastewater plant with associated sludge and odour management. A modular biological system such as MMBR is envisaged for operations. Wastewater sludges will be collected and disposed by an authorized company (namely JKP doo Vareš) under contract with the project owner;
- Planning and preparation of works to ensure all precautions are taken in order to provide protection to watercourses, groundwater and attenuation features, where relevant;
- A Water and Waste Water management plan will be produced and implemented across the site to prevent adverse impacts to the water environment. Water management measures include, but are not limited to:
    - Diversion of surface water run-off (non-contact waters) away from the mine, stockpiles and WRD via a series of ditches and channels to sediment traps or sedimentation/attenuation pond prior to discharge within the Vruci Potok catchment;
    - Diversion of surface water run-off (non-contact waters) away from VPP infrastructure via a series of ditches and channels to sediment traps or sedimentation/attenuation pond prior to discharge within the Mala River Catchment;
- ARD will be treated prior to realise into the environment. Heavy metals such as iron, zinc, nickel, copper, cadmium can be relatively easily removed using a single stage conventional low density lime neutralization plant treatment process, which is based on a combination of pH adjustment to a circum-neutral pH to reduce metal solubility and co-precipitation with iron;
- Keeping contact water and non-contact water separate;
- Surface water and groundwater monitoring around the site and wider river basin (Borovicki, Vruci Potok, Mala and Bukovica) catchments;
- Groundwater level monitoring within the underground mine area and seepage monitoring;
- General inflow to the underground mine will be routed to a series of underground sumps prior to pumping to surface and inclusion within settlement lagoons prior to re-use within the underground mine;

- Reagents, chemicals, fuels etc will be appropriately stored in designated, suitably bunded containers and placed upon impermeable surfaces, isolated to ensure no contamination to the water environment;
- Appropriate settlement of contact waters bearing sediment will be conducted prior to discharge to the Vruci Potok/Mala;
- The use of integral drip trays (of 110% of the capacity of the fuel tank) for any static machinery/ plant, where practicable;
- All plant, vehicles and machinery will also be regularly inspected for leaks;
- Refuelling will be undertaken in a designated refuelling area and the use of biodegradable oils and lubricants will be considered where possible;
- An adequate supply of spill kits will be employed at each concession area in order to clean up any accidental spillages that may occur throughout construction and operation. Spill kits should comprise oil absorbent granules and pads;
- Where applicable, the facilities have been designed to be hydrologically isolated;
- Pollution incident response plans will identify the type and location of on-site resources (spill kits, absorbent materials, oil booms etc.) available for the control of accidental releases of pollution and other environmental incidents. These resources will be available to contractors at all times of operation; and
- Good international industry practice is to be followed at all times.

A key overarching element of planning for mitigation of all the identified impacts will be the development and implementation of management plans, in particular, but not limited to: Water and Wastewater Management Plan, mineral waste management as part of the general mine Environmental and Social Management Plan (ESMP).

From a groundwater and surface water standpoint, there are no significant impacts to consider mitigation for, however additional water treatment may be required for all water arisings from the underground mine prior to reuse.

5.7.5 Residual Impacts

5.7.5.1 Surface Water

The development of the mine is not expected to cause any moderate or major impacts on surface water resources and thus there are no identifiable residual effects on water quantity.

5.7.5.2 Groundwater

The development of the mine is not expected to cause any moderate or major impacts on groundwater resources and thus there are no identifiable residual effects on water quantity

With the measures identified in Section 5.7.4, the development is not thought to have any significant effect on the water environment. The ESMP will provide a framework for constant monitoring to assess effectiveness of mitigations.

5.8 Geochemistry

5.8.1 Introduction

This section gives results of assessment of the potential impacts from construction, operation, and closure of the Vares Polymetallic Project across both the Rupice mine site and Vares Processing Plant site, including Tailing Storage Facility, from acid rock drainage ("ARD") and metal leaching ("ML") on soil and water resources. This assessment of impacts to soils and water from ARD/ML requires understanding of the acid generating- and neutralisation- potential of the rock material to be exposed by the Project; the quantity of potentially acid generating ("PAG") materials to be deposited in external emplacements, as waste rock, ore stockpiles and tailings; location and amount of PAG material exposed in the walls of the underground workings; and any modified waste material to be used in underground backfill. The geochemical mechanisms associated with generation of ARD and metal leaching have been described previously in the Geochemical Baseline Chapter, together with results and conclusions of the geochemical studies undertaken.

5.8.2 Project Activities

The assessment considers Project activities that could lead to ARD and metal leaching and includes the following potential sources of impact:

- Contamination of mine water (in underground sumps) from exposure of sulphidic- and metal-rich mineralogy in underground development and inflow of groundwater;
- Generation of ARD and/or metal-rich water from runoff and seepage through waste rock in the temporary Waste Rock Stockpile (WRS);
- Generation of contaminated water in run-off and seepage from stockpiles of ore at Rupice if left exposed for any extended periods;
- Generation of ARD and/or metal leach water from tailings stored in the Tailings Storage Facility (TSF) at the Vares Plant site; and
- Generation of contaminated water from the waste-containing backfill material placed in excavated underground stopes at Rupice.

The construction phase of the Project will include superficial exposure and ground disturbance at the processing, WRD and TSF sites; and at the mine site at Rupice - with stripping of topsoil, foundation preparations for all mining/processing infrastructure and initial underground development.

The development and operation of the underground mine at Rupice with placement of initial U/G development waste rock in a surface WRS; stockpiling of mined ore into different piles; return and preparation of process tailings at the paste backfill plant for placing underground with waste rock as backfill; and deposition of excess tailings into the TSF are the primary operational impact disturbances of the Project.

Closure of the Project will include flooding of the mine and sealing the access portals/declines/raises and establishment of long-term water management (as necessary); final rehabilitation of any remaining WRD (depending on backfill use) and TSF; and dismantling and footprint restoration of ore stockpile pads, infrastructure, and all processing facilities, including the paste backfill plant.

5.8.3 Prediction and Evaluation of Impacts

The Impact Assessment method used to assess potential geochemical affects is as described in Chapter 5.1 of this ESIA document. The significance of geochemical impacts is assessed from a combination of duration, receptor sensitivity and magnitude. There are no positive Impacts from ARD/ML, so the direction of impact is not applicable. All geochemical impacts negatively affect the soil and water receptors, and, depending on the significance of the impact, may require additional management activities to mitigate the effects. Significance is given for the short-term, during the construction and operational stages of the Project, through to mine-closure; and the long-term, post-closure following site rehabilitation and into on-going monitoring.

The potential impact predictions described in this assessment are based on the ARD/ML studies previously discussed in the baseline geochemistry section, undertaken on the range of lithologies to be encountered in the development of this Project. While the ARD/ML studies used samples representative of the waste rock and ore material, it should be noted that availability of test material is obviously restricted to exploration drilling core and there will always be some uncertainties. While the baseline testing and field trials undertaken provide reasonable understanding of rock characterisation, uncertainties are addressed by making conservative assumptions - on which impact assessment is based; and proposed mitigations, which follow *Good International Industry Practice (GIIP)*.

5.8.3.1 Duration

The duration of most potential geochemical impacts associated with the Project are long-term, by the nature of geochemical reactions that can occur in rock material over a long time. Once instigated, acid generation from sulphides, and dissolution and mobilisation of certain metals are often difficult to stop and may continue for as long as the source rock is exposed and under conducive oxidising or leaching conditions. The exposed underground development walls, WRD and TSF material will be permanent features and any local ARD/ML impacts may be continuous and long-term post-closure. Any ore stockpiles are expected to be processed during the mine life and are therefore should not present a post-closure source of geochemical impact.

5.8.3.2 Receptor Sensitivity

The main receptors for any geochemical impacts are the local soils and water resources at- and downstream- of the Project. Receptor sensitivity has been defined, and the potential magnitude of change from ARD and metal leaching impacts assessed. The value of the affected soil and water resources is based on their potential for beneficial use in comparison to the quality of resources available in the wider area. This is determined by reference to the natural water quality; and the types of soil, suitability of land-use and uniqueness.

Sensitivity of the soil receptor in and around both the Rupice mine site and the Vares Process Plant site is considered ***Minor***, given that the soil types in the area are not unique, are abundant and available outside of the affected area. Topsoil around the mine site and within the footprint of the various mine infrastructure will be removed prior to construction and stockpiled for later use in rehabilitation. While the soils are not necessarily resilient to change from geochemical impact affects, they do not constitute an important local resource, given that fertility is not notably high and land-use on these soils outside of the mine site is generally forest and meadow pasture.

The water resource of the area is considered of ***Medium*** sensitivity. Natural water occurrences in the area, although utilised by local communities, ecological biodiversity and by the Project itself for water supply source, have been shown to contain some elevated metals that reflect the local geology. Although the Mala River water resource receptor at the plant site is seasonal in abundance, as there is likely connectivity with both groundwater and the downstream Stavnja River and ultimately to the Bosnia River this is tempered by resilience to change through dilution and dispersion. Rupice raw water requirement is to be supplied from surface water using water dam impoundments, with abstraction from the Vruci stream, to store sufficient volumes for dry periods. Wastewater at Rupice from dewatering high flow horizons, dewatering/conditioning of paste tails at the Backfill Plant, 'contact' water from WRD-, stockpiles- and site- collection ponds and domestic 'grey' water will collect in a downstream settlement pond and may be discharged to the Borovički stream after treatment, as required. The resilience of water receptors is dependent upon the dilution effect of rainfall and snow melt; transient or short residence time; attenuation through interaction with the geology (especially the predominant carbonate-rich rock) it passes through; and dispersion over time and space. Local community water users/receptors are described in the Hydrology and Hydrogeology Chapter 409 and Ecosystem Services Chapter 413.

5.8.3.3 Magnitude

The magnitude of impacts is described in terms of the area of soil and water resources affected and the degree of restriction to their use caused by the potential contamination. Without mitigation, there could be ongoing change to receiving water and soil from any Project generated ARD and/or metal leaching from exposure of material from the mining activities. However, the effects of any ARD are likely to be buffered with amelioration from neutralising rock and alkaline waters and diluted with dispersion to groundwater and/or to surface downstream rivers.

5.8.4 Project Stages

Construction: Construction activities are likely to disturb soils, surface outcrops and existing exploration and drill sites. However, there is significant pre-production mining planned during the construction phase, which will excavate the Rupice mine portal and decline access development and produce a relatively small amount of rock material, some of which (Non-Acid Forming - NAF waste) will be used as foundation preparations for the backfill plant and other Rupice infrastructure; and to start development of the WRD. If any early-mined ore is produced during this development phase, this will have to be stockpiled until the Vares Process Plant is completed and commissioned. However, it is apparent from the cross-sections derived from the reactivity mapping (described in the baseline section) that most of the early mine development will be in the footwall to the orebody, and mainly outside the reactive envelope. Nevertheless, given that early field trials have shown some reduced water quality with elevated metal contents, even in non-acidic water, construction disturbance and the pre-production mining has the potential to impact on both soils and water resources at site through metal leaching. Given some uncertainty of the reactivity of the material to be mined in this period, and the possible stockpiling of ore, the impact is considered ***low to moderate*** and thus impact during construction is ***significant***.

Operations: The operation of the underground mine at Rupice will expose PAG rock as the deposit is excavated to extract ore. The underground stopes will be in ore and therefore expose PAG material until backfilled; waste rock excess to backfill requirements, including both PAG and NAF material will be deposited on surface at the temporary WRS; PAG mined ore will be stockpiled at surface for blending prior to haulage to the Vares Process Plant; and returned tailings (also PAG) will be processed at the Backfill Plant prior to pumping U/G. Overlaying the Rupice reactivity model on the mine-plan shows that nearly all the operational underground mine development will be in the footwall to the deposit, largely in FWMISED, which is mildly reactive and does contain some PAG material. However, the footwall rocks to be excavated also contain carbonates. Current design is for all excavated waste rock to be used in backfill, but there will be requirement for temporary storage of waste until needed. Availability of NAF waste material as the neutralizing component of temporary waste rock storage will be determined using the modeled wireframe of reactive rock together with mine plan scheduling. The best neutralizing material at Rupice are the LSTCHRT and FLTZN lithologies, which occur far up in the hanging-wall of the deposit and will not be excavated in the process of underground development.

Overall, it is anticipated that a small part of the total rock mass to be exposed in the Rupice underground workings and as mining waste in the WRD will be PAG, but there is still the potential for ARD; and metal leaching is shown to occur even in neutral or alkaline water, which may impact on quality of surface water and adjacent soils. There could also be contaminated runoff from ore stockpiles. While the geochemical studies indicate that there is buffering capacity in some of the waste rock and in the general carbonate-rich geology to reduce/neutralise acid generation, in the absence of mitigation, the potential impacts during operations to water quality, and to neighbouring soils is still ***moderate***, and are generally ***significant***.

Closure: The potential for acid generation and continuing metal leaching from the underground workings, WRD and Tailings Storage Facility may persist in the long term after closure of the mine. In the absence of mitigation these impacts at- and following closure could continue to be ***moderate,*** with ***significant*** effects.

5.8.5 Identified Impact Sources

Contamination of mine water from exposure of metal-rich and sulphidic mineralogy in the underground workings and pit walls: Possible receptors – groundwater from infiltration of mine sump water; surface water from pumping of mine water to surface. Magnitude – ARD may be possible from high sulphide mineralogy exposed in mine development and pit walls, however, the mineralogy of the deposit geology indicates that there is considerable neutralising potential in the surrounding rock to effectively buffer acid generated. Metals, particularly Cd, Cu, Pb, Zn, Mn and Ni could be released from mineralised rock exposed in mining surfaces, even in neutral to alkaline water, as is evidenced by the elevated metal levels in water from some drill holes, wells and the ARD field trials undertaken in the baseline studies. The potential for contamination of mine water is therefore considered to be ***low to moderate*** and conservatively the impact during operations ***significant.***

Generation of contaminated ARD and/or metal-rich water through runoff and seepage from PAG and metal-rich waste rock material temporarily stored in the WRS: Receptors for this potential impact are both the soil in the immediate vicinity of the WRS and water resources that may receive waste rock contact water. The geochemical characterisation of the Rupice waste rocks indicate that the main PAG materials are in the reactive envelope around the mine cut-off defined orebody – the HW- and FWMISED. However, these lithologies are highly variable, both in sulphide-, carbonate- and metals-contents. In the current mine plan, all the extracted underground waste rock is used in the cemented tailings backfill. Backfill waste rock requirements will start in year 2 of operations so initial waste rock production will be stored in a temporary WRS. This stored waste rock will reach a maximum of 750,000t in year 4/5 before progressively reducing as it is used in backfill, until all stored waste rock is removed by year 8/9. Thereafter there is a 170kt shortfall of rock aggregate for the ongoing backfill requirements. Potential impacts from stored waste rock are therefore limited to an 8 year period and over maximum footprint at full capacity in year 4.

The Waste Rock Stockpile will be lined to collect potential ARD ML and prevent seepage of this to groundwater. The material for the liner has not yet been determined. An ARD treatment plant will be present below the waste rock stockpile, the design of which is not yet finalised. The treatment plant will also treat seepage which is collected from the ore stockpiles and other contact water.

Given that metal leaching has been identified from the field trials and general water monitoring, together with the variability of waste rock geochemical characterisation and uncertainty of NAF:PAG waste rock amounts and timing of extraction, the magnitude of the contamination impact from the WRDs is conservatively assessed as ***moderate***, and therefore ***significant***.

Generation of contaminated water from stockpiled Rupice ore awaiting blending and haul to the Vares Processing Plant, particularly if left for extended periods: Both local soils and water resources are receptors for any potential impact from stockpiled ore materials. The high-sulphide Rupice ore is likely to be acid-generating with metal leaching. The field trial of Rupice ore gave rise to low pH and high metal content leachate, particularly Cd, Cu, Fe, Zn, Pb, Mn, Al, Ni and As. Operations will provide greater clarity about the reactivity, metal mobility and lag-time associated with stockpiling of the ore material. High Grade ore will be produced over 2 years; Medium Grade over 3 years; and Low Grade over the entire 15 years, but actual residence times on ROM stockpiles will depend on required blending for the processing plant. Given the potential magnitude of contamination from stockpiled ore, the impact is assessed as ***moderate to high***, which without mitigation, is ***significant***.

Contamination from seepage and runoff from the TSF dry stack: Receptors for contaminated water from the deposited tailings are both local soils and the Mala River water resources downstream of the stack. High metal contents and elevated metal leaching values from ore material indicate that the magnitude of geochemical risk from the Rupice ore is moderate to high, and even after metal extraction through flotation, the residual tailings are potentially still a source of metal leaching. The initial ABA and NAG testing of 2 tailings samples, followed by more recent testing of a high Ba tailings during baseline studies show the tails are acid generating with high S% and negative NNP. Initial sequential kinetic NAG results indicated likely time lags before acid generation under atmospheric oxidizing conditions are 9 to 14 months. Leachate analysis showed that significantly elevated metal contaminant levels are likely from stored tailings exposed to the atmosphere. As such, potential impacts from the TSF are assessed as ***high*** and are likely to be ***significant***.

Generation of contaminated water from the waste-containing backfill: There is also a risk of ARD/ML from the waste rock/tailings used in backfill in the worked-out stopes, although it is likely that the cementitious additives and surrounding carbonate-rich host rock should prevent instigation, or neutralise any acid generated. Receptors to ARD/ML from backfilled waste in worked-out stopes are mine water collected at the mine sump for pumping to surface; and potentially to groundwater through infiltration. While it is likely that the alkaline reactions during setting of the cementitious backfilled tailings and waste rock are sufficient to counter any potential acid generation from contained sulphides; and to seal metals within the cemented structure, until specific testwork on cemented backfill provides this assurance, the risk is still assessed as ***low to moderate*** and impact ***significant***.

Although pyrite is by far the dominant sulphide responsible for the generation of acidity, other sulphide minerals react differently and not all of them generate acidity when oxidized. Generally, iron sulphides (pyrite, marcasite, pyrrhotite); sulphides with molar metal/sulphur ratios < 1; and sulpho-salts (like enargite), generate acid by reacting with oxygen and water. Sulphides with metal/sulphur ratios = 1 (like sphalerite, galena, chalcopyrite) tend not to produce acidity when oxygen is the oxidant. However, when aqueous ferric iron is the oxidant, all sulphides may generate acidity. The amount of iron sulphide present in the ore deposit or mine waste is therefore crucial to determining the characteristics of the mine drainage. While pyrite is the most common source mineral for iron, chalcopyrite and ferriferous sphalerite can also act as iron donors, so mine drainage from rock with these minerals tend to be significantly more acidic than discharges from sulphide assemblages that primarily include sphalerite and galena, as is the case at Vares. Oxidation of the sphalerite and galena still occurs, releasing sulphate and trace zinc and lead, but it is commonly neutral mine drainage (NMD) where these metals remain in solution – as seen in many of the Vares studies.

Geochemical changes to soil and water resources that potentially affect ecology in the Project area and immediately downstream, are addressed in Chapter 5.4 Biodiversity Impact Assessment.

The measures proposed to mitigate these identified impacts and the assessment of residual impacts after mitigation, are discussed below.

5.8.6 Mitigation Measures

While adverse impacts rated as ***Significant*** must be mitigated to reduce the level of effect of the residual impact, under *GIIP* some with ***no- or low significance*** effects should also be mitigated, especially where uncertainties exist. As geochemical characterisations are still on-going and there have been variable test results (laboratory versus field tests), a conservative approach is taken to the management of ARD and metal leaching risks. Some of the measures described here may be deemed unnecessary once the different ore and waste materials have been better characterised.

Efficacy of these mitigation measures will be determined through careful operational monitoring and measures/procedures for this are also given.

The key element for mitigation of all the identified potential geochemical impacts will be the development and implementation of a Mineral Waste Management Plan as part of the general mine Environmental and Social Management Plan (ESMP). This will include:

- Continued geochemical characterisation of Project ore and waste rocks;
- Identification of potentially PAG and high metal material during operations;
- Management and operational procedures for WRD and ore stockpiles;
- Management measures for the tailings dry-stack storage facility; and
- Development of a suitable rehabilitation and closure plan for any remaining waste deposits at end-of-mine-life.

These aspects will be further developed during detailed design and will be regularly updated during construction and operation as new information becomes available on the nature, quantities and risks associated with ARD and metal leaching materials and the future land use plans for the site.

The mitigation hierarchy requires measures are structured to avoid or prevent, then reduce, isolate and control potential impacts. Prevention is particularly important for geochemical risks as it is much more difficult to control or stop ARD/ML once started. The fundamental requirement that underpins the approach to mineral waste management is to continuously validate characterisation of mine waste and ore in terms of the acid-forming and metal leaching risk.

The temporary WRD, ore stockpiles and the TSF will incorporate measures in their design, construction and operation to:

- Prevent or minimise the generation of ARD;
- Control any metal leachate generation;
- Promote geochemical stability with designs reviewed by an appropriately qualified and experienced engineer;
- Reduce surface water ingress and, where possible, reduce O_2/air contact;
- Control, contain and manage water seepage and runoff from the facilities; and
- Prevent migration of metal leachate or ARD to surface water, groundwater and soils.

Detailed Waste rock stockpile, ore stockpile and TSF management measures are described below. All these precautionary measures will be re-evaluated as and when more data is obtained and there is a better understanding of the acid generating potential at the mine from continual study carried out during operations.

The main mitigations of potential geochemical impacts from the Project are through design and engineering of the proposed mine plan, and operational management measures. This includes design of the U/G sump and mine water management; WRD construction; ore stockpile pads; and the TSF dry-stack, to prevent/reduce the potential for oxidation of sulphides or release of metal contaminants. The water management system will collect all mine contact water for re-use within the operations in a largely closed system, or treatment prior to discharge if necessary, as a fundamental control of ARD and metal leachate release and distribution.

Design considerations include:

Mine water - Underground mine water from Rupice is estimated to be minimal at around 0.7L/s. Modelling has shown that the mine is expected to have a negative water balance. Depending on the quality of this water, once pumped to surface, it will either be directed to the site water supply dam; or to the contact-water settlement pond. This water may need treatment prior to discharge.

Waste Rock Stockpile – The waste rock will be placed on a prepared footprint adjacent to the ROM ore stockpile pads, close to the mine, cleared of vegetation and topsoil, with initial foundation placement and a toe berm of non-acid forming (ideally neutralising) material. Operational management of the waste rock will depend on accurate identification of higher-risk PAG rock in the mine development, as part of the geological grade control system. The current plan is for this material to be co-mingled with NAF waste rock on the temporary dump depending on distribution within the excavated declines, drives, cross-cuts and raises; and the mine waste scheduling. Drainage ditches will collect all water runoff from and seepage through the Waste rock stockpile and direct it to the contact-water settlement pond. This downstream pond allows monitoring of water quality and efficacy of geochemical mitigations, and redirection of contaminated water, if necessary, for re-use or treatment. The stockpile will be lined and a treatment plant will be used.

Selected NAF waste rock will be used for the construction of the ore stockpile pads and other Rupice infrastructure items during the site construction phase.

Ore Stockpiles – The ore hauled from underground is to be stockpiled on pads at Rupice, to allow for blending, prior to haulage to the Vares Plant. These pads will be constructed with compacted NAF waste rock. Depending on results of further ore testing and scheduled residence time, the pads may need to be lined, given the high risk of acid generation and metal leaching. Run-off and seepage from the ore stockpiles will collect in toe drains and be directed to the settlement pond, treated as necessary, before being redirected to the water supply pond, for other re-use, or for released under appropriate conditions.

The main operational management for the mitigation of ARD and metal leaching impacts from the Project at Rupice is to maintain a site-wide collection system for all mine contact water. Wherever practicable, all mine contact water will be re-used within the Project. Any excess mine water will be directed for storage at the settlement pond and only released after testing and treatment where necessary. All collection ditches and ponds will be compacted and/or lined, to prevent/reduce infiltration to the underlying soil. Monitoring wells around all facilities will detect any migration to groundwater.

TSF - The dry-stack TSF at the Vares Processing Plant site has been designed to meet international best practice standards as described by the Australian National Committee on Large Dams and Canadian Dam Association. Only excess tailings not needed for the underground backfill at Rupice will be stored at the facility, estimated at 5Mt of dry tailings over the 14 years life of mine. The TSF stack will be developed in the valley immediately south of the Vares Processing Plant. Tailings delivered to the stack will have a planned moisture content of 8.7-9.3%. Throughout operations the surface of the dry tailings will be regularly compacted to reduce permeability, ingress of precipitation and oxygen; and periodically capped with compacted NAF rock material to further reduce infiltration.

The TSF stack footprint will be cleared and compacted prior to deposition. An underdrainage system will comprise a main collector drain along the valley floor, fed by a series of finger drains arranged in a herringbone pattern, adjusted to fit ground conditions. Drainage will be directed to a seepage collection pond with a pumping system to return collected water to the process plant. A surface water diversion system will be constructed above the TSF to minimise water infiltration to the stored tailings. Monitoring wells downstream of the TSF will detect any water seepage through the system and be used to pump any contaminated water if needed. Evaluation of compacted low permeability soil versus a TSF liner will depend on ground conditions, availability of suitable material and prediction of efficiency of the layered compacted capping material. Efficacy of compaction and periodic capping of the dry tailings throughout the operational life of the facility will be key to counteracting geochemical impacts and will need to be constantly monitored.

5.8.7 Closure Measures

The Conceptual Mine Closure plan contains the following actions and procedures for managing long-term geochemical impacts:

Mine - The closure plan for the Rupice mine is to allow the underground development to flood to prevent oxidation of sulphidic material below the water line. During operations, there will be on-going monitoring of mine water and modelling for prediction of final mine water quality. Geochemical impacts, if any, from the backfilled stopes should be well understood prior to closure, which will allow progressive refining of water quality predictions and evolving closure strategies. Continued studies will also investigate water inflow sources/pathways to determine the likely post-closure hydraulic connectivity with groundwater.

WRS - The current mine plan is to use all waste rock in backfill before the end of mine life and subsequently, there will be no WRS at closure. Assuming this is the case, the WRD footprint can be ripped, covered with topsoil as required and revegetated as soon as it is cleared, scheduled for year 8/9.

Ore Stockpiles – All ore stockpiles should have been removed for processing by the end of mine life, so closure will involve progressive rehabilitation and revegetation of the footprints as the ore is finally cleared. This should follow thorough assessment of the pads for any remnant ARD/ML ore material that may remain, and addition of neutralising material if necessary.

TSF - At end of mine life, the final dry-stack TSF surface will be contoured, compacted, and covered with composite layers. A geomembrane may be added to the closure cover layers if on-going geochemical monitoring identifies long-term ARD and/or metal leaching from the TSF post-closure. Both surface water diversion ditches and the underdrainage system will remain in place post-closure, with runoff and seepage directed to the downstream pond, and passive treatment as required, prior to release to the environment. The surrounding surface will be graded and revegetated.

5.8.8 Residual Impacts

Re-assessment of impact significance after mitigation is applied (assuming effective implementation of mitigation measures) is undertaken to derive residual effects from Project activities. This assessment is based on the same methodology and Impact Significance Matrix used to assess unmitigated impacts. Appropriate risk analysis will continue based on the monitoring programme targeted to assess the effectiveness of the mitigation measures on potential impacts.

With these measures in place the impact of acid rock drainage and metal leaching on soil and water resources at Rupice and at the Vares TSF site is likely to be a minor issue to manage on a routine basis in the mine plan, but the ESMP will provide a framework for continuous monitoring to assess effectiveness of mitigations. With implementation of the controls described above the risk of adverse impacts on soils and water from ARD and metal leaching during construction, given the pre-production mining, will be reduced to ***minor***, and during operations will be reduced to ***minor***. Once the mine reaches the closure stage, effectiveness of progressive revegetation of the WRD footprint and the temporary waste rock ARD/ML controls will have been monitored for some time; and modelling of post-closure mine water quality should be conclusive. Acid rock drainage and metal leaching from the mine and WRS footprint is not therefore expected to cause significant impact in the long-term. Proposals for the decommissioning, closure, and rehabilitation of the TSF will have been refined with additional understanding of tailings properties and effectiveness of periodic compacted capping layers. Failure of the post closure TSF control systems could lead to a ***minor*** risk of impact on downstream water and soils after closure.

The results of mitigation measures on residual impacts are summarised in Table 5.8.1 below.

Table 5.8.1 Summary of Mitigation and Residual Impacts				
Impact	**Mining Stage**	**Impact before mitigation**	**Key Mitigations**	**Residual Impacts**
Release of ARD and/or metal leachate from construction disturbance and pre-production mining.	Construction	Low to Moderate	Removal and storage of soils and any material accumulated from construction. Design placement of WRS and ore stockpiles with careful designation of rock. Water management system to collect all contact water to settlement pond for reuse. On-going monitoring of water discharges.	Minor
Contamination of mine water from PAG and metal-rich rock exposed in underground development and from tailings and waste rock backfill	Operations	Low to Moderate	Continued characterisation, identification and delineation of PAG and metal-rich rock in the development drives and cross-cuts. Collection and pumping of all mine sump water to the surface settlement pond for monitoring and re-direction/treatment, as necessary. Monitoring of groundwater around and below the mine workings.	Negligible
	Closure	Low to Moderate	Modelling of final mine water quality and hydrology for predicting post closure risk from ARD/ML prior to mine flooding and sealing. Post-closure monitoring of groundwater around the mine to ensure the effectiveness of mitigations.	Minor
Contamination from ARD and/or metal leachate from WRS runoff and seepage.	Operations	Moderate	Continued characterisation, identification, and delineation of PAG and high-risk waste rock in the block model and underground development. The temporary Waste Rock Stockpile will be a lined facility to collect ARD ML and prevent seepage of this to groundwater. An ARD treatment plant will be present below the WRS. . Collection and monitoring of run-off and seepage in downstream settlement pond. On-going monitoring and refinement of ARD and metal leaching controls and waste emplacement operation.	Minor
			Covering and revegetation of WRS footprint as soon as the last waste rock is removed from the WRS area.	

Table 5.8.1 Summary of Mitigation and Residual Impacts				
Impact	**Mining Stage**	**Impact before mitigation**	**Key Mitigations**	**Residual Impacts**
ARD and/or metal leachate contaminated runoff or seepage from ore stockpiles	Operations	Moderate to High	Design and construction of ore stockpiles to contain identified high-risk material. Collection of contact water for reuse within the Project. Monitoring of surface run-off, seepage, and groundwater in the vicinity of ore stockpiles to inform the management measures. An ARD treatment plant is located below WRS to treat seepage from the ore stockpiles and other contact water Ensure removal for processing of all ore material at end of mine life. Rehabilitation and revegetation of scarified ore pads footprints	Minor
	Closure	Low		Negligible
ARD and metal leaching contamination from dry-stack TSF	Operations	High	Continuing characterisation of ore and tailings material to define the risk from ARD and metal leaching. Underdrainage system to collect and direct all seepage to the TSF seepage pond for return to the plant. Diversion ditches above the stack to reduce water infiltration. Monitor surface- and groundwater below the TSF to identify any seepage/leakage. Progressive periodic capping with compacted NAF rock material.	Minor
	Closure	Moderate to High	Cover, seal and vegetate the TSF surface as soon as tailings disposal ceases. Post-closure monitoring of surface- and groundwater below the TSF to identify seepage and monitor water quality.	Minor

The ESMP will include a range of controls integrated with the design and operational plan for the mine to ensure the identification and management of all potentially acid generating material and high-risk metal containing material. On-going studies/monitoring will continue to be undertaken to define the risk of ARD and metal leaching and update appropriate necessary control measures.

As sulphide minerals have different oxidation reactivity it is critical to determine the types of sulphide with XRD and/or mineralogical study. Equally, an understanding of the form of neutralising minerals available helps to predict the geochemical buffering reactions that will occur in the field. While whole rock analysis values give an indication of potential metal contaminants, an understanding of metal occurrence in mineralogy, mineral stability and element mobility, pollution pathways and types of receptor will help understanding of the actual impact risk.

Dependent on future test work and monitoring, the ESMP measures may include the following:

- Continued delineation and characterisation of potentially acid-generating material by:
  - ongoing ARD/metal leaching investigation programme;
  - continuous mapping underground development to define reactive rock types;
  - routine sampling of excavated waste material to provide operational information regarding acid generation potential and metal content;
  - sulphur analysis of production drill cuttings; and
  - geological delineation of working mine faces to facilitate selective handling.
- Continuous updating of calculation of types, volumes and time-scheduling of PAG and NAF waste rock through advancing underground development.
- Selective handling and segregation of high-risk material in waste emplacements.
- Selective extraction of high-carbonate material for use in encapsulation of PAG.
- Co-disposal of high-risk PAG waste with inert or buffering high-carbonate material as barrier.
- Shape temporary waste emplacement surfaces to reduce ponding of water/snow and infiltration of rainfall.
- Construct ore stockpile pads with compacted NAF waste rock.
- Install underdrains and toe drains to collect and separate any leachate from the WRS and ore stockpiles.
- Provisions for leachate treatment if required to comply with the discharge criteria for receiving waters.
- Monitor leachate from temporary WRS, all ore storage and stockpiles, and TSF; groundwater from appropriately located monitoring wells; and all contact mine water; and
- Periodic monitoring of soil quality compared with baseline condition.

5.8.9 Monitoring and Audit

The level of monitoring that will be necessary is identified, over a defined period, to ensure that mitigation measures remain appropriate and maintain actual impacts within acceptable limits. Sufficient monitoring boreholes and a comprehensive and frequent sampling programme that reflects concerns will be planned, to be modified as the geochemical understanding gives more robust confidence in the potential for ARD and metal leaching at the mine.

The primary objectives of the mine water, WRS, ore stockpiles and TSF monitoring program are to:

- Provide timely information on the adequacy of management practices and allow improved practices and procedures to be developed;

- Detect and measure trends or environmental changes, and enable analysis of their causes; and
- Confirm impacts of different activities and identify unforeseen effects and the need for additional remedial measures.

The geochemical monitoring program will be linked with the broader monitoring program described in the ESMP and Mine Water Management Plan, but will include:

- Monitoring of mine sump water, surface runoff and seepage water quality (when flowing) from the WRS, all ore stockpiles and the TSF initially on a weekly basis until management measures are seen to be effective. This can then be reduced to monthly;
- Water quality monitoring from wells located around and downstream from all potential geochemical impacts source areas – mine; WRS; ore stockpiles and TSF;
- Monitoring of the integrity of the WRS, ore stockpiles and TSF (focus on signs of erosion or seepage in the outer bunds and faces) and operating procedures (i.e., water levels);
- Regular (once per shift) inspection of the mine, WRS, ore stockpiles and TSF water collection channels and ponds;
- Continuous monitoring of wildlife activity (particularly water birds) in any channels, sumps and sediment ponds; and
- Annual monitoring of soil quality adjacent to any stored mineral material.

The above measures will be supplemented by regular inspection of surface- and groundwater at monitoring bores or designated surface water sampling locations, as per the Mine Water Management Plan, including periodic analyses of pH and metal content. In particular, the geochemical mitigation measures performance shall be determined primarily by evaluation of water quality, with identification of environmental impacts associated with ARD and metal leaching, especially As and Cd, but also for Al, Fe, Mn, Pb, Ni and Zn, and compliance with applied standards. Contact water should be recycled at site as necessary, with discharge criteria and compliance limits applying to any planned or accidental discharge. The monitoring data collected will be reviewed on an ongoing basis and compared to expected conditions and compliance requirements.

An audit program shall be implemented to:

- Monitor/inspect and audit ARD and metal leaching management activities, to ensure correct application of described mitigation measures and procedures;
- Report the results of inspections and audit to mine management; and
- Register and report incidents to the relevant authorities.

5.9 Social Impact Assessment

5.9.1 Introduction

This chapter aims to identify the potential social impacts from the Vares Project and required mitigation measures. Potential impacts are identified through the interaction between Project activities (Chapter 3) and the baseline information from the socioeconomics and community health, safety, and human rights sections (Chapters 4.11 and 4.12).

The general impact assessment methodology is outlined in Chapter 5.1. This methodology determines impact significance in two steps: before and after the implementation of mitigation measures (pre- and post-mitigation assessment). Impact significance will be determined through a combination of receptor sensitivity and impact magnitude, resulting in a residual impact significance. Impacts to community receptors have been determined based on whether they are socioeconomic in nature (SE) or link predominantly to community health, safety and human rights (CHR), see Table 5.9.1. Human Rights are a cross cutting aspect throughout the ESIA, these impacts have been accumulated here as these impacts directly relate to social receptors. Reference has been made to other ESIA chapters, where applicable, for context.

As part of the pre-mitigation assessment, the existing mitigation measures, embedded in Project design or required for compliance with applicable regulations, are presented in Section 5.9.3. Impacts are evaluated per Project stage (construction, operation, decommissioning), although in some cases, impacts may remain across the life of mine or be relevant in multiple phases of project development. The post-mitigation assessment, included in the impact summary section (Section 5.9.5.3) will consider additional mitigation measures for impacts of moderate and major significance. Additionally, effects on vulnerable groups will be assessed qualitatively to highlight potentially disproportionate effects (Section 5.9.5.3). Unplanned events, such as accidents and emergencies, are presented in Section 5.9.9.

Potential environmental impacts are detailed and assessed in their respective chapters, such as increases in noise or dust, as well as affects to hydrology or air quality. However, this section will generally refer to their effects on *social* receptors.

5.9.2 Potential Impacts

The following table presents the key Project activities that are likely to interact with and potentially impact existing social receptors.

Table 5.9.1: Project activities and potential impacts			
Project Activity	**Impact Pathway**	**Receptor**	**Impact Description**
Socioeconomic Impacts			
Construction: Project announcement and start of construction activities Operation: Operational Activities	The Project announcement could generate expectations of economic opportunities.	Economically active population Direct and indirect communities	**SE01 - Project-induced population immigration** Influx of local, regional, and international workforce, as well as unemployed population, may occur throughout different Project stages, increasing demand of local services, straining their access / availability, and potentially increasing tensions with local communities.
Construction: erecting of site fencing and start of heavy vehicle use Operations: Restricted access to working areas Closure: Restricted access until closure activities complete	Public access to the construction site will be limited by a perimeter fence and security booths. Project vehicles will use local roads.	Direct and indirect communities	**SE02 – Reduction of public access** The Project site will not be accessible to local public who may have used it previously (e.g. to traverse to other locations or for recreational hunting purposes). Includes reduction of access to informal swimming activities in the historic iron ore pit around which the haul road transport route is planned.
Construction: Land acquisition	Change in ownership of land, compensation and livelihood restoration	Land Owners	**SE03 – Land Acquisition** The Project will be required to acquire private and municipal land parcels for Project Development.
Construction: Start of heavy vehicle use and workforce vehicles	During construction activities, heavy vehicles and workforce commuting will use existing roads until a new road is built.	Local road users, Direct and indirect communities	**SE04 – Deterioration of existing public roads and increased traffic** Heavy vehicle use can deteriorate and damage existing roads. Their use will increase traffic and transport time for local land users.
Construction: Increased population and vehicle use during construction of haul route. Operation: Increased population means more road users	Multi-use haul route and increased vehicles on existing roads due to immigration.	Local road users, Direct and indirect communities	**SE05 – Increased traffic** Workers' use of private vehicles can strain traffic loads, decrease availability of parking spaces and increase costs of vehicle-related services in the area.

Table 5.9.1: Project activities and potential impacts

Project Activity	Impact Pathway	Receptor	Impact Description
Start of construction activities	Construction activities will require 208 workers on site, between skilled and unskilled labour. Local supplies will be procured.	Economically active population, General local businesses	**SE06 – Direct Employment** Local employment could lead to increased income stability and a higher demand for specific professional skills. Supply chain growth may lead to higher demand for local goods and services giving way to indirect economic opportunities. These opportunities may incentivise young adults and sectors of the economically active population that had previously left in search of jobs to return to the Project area.
Operation and procurement	New workers are anticipated to work at the Project site. Project will require additional procurement of goods and services.	Project workforce, Economically active population	**SE07 – Diversification of economic opportunities** New direct and indirect jobs will be required during the mine operation, leading to a higher demand for skilled staff. As job transition occurs, the job sector might diversify, and local supply chain could become more specialised.
Construction, operation and closure	Payment of taxes and royalties	National, cantonal and Local governments, Economically active population, General local businesses, Direct communities	**SE08 – Macroeconomics** Positive impact from project royalties and taxes that will be paid at the state and cantonal level, and then distributed to the municipality level. Further economic impacts from Project, employee and contractor expenditures and employee tax contributions.
Construction: Project announcement and construction activities Operation: Ongoing Project activities	Project activities will be undertaken in an area with historical mining activities and underutilised infrastructure.	Economically active population, General local businesses, Direct communities	**SE09 – Increased shared value and sense of place** The return of population, particularly those of working age, to the area and the reinvigoration of mining activities could have non-monetary beneficial effects. For example, the rehabilitation of unused infrastructure, restoration of shared community values (esteemed professions) and the continuation of a mining tradition which could reinforce community cohesion.
Operation: Use of newly constructed haul road	A new, unlit road will be built as an alternative road with public access.	Land road users, Local businesses	**SE10 – Increased public infrastructure** Road construction and road improvement activities will benefit local road users, decreasing traffic on existing roads and increasing access routes.

Table 5.9.1: Project activities and potential impacts			
Project Activity	**Impact Pathway**	**Receptor**	**Impact Description**
Mine closure	Workers will be laid-off progressively as operations cease.	Project workforce Direct communities Local businesses	**SE11 – Job losses** Workforce and staff members will be progressively laid-off as mine shuts operations. Economic dependency on mine activities may result in economic losses for local businesses and communities
Post-closure Rehabilitation	Rehabilitated areas and reuse for industrial facilities	Direct communities Local businesses	**SE12 – Disruption of place-based attachment** Potential unemployment, job transitions and the rehabilitation of Project areas and associated facilities may disrupt the sense of belonging for the community and increase the need for local businesses to diversify their sectoral services.
Community Health, Safety and Humans Rights Impacts			
Construction: Project announcement and construction activities Operation: Operational activities	Workers will be accommodated in, and commute from, local communities.	Project workforce, Direct and indirect communities	**CHR01 – Increase in communicable diseases** Workforce interactions could occur with local communities, potentially resulting in increased rates of communicable diseases such as Sexually Transmitted Infections (STIs), respiratory diseases and epidemics (COVID-19).
Construction: Project announcement and construction Activities Operation: Operational activities	Changes in consumption habits based on increased income.	Project workforce, Direct and indirect communities	**CHR02 – Increase in non-communicable diseases** Changes in habits affecting health performance (alcohol, smoking, drugs) and exacerbating risks of non-communicable diseases (hypertension, diabetes, strokes, cancer, among others).
Construction and Operational activities	Hiring practices and income gaps may result in unequal benefits. May affect working environment.	Project workforce, Direct communities, Local organisations	**CHR03 – Inequity and potential contribution to existing human rights issues** Potential biases in work and labour practices could limit the Project's ability to respect rights of minorities, freedom of movement, protection of the child, health, equality before the law and non-discrimination, as well as labour rights (e.g., freedom of association, child labour, forced labour).
Construction and Operational activities	Greater expendable income in existing households, change in consumption, and influx of workers	Project workforce, Direct communities, Local organisations	**CHR04 – Exacerbated conditions for GBVH** Paired with a population influx, greater expendable income and consumption of alcohol are linked to increased cases of domestic violence and GBVH.

Table 5.9.1: Project activities and potential impacts			
Project Activity	**Impact Pathway**	**Receptor**	**Impact Description**
Construction: earth works, storage of topsoils. Operation: ore extraction and waste management	Different environmental impacts felt by social receptors.	Project workforce, Direct communities	**CHR05 – Increased community exposure to pollution** Project workforce and community members may be exposed to potential air emissions, water and soil contamination, and hazardous substances, decreasing community health and safety conditions.
Construction and Operation: Use of security personnel on site	Security guards will be posted in the Project site to secure entrances.	Direct and indirect communities	**CHR06 – Security Conflict** Security personnel may interact with local communities and the potential use of excessive or disproportionate force may occur. See details on security management requirements below (5.9.5.3) and also CHR04 (Gender based Violence and Harassment and Baseline Chapter 4.12)
Construction and operational phases	Multi-use haul route and increased vehicles on existing roads due to in migration.	Local road users, direct and indirect communities	**CHR07 – Increased Road Traffic Accidents** Increased traffic and the dual use of the haul route will lead to an increased risk of road traffic accidents. A higher population will inevitably lead to more pedestrians posing greater risk to increased accidents.
Construction and Operation	Limited health facilities	Direct communities, indirect communities and employees and their families and dependents.	**CHR08 – Impact to local health services** An increased population and potential for mining related activities will lead to an increased strain on the already limited health care facilities in Vares.

5.9.3 Embedded Mitigations

The following mitigations related to social aspects are considered to be embedded in Project planning and assumed to be implemented as basic compliance requirements with the applicable regulations (see Section 2.2), GIIP (Section 2.4), international conventions (Section 2.5) and existing company policies (Section 2.7). These mitigations will be considered during the pre-mitigation impact assessment.

- Monitored implementation of the following existing company policies[1]:
  - Anti-Bribery and Corruption Policy;
  - Audit and Risk Committee Charter;
  - ESG Committee Charter;

[1] https://www.adriaticmetals.com/corporate-governance/

  - Human Rights Policy;
  - Health & Safety Policy;
  - Human Resources Policy;
  - Social Performance and Community Policy;
  - Modern Slavery Statement;
  - Procurement Policy; and
  - Environment Policy
- Implementation of the **Stakeholder Engagement Plan (SEP)** to address Project disclosure, as well as feedback through the Project's **Grievance Mechanism**. The Grievance Mechanism will be communicated to relevant stakeholders through the SEP activities;
- Ongoing running of the Public Liaison Committee, as part of the SEP;
- Follow-up and monitoring of the Project's **Commitments Register**; and
- Operation of the **Adriatic Foundation**, which allocates funds for local development initiatives, led and administered by community members.

Additional mitigation and enhancement measures, including the management plans in Section 2.7, are considered for the post-mitigation assessment in the Impact Summary table (Section 5.9.6) and will be further detailed in the ESMP (see Chapter 7).

5.9.4 Socioeconomic Impacts

5.9.4.1 SE01 - Project-Induced Population Immigration

The Project has the potential to attract an influx of people in the area, both those looking for work within the Project, and those looking for in-direct economic opportunities. The Project workforce will not be housed in a project specific accommodation camp, but will instead live in the town of Vareš, or further afield such as Breza, Zenica or Sarajevo. The size of the Project may mean that the entirety of the Vareš municipality is not affected, but that local communities closer to the Project, Vareš town, Borovica and Tisovci, amongst others, may experience growth or reinvigoration.

Project-induced in-migration may increase demand for and costs of local services, potentially straining their access and availability. Services, namely health facilities and public transportation are already minimal in the region and an increased population could put more strain on these. The impact on these aspects, and planned mitigation is discussed in the proceeding impacts.

In-migration may also cause cultural issues due to difference in cultural customs, norms, and values. Workers may not have an understanding or experience of the local cultures and this has the potential to cause tension between local residents and the migrant workers. Vareš municipality has a largely evenly split population dominated by Bosniaks and Croats, with a minority of Serbs though none have been identified as returnees (See Baseline Chapter 4.11). Vareš town is the only community within the municipality to be equally Bosniak and Croat, with most other key communities being Croat, except for Daštansko, a predominantly Bosniak community. The in-migration of workers from outside of BiH, as well as those from other Cantons within BiH and between local communities has the potential to cause issues between the differing cultures experienced in each community. Employees are expected to rent property in the region, most likely the town of Vareš. Workers and the local community will therefore mix regularly on a day-to-day basis, potentially exacerbating the impact of culture clashes.

This impact could be adverse, will have a medium-long term duration during the construction and operation stages, its spatial extent could reach regional levels and it will affect a moderate number of receptors. Therefore, this impact has a high magnitude. The social receptors, economically active population (EAP) and indirect communities have a low sensitivity, while direct communities have a medium sensitivity, resulting in a **moderate significance** for the former (EAP and indirect communities), and a **major significance** for the latter (direct communities). After additional mitigation measures have been applied, such as the influence of the Adriatic Foundation and workers code of conduct, this adverse effect will be reduced to **minor adverse**.

5.9.4.2 SE02 – Reduction of Public Access

Project areas will not be accessible to the public once site fencing is erected and security booths are installed. These measures, although implemented to prevent the local community members from being exposed to construction and operational risks, will restrict access to the public, including people who may have used the site or nearby foot paths to access other locations. Even though the Project site is uninhabited, recreational hunting activities previously took place in the region of Rupice. Since the onset of exploration activities hunting activities in this area have been minimised and land elsewhere utilised instead. The haul road transport route is planned to travel around an inundated iron ore pit where informal recreational activities take place, such as informal, though legally forbidden, swimming during summer and occasional events (e.g., wedding photos). Public access to the iron ore pit will be reduced namely on the northern edge used as a viewpoint and for photo opportunities, where the haul route will pass.

This impact will be adverse, will have a long-term duration during the construction and operation stages, will be reversible, and its spatial extent could reach local levels. Therefore, this impact has a low magnitude. The social receptors, direct and indirect communities, have a medium and low sensitivity, respectively, resulting in a **minor significance** for both receptors. Although no additional mitigation measures will be required for this minor effect, the Project's SEP ensures to engage with land users to ensure appropriate and equivalent land is available for Project affected activities. The development of the haul route will provide better access to large parts of the forest that could be utilised for hunting purposes. This adverse impact will be kept as **minor adverse**.

5.9.4.3 SE03 – Land Acquisition

Regarding Land Acquisition for the Vares Project, Adriatic Metals are committed to aligning with BiH/FBiH law as well as applicable international best practice standards (EBRD's PR 5). Impacts to land acquisition have been assessed through an interactive process across the project inception and design period. Certain design choices, such as the routing of the haul road, have been optimised to avoid and minimise the impact of land acquisition.

A Land Acquisition, Compensation and Livelihood Restoration Plan (LACLRP) has been developed for the Vares Project in July 2021. The LACLRP defines the legal and regulatory framework to which the plan has been designed, project displacement impacts to landowners and vulnerable groups and the implemented strategy, mitigation and monitoring procedures. The LACLRP is available as part of the ESIA package.

The LACLRP provides the worst-case scenario for plots requiring acquisition for development of Rupice (Table 5.9.2). The one residential land plot is not currently envisioned as part of the Project, though has been included as part of the worst-case situation. Forestry and agricultural land plots identified are unused.

Note that at present the LACLRP states no acquisition is required for land at the Vares Processing Plant. However, six land plots will be required for development of the Tailings Storage Facility (TSF) and the LACLRP will require updating to reflect this. These land plots will only require acquisition at a later stage of Project development as they are not needed for the first phase of TSF construction, and the LACLRP will be updated prior to this work taking place. For the first phase only one single municipal land plot is required.

Acquisition required for haul route development is also not included within the LACLRP, however this will be undertaken by the municipality who will construct, own and manage the haul route. It is anticipated that affected land for road widening and development will be barren, forested land or unused agricultural land. No economic displacement of significance is anticipated for haul road development or the TSF.

Table 5.9.2: Land Acquisition at Rupice (Worst Case Scenario)

Properties	Number of Properties	Number of Owners	Total Surface area (ha)
Agricultural land plots	48	41	36.28
Forest land plots	12	4	2.64
Residential land plots	1	1	0.006
Total	61	45	38.92

At present, six plots of land have been identified as requiring acquisition in the first instance for Rupice. All land parcels at Rupice are privately owned and have a combined area of 36,169m^2. Of the six parcels at Rupice, five parcels are classified as pastoral land and one is forested land. All land that may require acquisition is listed within the cadastre of BiH though in some cases the registered owner has been identified as outdated. Eastern Mining have handled these cases by assisting with registering the current landowner at no cost to the landowner. Where landowners are living overseas, a power of attorney has been applied to the land.

As detailed in the LACLRP, Full Replacement Cost was achieved through land valuations undertaken by certified valuers from Sarajevo, in accordance with EBRD PR5.

This impact could be adverse or beneficial dependent on the individual receptor and their circumstances. For ease, land acquisition is being treated as adverse. It will have a long-term impact, and its spatial extent could reach local levels. This impact will have a low magnitude. The social receptor, landowners, have a medium sensitivity resulting in a **minor significance** impact. Note that this assessment relied on the implementation and continuous review of the LACLRP which is critical in managing land acquisition in line with EBRD PR5.

5.9.4.4 SE04 - Deterioration of Existing Public Roads during Construction

The start of heavy vehicle use and workforce commuter vehicles could have an impact of the existing road network across the Project area. Further, in-migration leading to a rise in the population will inevitably result in more passenger vehicles on roads. Increased road usage could damage existing roads, until a new road is built for the operations stage.

The Project has already improved local roads in the area used by the site team, notably close to the village of Pogar, as well as that leading to Tisovci, Pržići and Daštansko. The Project will also improve some existing routes, as part of the haul route development.

This impact will be adverse, will have a short-term duration during the construction stage until the new road is built, will be reversible, and its spatial extent reaches local levels. Therefore, this impact has a negligible magnitude. The social receptors, direct communities have a medium sensitivity, while road users and indirect communities a low sensitivity, resulting in a **negligible significance** for all receptors. No additional mitigation measures will be required, assuming the SEP and timely disclosure of the traffic management plan is available, keeping this impact as **negligible adverse**.

5.9.4.5 SE05 – Increased Road Traffic

There will be a combined impact from the haul fleet, staff buses and project delivery vehicles and an increased number of private cars on the road, due to in-migration and potential greater spending capacity of residents. An assessment of key junctions in the area has shown that there is capacity to handle this increase (Appendix 5.9.1.). Parking spaces in the main town of Vareš are already limited and will be further strained throughout construction and operation due to an increased population. The implementation of the employee park and ride service will assist in reducing parking needs within the town. This car park will be made available to the local community, assuming sufficient capacity.

This impact will be adverse, will have a medium-long term duration throughout the construction and operational stage and its spatial extent reaches local levels, giving it a low magnitude. The local road users have a medium sensitivity resulting in a **minor significance**. The implementation of the traffic management plan will ensure this impact remains as **minor adverse**.

5.9.4.6 SE06 – Direct Employment

The development of the Vares Project will result, and has already resulted in, employment opportunities throughout the development, construction, operations and closure periods. Whilst construction and haulage operations will be undertaken by contractors, Adriatic Metals have committed to ensuring these contractors are local and employ a large proportion of local people. During the operation phase a total of 320 jobs is envisioned across the operation of Rupice, the VPP and administrative roles.

Adriatic Metals have adopted a resourcing strategy within the strategic blueprint developed by Globe 24-7 Human Resources Consultants. The strategy states that with the exception of 10 roles for highly qualified technical specialists, all other employees will be FBiH nationals. Zones for employment have been prioritised, first looking at the Zenica-Doboj Canton, secondly Sarajevo Canton and thirdly Tuzla Canton. Local media outlets will be utilised to encourage those in Vareš and the Zenica-Doboj Canton to apply to available jobs. The expectations of local people will need to be managed and monitored, see Section 5.9.9.5 on managing community expectations.

In addition to the direct employment by the Project, formal and informal jobs linked to the Project supply chain may lead to increased income sources and higher demand for services. A local procurement strategy has been developed for the Project. Procurement will be prioritised with Vareš Municipality at the highest preference, followed by Zenica Doboj Canton, FBiH and then the wider Balkans region.

Suppliers will be encouraged and supported to establish warehouses and service facilities in Vareš. The Project will also provide assistance to business start-up projects in Vareš. Examples of services that may be required locally for the Project include: uniform/workwear manufacture, repair and branding, catering and food supply, building and vehicle maintenance, land management, IT, security, and laboratory analysis. This provides an opportunity for economic diversification (see below).

The economic dynamism expected during the construction and early operation stage could incentivise young adults and members of the economically active population that had previously left in search of jobs to return to the Project area.

This impact will be beneficial, will have a medium-long term duration during the construction stage, will be reversible, and its spatial extent could reach regional levels. Therefore, this impact has a low magnitude. The social receptor, the economically active population has a low sensitivity, and the local businesses have a negligible sensitivity, resulting in a **beneficial minor and negligible significance**, respectively. Additional enhancement measures such as the implementation of the local employment plan, clearly communicating the recruitment needs and process in the nearby communities, and additional training for unskilled workers in the area could increase magnitude, although the impact would still be kept as **minor beneficial**.

5.9.4.7 SE07 – Diversification of Economic Opportunities and Indirect Employment

During construction and operations, there are expected to be indirect economic opportunities, as well as a diversification of livelihoods, services and companies operating across Vareš. As well as suppliers directly linked to the supply chain for the Project, the expanding population and spending capacity of community members will provide opportunity for other business to grow or develop. Shops, cafes, restaurants and bars will likely have a larger customer base, providing greater indirect economic opportunities. Supply chain service providers will have an opportunity to diversify, expanding into specialised areas linked to the mining industry.

Increased spending capacity of the population will lead to creation of indirect job opportunities across the municipality of Vareš. Indirect opportunities can be estimated at approximately 2 times the direct jobs.

This impact will be beneficial, will have a long-term duration and its spatial extent could reach regional levels. Therefore, this impact has a low magnitude. The economically active population, the Project workforce, and direct and in-direct communities, have a low-medium sensitivity, resulting in a **beneficial minor significance** for all. Additional enhancement measures could be applied to increase the magnitude, such as developing training programmes for the EAP and collaborating with existing local businesses to anticipate supply chain needs. This effect is still likely to be kept as a **minor beneficial**.

5.9.4.8 SE08 – Macroeconomics

The construction and operational phase of the Project will have a positive impact on the national economy through payments of value added tax on construction supplies, including: materials and equipment, fuel, food stuffs, and advisory services and through construction workforce income tax contributions. The Rupice mine and VPP are located within the Company's 100% owned Concessions, No. 04-18-21389-1/13 and 18-21389-1/13, respectively, therefore only normal royalties will be due to the state.

The Project will also have positive macroeconomic benefits from Project, employee and contractor expenditures, including to the regional and local economy. The national economy will also benefit from workforce income tax contributions as well as economic stimulus by sourcing industrial supplies from within BiH, specifically focused on the local area where possible. The most immediate local economic benefits will stem from Project, employee and contractor expenditures.

Project royalties and taxes will be paid according to BiH legislation, at the state and cantonal level, and then distributed to the municipality level. Through stakeholder interviews it is evident that there is a perception within the community that money spent by the municipality does not always result in a shared benefit. The Adriatic Foundation has been established to support and promote local sustainable socio-economic development, with a particular focus on the communities associated with Adriatic's operations. The Foundation is a consultation body that channels social investment in an effective and responsible manner in order to leave lasting positive legacies. It supports programmes and projects that have long-term development impact, particularly in the areas of education, environmental protection, and healthcare.

The foundation is governed by a Board of Trustees, comprised of independent representatives and one representative from Eastern Mining. To support its objectives, the foundation also aims to attract partnership funding from donors and other foundations to co-fund programmes. The foundation will work throughout the life of the project, and beyond, to ensure social investments are managed in a fair, transparent and inclusive manner.

This impact will be beneficial, will have a long-term duration and its spatial extent could reach national levels, though will be felt most strongly locally. The impact has a medium magnitude. The economically active population, the Project workforce, and direct and in-direct communities, have a low-medium sensitivity resulting in a **beneficial minor significance** for national receptors, and **beneficial moderate significance** for local receptors.

5.9.4.9 SE9 – Increased Shared Value and Sense of Place

In addition to the effect of the Project-induced population searching for job opportunities (evaluated above), the Project may reduce the trend of young people migrating from Vareš to elsewhere in search of job opportunities, whilst simultaneously drawing new young and economically active people in. The start of mining activities could therefore bring, in addition to job opportunities, different non-monetary beneficial effects. Interviewees in the Project AoI reported that they currently do not view a positive future for their respective villages; however, they have hope that the Project will draw young people back and improve the prospects for the villages. Shared community values could be restored as mining-related jobs, esteemed professions among the local communities, are reinstated. Additionally, the continuation of a mining tradition, though in a modern form, could reinforce community cohesion and support for the Project. Closely held place and community identities can help to explain support or opposition to local development projects (Jacquet & Stedman, 2014). In this case, the communities may have developed a sense of place related to historical mining activities that could be reinvigorated by the Project.

This impact will be beneficial, will have a long-term duration during the construction and operation stages and its spatial extent could reach regional levels. This impact has a low magnitude. The social receptors, direct communities, economically active population, and general local businesses have medium, low and negligible sensitivities, respectively, resulting in a **minor significance** for the former two and **negligible significance** for the latter. After additional mitigation measures have been applied, such as the funding of community-led initiatives and entrepreneurial projects by the Adriatic Foundation to keep young people in the area, the magnitude could be increased to medium. This beneficial effect could then increase to **moderate beneficial** for the former two and **minor beneficial** for the latter.

5.9.4.10 SE10 – Increased Public Infrastructure

A new road will be built for project operations . The new haul route will be a multipurpose route for mine traffic, forestry traffic and will be open for public use. Whilst the general public will be discouraged from using the new route, in order to reduce potential road traffic accidents, the route will be beneficial for forestry workers. It is also anticipated that the new route will provide increased access north of Rupice to the Zvijezda mountain for people to partake in hunting and foraging activities. Public health and safety will be critical to the management of the route (see unplanned events section 5.9.9).

Adriatic Metals have already provided road upgrades in the vicinity of Pogar, Tisovci, Pržići and Daštansko, increasing accessibility. This will be managed by the foundation committee and not by Adriatic Metals. Taxes and royalties paid by Adriatic Metals can also be used by Vareš municipality to improve or develop public infrastructure.

This impact will be beneficial, will have a very long-term duration extending beyond the operation and decommissioning stages and its spatial extent is local. Therefore, this impact has a low magnitude. The social receptors, land road users and direct community members, have a medium sensitivity, and local businesses have a negligible sensitivity, resulting in a **minor significance** for the former and a **negligible significance** for the latter.

5.9.4.11 SE11 – Job losses

Job losses and demobilisation will initially occur at the end of the construction period. Contractors used during construction will result in a shift from transient workers to people who will live in and close to Vareš long term. As construction of the VPP will be undertaken by contractors, the expectation of demobilisation will be expected from the initiation point of works and will be managed by the contracting bodies. Supply chain opportunities relevant solely to the construction period will also cease following this phase of works. Adriatic will liaise with providers and where possible, assist in diversification of services to extend their use into operations.

Retrenchment of Project staff will be undertaken progressively as the decommissioning stage starts. As the mine operations are shut, indirect employment linked to mining activities are expected to phase out. Previous to the actual loss of job, the expectation of job losses is likely to cause stress and potential anxiety among workers in regard to their future activities. After 12 years of operation, the workforce may have developed skills and abilities that would not be easily transferable to other sectors without support. In addition, the economic dynamism of the area may have developed dependency to supporting the mining sector. Once the actual job losses occur, the local economically active population will seek new opportunities in the area or in other locations. If no alternative jobs are found, local communities may find it difficult to sustain their livelihood conditions.

The conceptual mine closure plan (MCP) allows for compensation for workers made redundant, in accordance with BiH law, as well as $2,500 per person to undergo specific training to assist in making their role transferable. Redundancy pay in the conceptual MCP has been assumed at 50% of normal months salary for 6 months.

This impact will be adverse, will have a short-term duration post-construction, a medium-term duration during the decommissioning stage and could linger further post-closure, its spatial extent could reach regional levels. Therefore, this impact has a high magnitude. The social receptors, general local businesses, Project and supply chain workforce and have a low and medium sensitivity, respectively, resulting in a **moderate significance** for the former, and **major significance** for the latter. After additional mitigation measures have been applied, such as a retrenchment plan to support transitioning professionals into alternative jobs, this adverse effect will be **moderate adverse**.

5.9.4.1 SE12 – Disruption of place-based attachment

Following the 12 years of Project operation, local communities may perceive the type of economic activities and employment sustained by mining activities as congruent with their place-based attachment. Changes brought by the Project closure, retrenchment of staff, and a transition towards other industries could result in a disruption of the local community's sense of place and attachment, potentially resulting in stress.

Over time, mining activities in the area have set social, economic, and even cultural attributes that have made it meaningful to the local communities. A mining memorial is located at the entrance to the Vareš town and on 16th August every year, Vareš Municipality Day is celebrated, which commemorates the first opening of the blast furnace in Vareš in 1891. The anticipation of change due to the closure of the Project and worry over future social changes may produce stress, potentially wearing the psychological well-being of the workforce, their families and the community.

This impact will be adverse, will have a medium-term duration during the decommissioning stage and post-decommissioning monitoring, will be reversible, and its spatial extent could reach regional levels. This impact has a low magnitude. The social receptor, direct communities, have a medium sensitivity, and the local general businesses have a negligible sensitivity, resulting in a **minor significance** for the former and a **negligible significance** for the latter. After additional mitigation measures have been applied, such as the Retrenchment Plan and work with the Adriatic Foundation to co-develop new community-led social, economic and cultural activities in the area, this adverse effect could be reduced to **negligible adverse**.

5.9.5 Community Health, Safety and Human Rights Impacts

5.9.5.1 CHR01 – Increase in Communicable Diseases

The influx of migrant workers, directly or indirectly related to the Project, has the potential to further increase exposure to communicable diseases, such as STIs, respiratory diseases, and exacerbating epidemics. (COVID-19 pandemic risks are further detailed in Unplanned Events). This could occur through the use of local commerce and services by the Project workforce and through other uncontrolled interactions between the workforce and community members.

Social determinants of health and the institutional factors (infrastructure capacity) in the area are detailed in the socioeconomic and community health and safety baseline (Chapters 4.11 and 4.12). Within the municipality of Vareš there is one specialist clinic, one optician, and two pharmacies within private ownership; the JU Dom Zdravlja Vareš is the public health institution. Tradition treatments and medicines are known in the area, primarily through the picking and collection of medicinal plants and herbs. The following communicable diseases could be increased:

- Respiratory diseases related to housing – acute respiratory infections, pneumonia, tuberculosis, meningitis; and
- Sexual and reproductive health diseases – HIV/AIDS, other STDs, unplanned pregnancies.

Interviewees in the local health centres reported that STDs, HIV and respiratory diseases are minimal in the area. However, the increase in population and uncontrolled interactions could increase these cases.

This impact will be adverse, will have a medium-term duration during the construction and operation stages and its spatial extent could reach local levels. Therefore, this impact has a low magnitude. The social receptor, project workforce and indirect communities have a low sensitivity, and direct communities have a medium sensitivity, resulting in a **minor significance** for all receptors. No additional measures will be required, assuming the implementation of the Health and Safety Policy and workers' code of conduct, keeping this impact as **minor adverse**.

5.9.5.2 CHR02 – Increase in Non-communicable Diseases

Changes in habits affecting health, induced by increased income and economic dynamism in the area, could exacerbate non-communicable diseases such as hypertension, diabetes, stroke and cancer. Individual factors affecting health determinants include household and workers' habits of alcohol, tobacco, and drug use, in addition to eating habits. Smoking is prevalent in the national context, with up to 8,600 citizens dying of tobacco-caused diseases annually (Section 4.12.3). Smoking is rife in children and adults alike, with a strong prevalence in male smokers (56%) and a relevant proportion of female smokers (31.6%).

In 2019, the five largest causes of death across BiH were ischemic heart disease, stroke, lung cancer, diabetes, and colorectal cancer, which had increased from the last decade. Deaths caused by heart disease had the largest increase of 16.3%. Within the Zenica Doboj Canton the leading diseases are heart and blood vessel diseases (51%), including heart failure, acute heart attack and strokes. Fibrosis and cirrhosis of the liver are the leading causes of death from diseases of the digestive system. These liver diseases are often linked to hepatitis B or C, and heavy drinking, with the potential to advance to liver cancer. In the area, elderly adults were reported as being afflicted with chronic conditions like heart disease, cancer, and diabetes. Mental health problems are also reported as increasing due to stress and the standard of living in the area.

This impact will be adverse, will have a long-term duration during the construction and operation stages and its spatial extent could reach regional levels. This impact has a medium magnitude. The social receptor, Project workforce and indirect communities have a low sensitivity, and direct communities have a medium sensitivity. The impact has a **minor significance** for the former two, and a **moderate significance** for the latter. After additional mitigation measures have been applied, such as the development of a Community Health, Safety and Security Management Plan with a focus on cardiovascular, respiratory and digestive diseases linked to consumption habits. Additionally, relevant environmental management policies referring to the management of substances potentially harmful to human health, such as management plans for air quality, noise, and water. This adverse effect will be reduced to **minor adverse**.

5.9.5.1 CHR03 – Inequity and Potential Contribution to Existing Human Rights Issues

Hiring practices and income gaps may result in unequal benefits for the workforce and local communities. Additionally, uncontrolled work and labour practices by the Project or its supply chain could affect the rights minorities (discrimination), rights of the child (child labour), right to health (occupational health and safety - OHS), non-discrimination, and labour rights (forced labour, freedom of movement, association) in the area.

In terms of OHS, observers have reported hazardous OHS conditions in the metal and mining industries in BiH, although no serious injury or fatalities reports from industrial accidents were registered in 2020 (see Section 4.12.1). Discrimination was reported in employment and occupation practices in BiH and outside of the working environment. General discriminatory practices were reported against LGBTI individuals (hate speech) and ethnic minorities (hate crimes), including continuous expression of racial, ethnic and identity intolerance in public discourse, as well as segregation of different ethnicities (e.g., in education and language barriers). Discrimination against persons with disabilities include employment discrimination and lack of infrastructure access for persons with disabilities, also affecting people with disabilities resulting from the 1992-95 conflict in civilian victims or war veterans.

Discrimination against women in BiH was found to be persistent in gender pay gaps and occupation segregation. There are no specific employment strategies to target gender inequalities. Disparity in maternity benefits, and unpaid social contributions by employers on pension and health insurance benefits for women were observed. Sexual harassment incidences are prevalent (see below for GBVH).

Note that as part of the Local Procurement Policy all suppliers will be required to pass a prequalification stage. All suppliers will be assessed in the following areas: anti-bribery and corruption;

environmental, social and governance; supplier code of conduct (in line with that of Adriatic); Human Rights and Modern Slavery and Health & Safety.

This impact will be adverse, will have a long-term duration going beyond the construction stage and into the operation and its spatial extent could reach regional levels. Therefore, this impact has a medium magnitude. The social receptor, project workforce, has a low sensitivity, and direct communities and local organisations have a medium sensitivity, resulting in a **minor significance** for the former and **moderate significance** for the two latter. After additional mitigation measures have been applied for the latter two, such as the implementation of a Non-Discrimination Policy focused on labour rights, this adverse effect will be reduced to **minor adverse**.

5.9.5.1 CHR04 – Exacerbated Conditions for GBVH

An increase in people associated directly or indirectly with the Project is expected during the construction and operational phases. Most of the expected influx will likely be comprised of men, which could worsen the conditions of OHS (work-based harassment) and can also increase the risk of Gender-Based Violence and Harassment (GBVH) during interactions with local communities from both Eastern Mining employees and construction, mining and haulage contractors.

On a national level, BiH is undergoing post-conflict transitional justice processes which are focused specifically on conflict-related sexual violence victims. National GBVH cases were found to be underreported and had a low prosecution and conviction rate (see Section 4.12.2). On a local level, the Centre for Social Work in Vareš, the Vareš Health Centre and the Vareš Police Station cooperate in cases of reported violence, in coordination with the MEDICA safe house located in Zenica-Doboj Canton. Incidents of domestic violence reported an increase in 2019 and decreased in 2020, which, according to the interviewed staff, was related to underreporting. Additionally, three out of four cases reported in the police station in 2020 were dropped. Interviewees reported this may be due to the position of vulnerability and dependency of the victims, lack of economic opportunities to become independent and lack of housing alternatives. Interviewees mentioned that incidents of domestic violence are closely related to alcohol abuse, a problem that was more prevalent during the previous industrial period when expendable income was greater.

This impact will be adverse, will have a long-term duration during the construction and operation stages, will be reversible, and its spatial extent could reach regional levels. This impact has a medium magnitude. The social receptors are similar to the previous impact, with a low sensitivity for the Project workforce and medium sensitivity for direct communities and local organisations, resulting in a **minor significance** for the former and **moderate significance** for the latter two. After additional mitigation measures have been applied for the latter two, such as specific anti-GBVH training in accordance with EBRD good practice guidance for addressing GBVH, for the workforce and contractors, and collaboration with local organisations to prevent GBVH, this adverse effect will be reduced to **minor adverse**.

5.9.5.2 CHR05 – Increased Community Exposure to Pollution

As described in the CHS baseline (Section 4.12.3), impacts from increased air emissions, noise, water and soil contamination, and potential exposure to hazardous substances are environmental determinants with effects on human health. According to the Project's Health Impact Assessment (HIA) (Appendix 4.13.1), the local population is most concerned about pollution from previous mining activities related to environmental aspects such as soil, watercourses and air (presence of dust and other particles) as well as noise from the pre-existing plant. Soil, water, and waste-related diseases could include diarrhoeal diseases, hepatitis A and E, as well as soil-transmitted helminths (parasitic worms).

Interviewees from the health centres reported that cases of chronic lung and respiratory conditions have been elevated in the past, perceived by local communities to be attributable to the iron foundry as well as previous mining operations. The HIA found that potentially high levels of thallium and mercury, identified in basic tests in sediments in groundwater and soils, could potentially contaminate watercourses during the Project operation. Thallium has been found in the ore at Rupice during geochemical test works, and thallium concentrations, reported within baseline surface water, spring and groundwater samples collected from the Rupice mining concession, have been seen to regularly exceed national Maximum Permissible Concentrations. The HIA described that the accumulation of thallium in the human body can cause adverse effects on the nervous system, organs such as the lungs, heart, and kidney, as well as causing temporary hair loss and vomiting.

Thallium has been identified as part of the natural background geology, and not related to ore-forming geological events. During processing of lead and zinc ores the concentration of thallium within process waters can increase[2]. Spills and accidental discharge of untreated, thallium enriched, process waste waters has the potential to contaminate the underlying groundwater as well as surface watercourses. Chapter 5.7 Hydrology and Hydrogeology impact assessment provides a full assessment of the potential impact from thallium on surface water and ground water receptors. It notes that as there is no clear indication of thallium enriched ores combined with the zero-discharge operation of VPP. Heavy metals, including thallium, amongst others, have the potential to cause an occupational health and safety hazard. Worker exposure in the plant/concentrate handling areas is possible and best practices will be implemented such as installation of ventilation and exhausts, PPE, and GIIP operational practices. The impact of contamination and hence human health impact from heavy metals, including thallium, is expected to be of **minor significance**.

Further impact assessment for noise, air quality and soils have found that there are no significant impacts to human health from environmental pollution, assuming that the appropriate mitigation is implemented, as defined in the appropriate chapters of this ESIA. To retain the potential for limited impacts mining and haulage contractors will be required to implement an Environmental and Social Management System, in line with EBRD requirements and that adopted by Adriatic Metals.

[2] Karbowska, B., et al., 2014. Translocation and mobility of thallium from zinc–lead ores. Journal of Geochemical Exploration, 143, pp.127-135.

In summary, this impact will be adverse, will have a long-term duration during the construction, operation and closure stages, and its spatial extent could reach regional levels. Therefore, this impact has a medium magnitude. The social receptor, the Project workforce, has a low sensitivity, and the direct communities have a medium sensitivity, resulting in a **minor significance** for the former and a **moderate significance** for the latter. Additional mitigation measures such as the development of the Community Health Safety and Security Management Plan, ongoing environmental monitoring, the implementation of measures included in the HIA, and a thorough human health monitoring programme, could reduce this effect to **low adverse**.

5.9.5.3 CHR06 – Security Conflict

Following the fencing of the Project areas, security booths will be installed with a number of security guards present. In addition to fences, security installations could include peripheral and exterior lighting and cameras. Security personnel are assumed to be trained according to Adriatic Metals Human Rights Policy and the Community Health, Safety and Security Management Plan and must be monitored by the Project's security officer. This Human Rights Policy requires that personnel responsible for security conduct themselves in accordance with the Voluntary Principles on Security and Human Rights (VPSHR)[3]. Human rights observers have reported that local police and security forces in BiH have undergone security training to combat abuse and corruption and promote respect for human rights (Section 4.12.1). Security staff will secure the site, monitor site visitors, and assist to direct traffic at access points. Recreational hunters or potential job seekers may have interaction with the Project's security. This interaction may lead to community grievances being raised due to actual or perceived disproportionate use of force.

This impact will be adverse, will have a medium-term duration during the construction and operation stages, will be reversible, and its spatial extent could reach local levels. Therefore, this impact has a low magnitude. The social receptor, direct and indirect communities, have a medium and low sensitivity, respectively, resulting in a **minor significance** for both receptors. Although no additional mitigation measures will be required, security forces' training on human rights and adherence to the Human Rights Policy, as well as implantation of the grievance mechanism, can reduce this impact to **negligible adverse**.

5.9.5.4 CHR07 – Increased Road Traffic Accidents

Increased road traffic (see impact SE05) could lead to a potential increased risk in road traffic accidents and poses a risk to pedestrians in the area. The haul route has been designed to avoid communities as far as possible, particularly in the stretch from Vareš town to Rupice. Whilst it will be a publicly accessible route, signage will be installed to advise users of the heavy vehicles using the road. A traffic management plan will be developed, limiting haul truck and heavy vehicle drivers to a low-speed limit (30km/h as per the haul route basis of design). Community members will also be encouraged to use the existing and more direct routes between villages. During winter months there may be some who

[3] In addition, the management of security forces is required by IFC PS 4, the IFC Good Practice Handbook on the Use of Security Forces, and the International Code of Conduct for Private Security Providers.

choose to use the haul route as it will be more accessible due to snow clearance. Severe road traffic accidents are covered in Section 5.9.9, Unplanned Events.

This impact will be adverse, will have a medium-long term duration throughout the construction and operational stage and its spatial extent reaches local levels. The local road users have a low sensitivity resulting in a **minor significance**. The implementation of the traffic management plant and employee code of conduct will ensure that this impact remains as **minor adverse**.

5.9.5.5 CHR08 - Strain on Local Health Services

Increased in-migration by those looking for employment and their families/dependents, as well as those seeking indirect economic opportunities will result in an increase in the population across Vareš municipality. At present health services are already strained and limited in the region. Access to health care is a concern currently for many of the key communities, as determined in the household survey, with services only reaching remote villages (Borovica) once per month.

An increased population combined with the potential for accidents associated with project activities will mean that there will be an increased number of people requiring access to health services in Vareš. The current facilities do not have the capacity to deal with this increased demand, and it could be detrimental to vulnerable groups, particularly the elderly and disabled, should this resource be further strained.

Regarding emergency events, Adriatic Metals will utilise the Breza mine rescue service at the beginning of mine life before developing their own. An Emergency Response Plan and Procedure has been developed for the Project.

This impact will be adverse, will have a medium-long term duration throughout construction and operation and its impact will reach local-regional levels. The magnitude of impact is high. The receptors, direct population has a medium sensitivity, whilst indirect communities and employees have a low sensitivity. The impact is therefore **moderate significance** for indirect communities and employees and **major significance** for direct communities.

Adriatic have committed to provide a health clinic in Vareš and are currently in negotiations with a health care provider. The clinic will be developed in Vareš or Vareš Majdan in agreement with a private landlord and the municipality. The clinic will provide GP type services, in addition to basic diagnostics including Pathology, CT and X-Ray. They will be able to provide first and second level trauma services via a dedicated high spec ambulance service, which if required could also transport patients to a private hospital in Sarajevo. The intent is that Eastern Mining will provide private health insurance for all staff, their adult spouse/partner, and dependent children. The Clinic will augment the current state facility, and all services will be available to the community. The clinic will also provide pre-employment medical screening and routine assessments for employees; the results of the latter will not be shared with Eastern Mining without employee consent.

Through the development of the medical clinic and employment medical screening, this impact will become **moderate beneficial** for direct communities, and **low beneficial** for indirect communities and employees.

5.9.6 Impacts on Vulnerable Groups

The impacts presented above can have a disproportionate effect on vulnerable groups. As described in Section 4.12.4, vulnerable groups have limited or restricted capacities / access to resources to adapt to external changes, including children, women, elderly adults and people with disabilities. The following table presents the identified vulnerable groups in the Project AoI.

Table 5.9.3: Impacts on Vulnerable Groups

Potential impacts	**Ethnic minorities**	**People with disabilities**	**Widows, female headed households and women in special circumstances**	**Elderly adults**
SE01 - Project-induced population in-migration	Increase strain on supply of local goods and services making them more difficult to obtain or more expensive.	Increase strain on supply of local goods and services making them more difficult to obtain or more expensive.	Increased male presence, potential for increase in GBVH. Increase strain on supply of local goods and services making them more difficult to obtain or more expensive.	Increase strain on supply of local goods and services making them more difficult to obtain or more expensive.
SE02 – Reduction of public access	Fewer accessible leisure and cultural areas.	Fewer accessible leisure and cultural areas.	Fewer accessible leisure and cultural areas.	Fewer accessible leisure and cultural areas.
SE03 – Land Acquisition	Returning Serbian land owners have potential to be impacted by land acquisition. At present this is not the case for the Vares Project.	May feel vulnerable or pressured in terms of acquisition. If identified, additional assistance may be required.	May feel vulnerable or pressured in terms of acquisition. Land may not be registered if the head of household is a widow.	May feel vulnerable or pressured in terms of acquisition.
SE04 – Deterioration of public roads		Increases the difficulty in travelling through the local areas.		Increases the difficulty in travelling through the local areas.
SE05 – Increased Traffic	Community health and safety risk.	Community health and safety risk. Limited disabled parking in Vareš which may be compromised.	Community health and safety risk.	Community health and safety risk.
SE06 – Increased economic opportunities			Feelings of inequity due to lack of opportunities to work	Feelings of inequity due to lack of opportunities to work due to age.

Table 5.9.3: Impacts on Vulnerable Groups				
Potential impacts	**Ethnic minorities**	**People with disabilities**	**Widows, female headed households and women in special circumstances**	**Elderly adults**
			due to societal pressures.	
SE07 – Diversification of economic opportunities			Feelings of inequity due to lack of opportunities to work. Diversification of economic opportunities may provide services and job opportunities for women.	Feelings of inequity due to lack of opportunities to work.
SE08 - Macroeconomics		Additional capacity for municipality to spend on resources and infrastructure for those living with disabilities.	Improved macroeconomics benefits to women could mean an increased capacity to provide: • Increased access to education, skills development and training; • Access to quality/ decent paid work; • Address unpaid care and work burdens; • Access to property, assets, and financial services; • Collective action and leadership; • and perhaps even social protection.	Additional capacity for municipality to spend on resources and infrastructure for elderly and remote population.
SE9 – Increased shared value and sense of place	Dependent on the influx population, some may feel further ostracised whilst the general population has an increased sense of place.			Restored sense of place due to immigration, influx of younger population and reinvigoration of the mining industry.

Table 5.9.3: Impacts on Vulnerable Groups				
Potential impacts	**Ethnic minorities**	**People with disabilities**	**Widows, female headed households and women in special circumstances**	**Elderly adults**
SE10 – Increased public infrastructure	Increased access to services.	Increased mobility and access to services.	Increased access to services.	Increased mobility and access to services.
SE11 – Job losses	Gained skills which are difficult to transfer to other roles, leading to economic losses.		Gained skills which are difficult to transfer to other roles, leading to economic losses.	
SE12 – Disruption of place-based attachment	Loss of community cohesion due to cessation of mining activities and outmigration.	Loss of community cohesion due to cessation of mining activities and outmigration.	Loss of community cohesion due to cessation of mining activities and outmigration.	Loss of community cohesion due to cessation of mining activities and outmigration.
CHR01 – Increase in communicable diseases	Increased risk of contracting a communicable disease (STIs etc.).		Increased risk of contracting a communicable disease (STIs etc.).	
CHR02 – Increase in non-communicable diseases	Greater disposable income leading to potential increase of non-communicable diseases through smoking, alcohol etc.		Greater disposable income leading to potential increase of non-communicable diseases through smoking, alcohol etc.	
CHR03 – Inequity and exacerbated conditions for human rights and GBVH	Increase in population associated with the Project (typically males) leading to increase in human rights violations.	Increase in population associated with the Project (typically males) leading to increase in human rights violations.	Increase in population associated with the Project (typically males) leading to increase in GBVH and human rights violations.	Increase in population associated with the Project (typically males) leading to increase in human rights violations.
CHR05 – Increased community exposure to pollution	Increased risk of non-communicable diseases (e.g., respiratory issues).	Increased risk of non-communicable diseases (e.g., respiratory issues).	Increase in risk to non-communicable diseases (e.g., respiratory issues).	Increase in risk to non-communicable diseases (e.g., respiratory issues) already known to be highest in this group.
CHR06 – Presence of security guards	Typically, a male dominated role. Increased male presence, potential for abuses of power.	Typically, a male dominated role. Increased male presence, potential for abuses of power.	Typically, a male dominated role. Increased male presence, potential for abuses of power.	Typically, a male dominated role. Increased male presence, potential for abuses of power.
CHR07 – Increased road traffic accidents	Community health and safety risk.	Community health and safety risk.	Community health and safety risk.	Community health and safety risk.

Table 5.9.3: Impacts on Vulnerable Groups				
Potential impacts	**Ethnic minorities**	**People with disabilities**	**Widows, female headed households and women in special circumstances**	**Elderly adults**
CHR08 – Strain on local health services	Decreased access to health services due to stretched capacity.	Decreased access to health services due to stretched capacity. Could be critical to health and every day activities. A new clinic would improve the current situation for disabled people.	Decreased access to health services due to stretched capacity.	Decreased access to health services due to stretched capacity. Elderly population live in remote areas with already limited access. A new clinic would improve the current situation for elderly population.

5.9.7 *Impact Summary*

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				**Post-mitigation Assessment**	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
Con/Op	SE01 - Project-induced population in-migration	EAP	Low	High	Moderate	Implementation of the following: • Community Development Plan • Workers' Code of Conduct Training on CHS	Low	**Minor Adverse**
		Direct communities	Medium		Major			
		Indirect communities	Low		Moderate			
Con/Op	SE02 – Reduction of public access	Direct Communities (Hunters)	Medium	Low	Minor	**Not required**	Low	**Minor Adverse**
		Indirect Communities	Low		Minor			
Con	SE03 – Land Acquisition	Land Owners	Medium	Low	Minor	Implementation of the Land Acquisition, Compensation and Livelihood Restoration Plan, in accordance with EBRD PR5.	Low	**Minor Adverse**
Con	SE04 – Deterioration of Public Roads	Road Users	Medium	Negligible	Minor	Implementation of the SEP and timely disclosure of traffic management plan is assumed.	Negligible	**Negligible**
		Direct Communities	Medium		Minor			
		Indirect Communities	Low		Negligible			
Con/Op	SE05 – Increased Road Traffic	Road Users in direct Communities	Medium	Low	Minor	All employees and contractors to be trained on appropriate use of public roads, to be covered within the employee code of conduct and traffic management plan.	Low	**Minor Adverse**
Con/Op	SE06 – Increased Economic Opportunities	Economically Active Population	Low	Medium	Minor	Enhancement measures such as:	Medium	**Minor Beneficial**

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				**Post-mitigation Assessment**	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
		Local Businesses	Low			• Implementation of Local recruitment strategy • Additional induction and training for unskilled workers		
Con/Op/Clos	SE07 – Diversification of economic opportunities	Economically Active Population	Low	Low	Minor	Enhancement measures such as: • Training programmes for the economically active population • Collaborate with local businesses to anticipate supply chain needs and train for future needs	Medium	**Minor Beneficial**
		Local Businesses	Low					
		Project Workforce	Low					
Con/Op	SE08 - Macroeconomics	National Gov and Population	Low	Medium	Minor	Enhancement measures include the workings of the Adriatic Foundation.	Medium	**Minor-Moderate Beneficial**
		Cantonal Gov and Population	Low		Minor			
		Municipal Gov and Population	Medium		Moderate			
Con/Op	SE09 – Increased Shared Value and Sense of Place	Direct Communities	Medium	Low	Minor	Enhancement measures such as funding of community projects through the Adriatic Foundation, school projects and visits to the Project.	Low	**Minor Beneficial**
		Economically Active Population	Low		Minor			
		Local Businesses	Low		Minor			
Con/Op/Clo	SE10 – Increased Public Infrastructure	Local Road Users	Medium	Low	Minor	None required.	Low	**Minor Beneficial**
		Local Businesses	Low		Minor			

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				Post-mitigation Assessment	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
Clo	SE11 – Job Losses and Retrenchment	Local Employees and their dependents	Medium	High	Major	Implementation of the following: • Retrenchment Plan to support job transitioning • Clear disclosure of closure and retrenchment plans through the SEP to manage supply chain and workforce expectations through employees and unions • Provide training to employees to ensure transferable skills are developed	Medium	**Moderate Adverse**
		Supply chain employees and providers	Medium		Major			
Clo	SE12 – Disruption of place based attachment	Direct Communities	Medium	Low	Minor	Implementation of the following: • Retrenchment Plan including provisions for workers' families • Adriatic Foundation co-development of grassroots activities to help adaptation	Low	**Minor Adverse**
		Local Businesses	Medium		Minor			
Con/Op	CHR01 – Increase in communicable diseases	Project workforce	Low	Low	Minor	Not required. Implementation of the Health and Safety Policy and code of conduct expected. Training on STIs could be provided as part of ongoing CHS management.	Low	**Minor Adverse**
		Direct Communities	Medium		Minor			
		Indirect Communities	Low		Minor			
Con/Op	CHR02 – Increase in non-communicable diseases	Project workforce	Low	Medium	Minor	Implementation of the following: • Community Health and Safety Plan	Low	**Minor Adverse**
		Direct Communities	Medium		Moderate			

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				Post-mitigation Assessment	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
		Indirect Communities	Low		Minor	• Relevant environmental management policies referring to the management of substances potentially harmful to human health.		
Con/Op	CHR03 – Inequity and potential contribution to existing human rights issues	Project Workforce	Low	Medium	Minor	Implementation of the Human Rights Policy is assumed, including these additional measures: • Clear documentation and induction on labour rights (see details in 5.9.8) • Development of a Non-Discrimination Policy on labour rights (Section 5.9.8)	Low	**Minor Adverse**
		Direct Communities	Medium		Moderate			
		Local Organisations	Medium		Moderate			
Con/Op/Clo	CHR04 – Exacerbated conditions for GBVH	Project workforce	Low	Medium	Minor	Implementation of the Human Rights Policy is assumed, including these additional measures: • Anti-GBVH training for workforce and contractors • Collaboration with local organisations to prevent GBVH and against its normalisation	Low	**Minor Adverse**
		Direct Communities	Medium		Moderate			
		Indirect Communities	Medium		Moderate			
Con/Op/Clo	CHR05 – Increased community exposure to pollution	Project Workforce	Low	Medium	Minor	Implementation of the following: • Development of a Community Health and Safety Plan, including specific measures (Section 5.9.8)	Low	**Minor Adverse**
		Direct Communities	Medium		Moderate			

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				**Post-mitigation Assessment**	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
						• Health Impact Assessment mitigation measures • Human health monitoring programme • Implementation of specific environmental mitigation measures as per management plans and the ESMS		
Con/Op	CHR06 – Security Conflict	Direct Community Members and land users	Medium	Low	Minor	Compliance with BiH law and GIIP, including the community health, safety and security policy is assumed. Implementation of the following: • Security arrangements are guided by principle of proportionality. • Training for security personnel in the use of force and conduct towards the community • Complementary training on human rights and conflict shall be provided to contractors after a gap analysis.	Low	**Minor Adverse**
Con/Op	CHR07 – Increased Road Traffic Accidents	Road Users	Medium	Medium	Moderate	Implementation of the traffic management plan, specific training for haul route contractors to ensure implementation of the plan, encouragement of municipality to undertake road clearance in remote areas (limiting public use of haul route)	Low	**Minor Adverse**

Table 5.9.4: Social Impacts Summary								
			Pre-mitigation Assessment				**Post-mitigation Assessment**	
Project Phase	**Impact**	**Receptors**	**Receptor Sensitivity**	**Impact Magnitude**	**Impact Significance**	**Additional Mitigations**	**Residual Magnitude**	**Residual Significance**
Con/Op	CHR08 – Impact on Local health Services	Employees and their dependents	Medium	High	Major	Facilitation of a private health clinic in Vareš, accessible for employees, their spouse/partner, and dependent family members. The clinic will augment the existing health services in Vareš and be accessible to community members as required. Employee health screening checks will be conducted.	Medium	**Moderate Beneficial**
		Direct Communities	Medium		Major			
		Indirect Communities	Low		Moderate			

5.9.8 Additional Mitigations

The following additional mitigation actions are considered as relevant for the expected impacts.

- The **Local Employment Plan** should include measures and performance indicators for the management of local employment, including:
  - Procuring goods and services from local/regional businesses (local procurement plan);
  - Developing and implementing capacity building and training program to encourage local employment and local suppliers to the Project at all stages;
  - Incorporate aspects of the Procurement Policy with respect to supporting local suppliers and building capacity;
  - Women should be encouraged to apply for available positions;
  - Developing a local hiring strategy; regular posting of available positions in publicly accessible locations; maximise the use of local labour and contractors; and
  - Clearly communicating the recruitment process and the use of contractors to the local communities;
  - The communication strategy should seek to prevent unrealistic employment expectations.
- **Traffic Management Plan** to address traffic flows both in Vareš and along the haul route, identify ways to avoid delays, especially at junctions and roundabouts. The Traffic Management Plan must include as a minimum:
  - Contact details of Logistics/Transport Manager and clearly define traffic routes as agreed;
  - The Project is to agree and communicate to all drivers speed limits in urban areas and settlements;
  - Notification signs shall be erected at main public areas to warn local communities about the hazards around the Project sites and transport routes, the presence of heavy vehicles, and any closure or rehabilitation of roads, including alternative routes;
  - Transparent and clear explanations must be provided to justify the implementation of exclusion and safety zones around the Project site and transport routes;
  - Construction road traffic of heavy vehicles via residential areas of Pogar, Položac, Tisovci and Seminova Ponikva must be banned between night-time hours of 10PM to 6AM which must be included in the Traffic Management Plan;
  - All Project vehicles will carry appropriate lights for night time and periods of poor visibility. The level of lighting will be in compliance with safety regulations, and it is necessary for human safety; and
  - Snow clearing during winter months on haul route, transport routes and existing public roads.
  - Specific training to be carried out with haulage contractors on a regular basis.
- Develop an **Emergency Preparedness and Response Plan** that includes engagement with the local civil protection authorities and local communities about Project-related risks, including emergency response procedures and disclosure of risk assessments;
- **Community Health, Safety and Security Plan**. Develop a CHSSP with the following measures:

  - The CHSSP will contain measures to reduce exposure to the environmental determinants of health (pollution / emissions impacts) and manage individual and social determinants of health (communicable and non-communicable diseases, consumption habits);
  - Traffic and pedestrian management methods, specific to local communities, as per the traffic management plan;
  - Employee training programmes to cover cultural integration, GBVH and code of conduct;
- **Security Management**. Security personnel and contractors will undergo training on:
  - The IFC (2017) Good Practice Handbook on Use of Security Forces;
  - The Code of Conduct for Law Enforcement Officials;
  - The International Code of Conduct for Private Security Providers; and
  - The Voluntary Principles on Security and Human Rights (VPSHR). The VPSHR steps must be followed[4], specifically strengthening the screening process for security providers, given the post-conflict transitional justice processes in BiH focused on conflict-related sexual violence victims.
- **Workers' Code of Conduct**. The Contractor will prepare and implement a Code of Conduct (including alcohol and drug policy, and rules of conduct to avoid anti-social behaviour), that will be approved by Adriatic Metals. Training will be provided on this, as per the Community Health, Safety and Security Management plan. Aspects of the code of conduct should also be taken and specific training provided to contractors.
- **Human Resources, Human Rights Policy and the Employee Code of Conduct** cover the following aspects in regard to labour rights and non-discrimination:
  - Provide workers with clear and understandable labour rights in applicable languages;
  - Ensures migrant workers and ethnic minorities are engaged in equitable terms and conditions to national workers carrying out the same work;
  - Upholds the fair treatment of employees and prohibits discrimination in the hiring processes, remuneration and career progression, regardless of age, gender, sexual orientation, ethnicity, nationality, religion or disability;
  - supports equal opportunity and treatment, fair remuneration, and diversity in our organisation;
  - Employees are obliged to adhere to the principle of political neutrality in the performance of their work;
  - Enforces treating of the workforce with dignity and not tolerating any form of violence, bullying or harassment;
- **Prevention of GBVH**. Implement the following measures as part of the Human Rights Policy, Employee Code of Conduct, Human Resources Policy and Community Health, Safety and Security Plan:
  - Specific training to be provided to all employees and contractors covering what GBVH is and identification signs. This training should be undertaken in line with EBRD and

[4] 1) Define and assess private security requirements; 2) Conduct due diligence and select / contract a private security provider; 3) Deploy and monitor selected private security provider; 4) Respond to private security provider misconduct; and 5) Address private security provider challenges.

IFC's GBVH guidance note prepared in 2020. Specific questions are presented for employees.
    - Within the grievance procedure GBVH should be treated confidentially and with extreme sensitivity.
    - Respond to reports of GBVH in a survivor-centred approach, maintaining confidentiality throughout. This method of reporting should be developed as part of the HR system. Access to support systems or treatment should be in place for employees.
    - Develop a form of ongoing monitoring to track GBVH across Project operations and contractors through employee forms and feedback following annual training sessions.
    - Should GBVH be raised as a concern by any employee or community member an in-depth GBVH risk assessment should be carried out across the Project operations.
- **Retrenchment Strategy**. Including the following:
    - Workers must receive notification of dismissal and severance payments, as required by applicable regulations and collective agreements, in a timely manner (IFC 2012);
    - Provide alternatives to retrenchment, including negotiated working-time reduction programmes, employee capacity-building programs, long-term maintenance works for post-decommissioning stages, among others.

The following additional enhancement measures are considered as relevant for the expected beneficial impacts.

- Collaboration with local organisations, including:
    - Engage with local academic sector to support research in mining and processing methods and invest in pilot projects to implement the research projects.
    - Local schools teaching mining engineering in partnership with local academic sector with long-term beneficial effects.
- Engage with appropriate municipality ministries to identify most suitable development projects in the region;
- Economic enhancement measures – These benefits may not remain in the area or may only benefit some stakeholders without enhancement measures for equitable access to opportunities.

5.9.9 Unplanned Events

5.9.9.1 Overview

In addition to the expected impacts linked to routine Project activities, there is a potential for unplanned events to occur during the different Project stages. Unplanned events include emergencies, accidents and disasters occurring from uncontrolled developments during the Project or naturally occurring extreme events. Major accidents involving the release of toxic materials, flammable materials, fires, explosions, and major structural failures are further described throughout the ESIA.

From a social perspective, risks related to Occupational Health & Safety (OHS) and Community Health & Safety (CHS) are presented below.

The following unplanned events are presented without assessing their respective likelihood or probability due to the lack of accurate information to determine risk levels. Additionally, unplanned events are generally likely to be of major significance. However, it is assumed that Project planning and design criteria are established in order to reduce the likelihood of unplanned events to a level that is As Low As Reasonably Practicable (ALARP). This would include periodic risk assessments during the Project lifecycle and monitoring of the efficiency of risk reduction and mitigation measures to maintain risks within a tolerability threshold criteria.

5.9.9.2 Occupational Health and Safety

Although the Project is assumed to align to OHS best practices (i.e. IFC PS 2, EP 3, and EBRD PR 2), unplanned events can still occur across site operations. In case of negligence, unintended OHS incidents may occur to the Project's workforce (CHS presented below). Based on IFC PS 2, negligence to provide a safe and healthy work environment, taking into account the inherent risks and hazards in its work areas, may include risk of exposure to physical, chemical, biological and radiological hazards, as well as specific risks to women in the workforce.

The following is typically required for compliance with GIIP:

- Ensure a hazard and risk identification process is in place.
- Develop and implement an Emergency Preparedness and Response Plan (EPRP) specific to the Vares Project context, including scenarios and plans to respond to Project-related incidents that may affect communities, containing information on possible affected communities as well as communication and notification strategies and procedures.
- Disclose the EPRP and undertake engagement with the local emergency response organisations as well as local communities who may be affected by the risks/scenarios identified in the hazard and riak identification process.
- Community engagement around the planning and preparedness for emergencies will be aligned with the United Nations Awareness and Preparedness for Emergencies at Local Level (APELL) process.
- Emergency response teams will be appropriately trained to deal with anticipated potential emergency situations.
- Establish mutual support agreement with local and national police, any emergency services, as feasible.
- Manage the procurement, transport, storage, use and disposal of reagents and chemicals consistently with GIIP (Hazardous Materials Management Plan)
- Maintain an inventory and ensure contingency measures are in place for heating, water, and power to maintain worker H&S in the event of an emergency situation.
- Develop a business recovery plan as part of the EPRP process.

5.9.9.3 COVID-19

Since 2020, the Coronavirus (COVID-19) pandemic has presented a high OHS risk to workers, specifically for workers at project sites and the community members with whom workers may come into contact. The following examples show the type of measures that should be followed to mitigate the potential spread of COVID-19:

- Follow public authorities' guidance regarding prevention measures;
- Work shifts should be split to avoid large numbers of staff working together;
- Peak times in shared use areas should be split;
- Personal protection equipment (PPE) should be provided, including hand sanitizers and masks for all personnel and visitors;
- Temperatures should be taken periodically and, if applicable, staff should be provided with disposable plates and forks to avoid using common utensils;
- Suspected COVID-19 cases should be quarantined for 14 days and taken to the nearest hospital, if required, until they have been cleared after testing or otherwise taken into public healthcare;
- Adriatic Metals should develop an emergency response team comprised of managers for quick decision-making processes;
- Medical awareness campaigns should be provided to the workforce in all the applicable languages; and
- Project risk assessment must consider COVID-19 exposure on the construction site and during Project operation.

5.9.9.4 Road Accidents

Increased traffic volumes and presence of heavy vehicles on the roads were evaluated as a potential impact above, based on planned activities. However, unplanned events such as road accidents could occur between the transportation of construction materials and machinery on roads which will also be used by private users. Increased risks could occur on the route for extraction of materials / waste in the northern part of Vareš, at crossings and uses of the main road. Larger volumes of traffic could increase land road users' risks, resulting in:

- Unintended vehicle collisions resulting in injuries and fatalities;
- Public and private asset loss or damage; and
- Collisions with pedestrians or animals in crossing areas or in case of lack of crosswalks, sidewalks or traffic signs.

It is assumed that traffic management plans and driver training will comply with IFC PS 4 to avoid, reduce or minimise the risks and impacts on CHS. Additionally, management plans such as a Community Health Safety and Security Plan and Traffic Management Plan can focus on reducing exposure and respond to emergencies.

5.9.9.5 Unmanaged / unmet Community Expectations

Community expectations related to employment and sharing in Project benefits through socio-economic development are expected. If these expectations are not appropriately and timely addressed with accurate disclosure of the amount of job opportunities and required skillsets, local stakeholders may be disappointed and develop opposition to the Project.

In a context of relatively high unemployment, local communities could be dissatisfied if access to the finite construction and operational stage jobs and the provision of associated services is perceived to be biased and preferential. Local recruitment targets are assumed to be complied with in Adriatic Metals and supply chain contractors, based on the existing company policies. Communication channels need to be accessible and transparent between local communities and the Project to allow stakeholders to discuss major concerns. A structured and on-going stakeholder engagement process must be monitored under the existing Stakeholder Engagement Plan and the Grievance Mechanism for both workforce and other stakeholders. The Public Liaison Committee has successfully created a platform for open dialogue between Adriatic Metals and the community. This will continue throughout the life of the Project, with local employment a key and ongoing topic of discussion.

5.9.10 Conclusions

The Project has the potential to create both beneficial and adverse impacts with a scope from local to regional and national. Local communities and the people and businesses who reside within them will be impacted the most. Affected peoples have been further divided into vulnerable groups to ensure that all affected people and impacts are identified and mitigated.

The majority of impacts have been identified to occur during the construction and operational phases of the Project. This is largely due to the influx of migrant workers, land use changes, opportunities for local people, and economic opportunities for businesses and local people. As the Project will be progressing, this is detailed further in the alternatives assessment (Chapter 6), although many of the impacts will be unavoidable. However, where possible mitigation will be implemented to reduce the severity. Additional mitigation measures will be further detailed in the ESMP (see Chapter 7).

More impacts have been identified and assessed as being adverse rather than beneficial. Pre-mitigation, the most severe adverse impact significance was major for job loss and retrenchment and impact to local health services. The former remains as a moderate impact post mitigation. The latter will become a positive impact when a new health clinic is facilitated in Vareš. All other residual impacts have a significance impact of minor or negligible. Where relevant, mitigation methods are being implemented to ensure the residual impacts remain minor.

It is anticipated that people within the economically active population will benefit the most from the Project, and that the EAP will likely consist of local people and people from a regional scale drawn to the Project area for work opportunities.

5.10 Archaeology and Cultural Heritage

5.10.1 Introduction

This impact assessment chapter identifies potential impacts of the Vareš Project polymetallic mine throughout all stages of its lifetime: construction, operation, and closure to archaeological and cultural heritage receptors.

The methodology, described in detail below, is based on guidelines of the European Bank for Recovery and Development (EBRD), World Bank and other prominent International Finance Institutions (IFIs) such as the, and the International Finance Corporation (IFC).

5.10.2 Impact Assessment Criteria

Heritage assets identified as *sensitive receptors,* have been assigned a value ranging from **negligible** – **high** (Table 5.10.1).

Table 5.10.1: Receptor Sensitivity Scale

Sensitivity of receptor	**Description of receptor**
Negligible	Abundant; Local importance or scale; Resilient to change; Potential for substitution within the local area.
Low	Regional importance or scale; undesignated Heritage assets recorded on the Archaeological Lexicon of FBiH; Reasonably resilient to change; Potential for substitution.
Medium	National importance or scale; Heritage assets designated by the Commission for Protection of National Monuments; Fragile and susceptible to change; Limited potential for substitution.
High	Very high sensitivity; Extremely rare; International importance or scale; UNESCO designated World Heritage sites, Very fragile; Highly susceptible to change; Very limited potential for substitution.
Note: the scale combines the description of the receptor together with its geographic extent. The general descriptions used in **Error! Reference source not found.** have been developed for each environmental aspect, taking into account the relevant performance standards that are applicable.	

Magnitude of change, ranging from **negligible** – **high** is described in Table 5.10.2.

Table 5.10.2:Magnitude of Change Scale	
Magnitude of change	**Description of change**
Negligible	Minimal detectable changes in baseline resource. Changes are either of short duration or infrequent or both
Low	During construction and operations there would be ongoing, detectable, change in the underlying characteristics or quality of the baseline conditions.
Medium	Partial loss of, or adverse alteration to, the baseline conditions of a specific environmental resource would occur. Post development characteristics or quality would be partially changed during construction and operational phases.
High	Degree of change is such that total loss of, or adverse alteration to, the baseline conditions of a specific resource would occur. Post-development characteristics or quality would be fundamentally and irreversibly changed.

Impacts can be either Beneficial or Adverse. Professional judgement is applied to determine Significance of Impacts via the combination of the magnitude of change and the receptor sensitivity, to create the Impact Significance Matrix (Table 5.10.3).

Table 5.10.3: Impact Significance Matrix				
Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

5.10.3 Baseline Summary

The archaeological and cultural heritage baseline study was undertaken in accordance with EBRD Performance Requirement 8: Cultural Heritage (EBRD PR 8) and has been compiled predominantly through a desk study, supported by archaeological investigation undertaken by the National Museum of Bosnia. Site visits and household surveys were carried out by WAI personnel. The full baseline is available in Chapter 4.14.

There are no World Heritage Sites or receptors of High Sensitivity in the vicinity. Eight designated cultural heritage assets of Medium Sensitivity are located within the municipality of Vareš, but none of these sites is located in close proximity to the proposed project. The fortified medieval city of Bobovac is located approximately 6.5km from the Rupice mine and 4.8km from the haul route.

In addition to the eight designated sites, 20 archaeological sites are recorded in the Archaeological Lexicon of FBiH within the municipality of Vareš. These undesignated sites include the medieval cemeteries at Borovica Donja, located c. 500m from the proposed haul road, Brezik, located less than 1km from the proposed processing plant, and Višnjići, located c. 2km south of Veovaca open pit.

Vareš has strong ties with the Bosnian War; the Army of Republic of Bosnia and Herzegovina (ARBiH), Croatian Defence Council (HVO), and the Army of Republika Srpska (VRS) were all active in the region until the Dayton Agreement was signed in November 1995. Consequently, memorials and cemeteries linked to the war are found throughout the region.

5.10.4 Potential Impacts

The Project consists of the polymetallic underground Rupice mine, and the Vareš Processing Plant facility, as well as a 24.5km haul route connecting the two. The Vareš Processing Plant is located on brownfield land used for processing metals during the previous period of mining in the 1990s.

Desk based studies and fieldwork undertaken by the National Museum of BiH revealed that there are no known, or unknown previously unrecorded, significant sites within, or near, the proposed infrastructure for the Project. Therefore, "appropriate measures for minimising and mitigating adverse impacts on the cultural heritage", as detailed in Paragraph 12 of EBRD PR.8, will not be required.

5.10.5 Mitigation

Consultation with religious leaders in Gornja Borovica and the Borovica community leader determined that pilgrimage routes to a number of Roman Catholic monuments coincide with the proposed haul road. Consequently, the proposed route of the haul road was redesigned, to ensure continued access in accordance with Paragraph 13 of EBRD PR. 8.

When pilgrimage processions take place, mining and haul activities should be minimised where they could potentially impact on the cultural activities. Whilst these routes are not along the proposed haul route, it can be anticipated that the general area of Borovica would be significantly busier, thus extra care would be required. The same is true for the duration of the Borovica art colony, where Vareš would expect to see a significant increase in the number of visitors. Vehicular movements during this time should be carefully managed to avoid busy periods in Vareš and Borovica.

5.10.6 Further Recommendations

Unexpected archaeological remains may be discovered during ground works and mineral exploitation. It is anticipated that the most likely finds will be related to historic mine workings in the region. In compliance with Paragraph 14 of EBRD PR. 8, the Client "will not disturb any chance finds until an assessment by a designated and qualified specialist is made and actions consistent with national legislation and this PR are identified". A chance finds procedure and cultural heritage management plan, in accordance with EBRD PR 8, has been developed for the Project.

Appropriate mitigation measures will be included in the overall Environmental and Social Management System (ESMS) and described in the project-specific Environmental and Social Management Plan (ESMP), in accordance with EBRD PR. 8, Paragraph 12. The ESMP will prescribe that mitigation measures are overseen by trained and qualified personnel and detail methods to ensure that any third parties, such as contractors, working on the project are fully briefed, managed and monitored in accordance with PR. 8.

5.10.7 Conclusion

There are no known, or unknown previously unrecorded significant sites within, or near, the proposed infrastructure for the Vareš Project. The client has been pro-active in taking steps to “anticipate and avoid” impacts to pilgrimage routes. All appropriate mitigation measures, including provision of a Chance Finds Procedure, have been adopted in accordance with EBRD PR. 8.

5.11 Landscape and Visual Impact Assessment

5.11.1 Introduction

This section describes the results of an assessment of the potential landscape and visual impacts resulting from the construction, operation, and closure of the Vares Polymetallic Project. For the purposes of the assessment, the project is separated into three components: the Rupice mine site, the Vares Processing Plant site, and the Haul Route connecting the two sites.

5.11.2 Methodology

5.11.2.1 General Approach

The general methodological approach to the impact assessment is outlined in Section 5.1 and is based on guidelines of the European Bank for Reconstruction and Development (EBRD), World Bank and International Finance Corporation (IFC). The general descriptions and criteria used in Section 5.1 for receptor sensitivity, magnitude of change and impact significance have been adapted considering the guidance contained within the Guidelines for Landscape and Visual Impact Assessment, Third Edition[1] (GLVIA 3).

Landscape effects associated with a development relate to changes to the fabric, character and quality of the landscape as a resource and how it is experienced. This requires consideration of the character of the landscape, the elements and features that it contains, and any values attached to the landscape. Visual effects relate closely to landscape effects, but they concern changes in views and visual amenity. Visual assessment concerns people's perception and response to changes in visual amenity. Effects may result from new landscape elements that cause visual intrusion or new features that obstruct views across the landscape.

GLVIA 3 stresses that the emphasis of landscape and visual impact assessments should be on the identification of likely significant effects, embracing all types of effects: adverse and beneficial, direct and indirect, and long and short term, as well as cumulative effects. It also stresses that the approach to the assessment needs to be proportionate to the scale of the project being assessed and the nature of the likely effects.

The UK based Landscape Institute produced Technical Guidance Note 06/19[2] to advise its members on the use of photography and photomontage in landscape and visual assessment and on visual representations of development proposals; the photographs in this LVIA have been produced and presented in accordance with this advice.

[1] Guidelines for Landscape and Visual Impact Assessment, Third Edition, by the Landscape Institute and Institute of Environmental Management and Assessment (2013)
[2] Visual Representation of Development Proposals, Landscape Institute Technical Guidance Note 06/19 (17 September 2019)

5.11.2.2 The Study Area

The Landscape and Visual Impact Assessment (LVIA) considers the proposed Vares Project comprising the polymetallic underground Rupice Mine and the Vares Processing Plant, both with associated infrastructure, and the Haul Route connecting these two project areas. The study area encompasses an area within a 2km radius of the Rupice Mine and Haul Route, and within a 3km radius of the Vares Processing Plant. The LVIA has been carried out by means of a process of desk and site survey and analysis of the study area.

5.11.2.3 Thresholds and Criteria

GLVIA 3 (paragraph 1.20) states that the guidance is "not intended to be prescriptive, in that it does not provide a 'recipe' that can be followed in every situation. It is always the primary responsibility of any landscape professional carrying out an assessment to ensure that the approach and methodology adopted are appropriate to the particular circumstances." This LVIA has therefore defined a set of criteria to assess the potential landscape and visual effects of the Proposed Development that reflect the circumstances of the site and the surrounding area and that consider the methodological considerations outlined in Section 5.1.

Where significant effects are predicted, these are highlighted in bold text. Whilst significant adverse effects may be identified in connection with a Proposed Development, this does not imply necessarily that the development taken as a whole would be unacceptable in environmental terms.

5.11.2.4 Methodology for the Assessment of Landscape Effects

The significance of the landscape effects identified is determined by a consideration of the sensitivity of the landscape receptors and the magnitude of the effects on the landscape. The sensitivity of a landscape receptor combines judgements of its susceptibility to the type of change or development proposed and the value attached to the landscape.

Susceptibility to change is defined as the ability of the landscape receptor (whether it be the overall character or quality/condition of a particular area of landscape, or an individual element and/or feature, or particular aesthetic and perceptual aspect) to accommodate the proposed development without undue consequences for the maintenance of the baseline situation (see paragraph 5.40 of GLVIA 3). Factors that may influence the susceptibility of the landscape to change include: scale, landform, pattern and complexity, settlement and human influence, condition, typicality and rarity, perceptual aspects (such as tranquillity, sense of remoteness, etc), and visual aspects of landscape such as skylines, intervisibility, views and landmarks and numbers of visual receptors. Landscapes with a higher susceptibility to change are those whose key characteristics are highly vulnerable to change; landscapes having a lower susceptibility to change are those whose key characteristics are robust and would not be adversely affected by the proposals.

An assessment of value is concerned with the relative value attached to different landscapes by society. A consideration of value at the baseline stage informs judgements of the significance of effects. Landscapes can be valued by different people for different reasons connected to a range of factors including landscape quality (condition), scenic quality, rarity, representativeness, conservation interests, recreation value, perceptual aspects and associations (see GLVIA 3 Box 5.1 for definitions). This consensus can be recognised at a local, regional or national or international scale.

As described above, landscape sensitivity combines judgements on the susceptibility of landscape receptors to change of the type proposed, with the value attached to the landscape. Generally, a higher sensitivity will be ascribed to landscapes which have a high value, and which are highly susceptible to change, and vice versa. The landscape sensitivity receptor scale is described in Table 5.11.1.

Table 5.11.1 Landscape Receptor Sensitivity Scale

Sensitivity of receptor	**Description of receptor**
Negligible	Key characteristics of the landscape are robust and would not be adversely affected by development. Value ascribed to the landscape is very low in terms of condition, importance, scenic quality and rarity. Areas of local scale which may typically be identified for recovery. Good potential for substitution.
Low	Few of the key characteristics of the landscape are susceptible to change. The landscape is likely to be able to accommodate development with only minor change in character. Value ascribed to the landscape may be low in terms of condition, importance, scenic quality and rarity. Areas of local or community scale which may typically be identified for improvement. Some or good potential for substitution.
Medium	Some of the key characteristics of the landscape are susceptible to change. Although the landscape may have some ability to absorb some development, it is likely to cause some change in character. Value ascribed to the landscape may be medium in terms of condition, importance, scenic quality and rarity. Areas of regional scale which may typically undesignated or designated locally, but with value expressed through demonstrable use. Limited potential for substitution.
High	Key characteristics of the landscape are highly susceptible to change. The nature of the development would result in a significant change in character. The value ascribed to the landscape is high or very high: very good condition, high importance, scenic quality, rarity and no or very limited potential for substitution. Areas of national or international scale and importance (e.g., National Park, World Heritage Site).

Judgements on the magnitude of change experienced by landscape receptors are assessed in terms of the size or scale of effect, the geographical extent of the area influenced and its duration and reversibility. Table 5.11.2 explains how these criteria are applied to determine the magnitude of change; this has been developed specific to this LVIA and is derived from GLVIA 3.

Table 5.11.2 Landscape Magnitude of Change Scale	
Magnitude	**Description of change**
Negligible	• Very minor loss of or alteration to key features or perceptual aspects of the baseline and/or the addition of new features that are not uncharacteristic with the surrounding landscape - approximating the ' no change' situation • The impacts would be at the site level, within the development site itself • The impacts would be very short term (< 1 year) and/or reversible
Low	• Minor loss of or alteration to key features or perceptual aspects of the baseline and/or the addition of new features that may not necessarily be uncharacteristic when set within the attributes of the receiving landscape • The impacts would be at the level of the immediate setting of the site • The impacts would be short term (1 – 5 years) and/or reversible
Medium	• Partial loss of or alteration to key features or perceptual aspects of the baseline and/or the addition of new features that may be prominent but may not necessarily be substantially uncharacteristic when set within the attributes of the receiving landscape • The impacts would be at the scale of the landscape character type/area within which the proposal lies • The impacts would be medium term (5 – 10 years) and/or partially reversible
High	• Total loss of or major alteration to key features or perceptual aspects of the baseline and/or the addition of new features considered to be totally uncharacteristic when set within the attributes of the receiving landscape • The effects would be of a large scale influencing several landscape character types/areas • The effects would be long term (10 – 25 years or beyond) and/or irreversible

The significance of impacts is defined via the combination of the magnitude of change and the qualitative descriptions from receptor sensitivity, to create the Impact Significance Matrix as per Table 5.11.3.

Table 5.11.3 Landscape Impact Significance Matrix				
Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

In terms of judgements on the significance of landscape effects, Paragraph 5.56 of GLVIA 3 states that *"At opposite end of a spectrum it is reasonable to say that:*

- *major loss or irreversible negative effects, over an extensive area, on elements and/or aesthetic and perceptual aspects that are key to the character of nationally valued landscapes are likely to be of the greatest significance;*
- *reversible negative effects of short duration, over a restricted area, on elements and/or aesthetic and perceptual aspects that contribute to but are not key characteristics of the character of landscapes of community value are likely to be of the least significance and may, depending on the circumstances, be judged as not significant;*

- *where assessments of significance place landscape effects between these extremes, judgements must be made about whether or not they are significant, with full explanations of why these conclusions have been reached."*

For the purposes of the current assessment, and in line with the general methodology outlined in Section 5.1, negligible and low significance will be considered as 'insignificant' impacts and will not require additional mitigation measures. Moderate and major significance will be considered 'significant' impacts and will be subjected to specific mitigation measures to reduce them to acceptable levels.

5.11.2.5 Methodology for the Assessment of Visual Effects

The significance of the visual effects identified is determined by a consideration of the sensitivity of the visual receptors and the magnitude of the change experienced by these receptors. The sensitivity of a visual receptor combines judgements of its susceptibility to the type of change or development proposed and the value attached to particular views. It should be noted here that visual receptors refers to people.

Susceptibility of visual receptors is primarily a function of the expectations and occupation or activity of the receptors (GLVIA 3, Paragraph 6.32). Paragraph 6.33 of GLVIA 3 states that *"The visual receptors most susceptible to change are generally likely to include:*

- *residents at home;*
- *people, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focused on the landscape and on particular views;*
- *visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience;*
- *communities where views contribute to the landscape setting enjoyed by residents in the area."*

Paragraph 6.34 of GLVIA 3 states that *"Visual receptors likely to be less sensitive to change include:*

- *people engaged in outdoor sport or recreation which does not involve or depend upon appreciation of views of the landscape;*
- *people at their place of work whose attention may be focused on their work or activity, not on their surroundings, and where the setting is not important to the quality of working life (although there may on occasion be cases where views are an important contributor to the setting and to the quality of working life)."*

Travellers on road, rail or other routes may fall somewhere in between these two ends of the spectrum.

The assessment of value attributed to visual receptors relates to the value of the view, which should typically take account of, for example, documentary evidence of the recognition of the value attached to particular views, such as recommendations to visitors, or reference within the special qualities of designated areas. Therefore, a high value view would be one which is promoted, or well-known and which people may visit purely to experience the view e.g., panoramic viewpoints marked on maps, key views in a designed landscape, etc. Conversely, a view of limited (public) value might be a purely private view, or a view of a townscape or landscape which has very low scenic value, condition, or importance.

As described above, visual sensitivity combines judgements on the susceptibility of visual receptors to change of the type proposed, with the value attached to the view. Generally, judgements of susceptibility and value are closely linked; for example, the most valued views are likely to be those which people go and visit because of the available view – and it is at those viewpoints that their expectations will be highest. The visual sensitivity receptor scale is described in Table 5.11.4.

Table 5.11.4 Visual Receptor Sensitivity Scale

Sensitivity of receptor	Description of receptor
Negligible	Views from urban roads, footways, railways, and industrial areas where viewers' attention may be focused away from the landscape and where tolerance to change is likely to be high. Users of motorways and other main roads travelling through landscapes of low scenic value; shoppers at retail parks, people at their (indoor) places of work and other commercial buildings or locations where people's attention may be focused on their work or activity.
Low	Low sensitivity receptors may include people engaged in outdoor sports or recreation (other than appreciation of the landscape), including users of sports facilities such as football grounds and golf courses that do not rely on appreciation of the landscape. Views are not valued locally or will not affect the setting of cultural heritage assets. The view contains several discordant or intrusive elements. Less sensitive visual receptors travelling through such landscapes.
Medium	Medium sensitivity receptors may include users engaged in outdoor recreation activities including footpaths, whose attention or interest may be focused on the landscape/townscape, such as hill walking, mountain biking, Nordic skiing, horse riding, sailing, fishing, or visiting attractions, such as parks, or archaeological sites. Communities where the development results in changes in the landscape setting or valued views enjoyed by the community. Views are attractive and valued locally; visible by visual receptors having a medium susceptibility to change. Receptors may also have a high susceptibility to change combined with views of limited (public) value, such as occupiers of residential properties.
High	High susceptibility to change combined with high value. For example, public views within areas of protected landscapes such as National Parks or designed views within heritage assets. Visitors to valued viewpoints or routes which people might visit purely to experience the view. Views are of good quality and are well valued. Views are valued for their distinctiveness and valued nationally. The view contains no or very few intrusive features. The view is visible by sensitive visual receptors (e.g., strategic or significant recreational footpaths, and views from important landscape features, beauty spots.)

Judgements on the magnitude of change experienced by visual receptors are assessed in terms of the size or scale of effect, the geographical extent of the visual effect and its duration and reversibility. Table 5.11.2 explains how these criteria are applied to determine the magnitude of change; this has been developed specific to this LVIA and is derived from GLVIA 3.

Table 5.11.5 Visual Magnitude of Change Scale	
Magnitude	**Description of change**
Negligible	• Very minor loss of or alteration to views and/or the addition of new features that would be almost imperceptible - approximating the ' no change' situation • Very brief glimpsed views • The views would be very distant, very oblique and/or only a tiny part of the view would be occupied by the proposed development • The effects would be very short term (< 1 year) and/or reversible
Low	• Minor loss of or alteration to views and/or the addition of new features that would not be prominent, and/or would not contrast with the existing view • Glimpsed views, experienced for a small part of a journey or activity • The views would be distant, oblique and/or only a small part of the view would be occupied by the proposed development • The effects would be short term (1 – 5 years) and/or reversible
Medium	• Partial loss of or alteration to views and/or the addition of new features that would be prominent, and/or would contrast with the existing view • Partial views, experienced for part of a journey or activity • The views would be middle distance, partially oblique and/or partially occupied by the proposed development • The effects would be medium term (5 – 10 years) and/or partially reversible
High	• Total loss of or major alteration to views and/or the addition of new features that would be very prominent, and/or would greatly contrast with the existing view • Full, open views, experienced for much of a journey or full duration of an activity • The views would be close, direct and/or totally occupied by the proposed development • The effects would be long term (10 – 25 years or beyond) and/or irreversible

The significance of impacts is defined via the combination of the magnitude of change and the qualitative descriptions from receptor sensitivity, to create the Impact Significance Matrix as per Table 5.11.6.

Table 5.11.6 Visual Impact Significance Matrix				
Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Medium**	**High**
Negligible	Negligible	Negligible	Minor	Moderate
Low	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Moderate	Major
High	Minor	Moderate	Major	Major

In terms of judgements on the significance of landscape effects, Paragraph 6.44 of GLVIA 3 states that *"There are no hard and fast rules about what makes a significant effect, and there cannot be a standard approach since circumstances vary with the location and context and with the type of proposal. In making a judgement about the significance of visual effects the following points should be noted:*

- *Effects on people who are particularly sensitive to changes in views and visual amenity are more likely to be significant;*

- *Effects on people at recognised and important viewpoints or from recognised scenic routes are more likely to be significant.*
- *Large-scale changes which introduce new, non-characteristic or discordant or intrusive elements into the view are more likely to be significant then small changes or changes involving features already present within the view."*

For the purposes of the current assessment, and in line with the general methodology outlined in Section 5.1, negligible and low significance will be considered as 'insignificant' impacts and will not require additional mitigation measures. Moderate and major significance will be considered 'significant' impacts and will be subjected to specific mitigation measures to reduce them to acceptable levels.

5.11.2.6 Zone of Theoretical Visibility Mapping

Zones of Theoretical Visibility (ZTVs) are also referred to as Zones of Visual Influence diagrams (ZVIs) or visual envelope maps (VEMs); however, ZTV is the preferred term as it emphasises the key factors of the plans – that they are theoretical and that they indicate potential visibility by coloured shading overlain on a mapped or aerial photograph background, to illustrate the areas within the surrounding landscape from which the proposals theoretically visible. As they are based upon computer modelling of inter-visibility based upon bare ground topography, they do not show the effects of screening of buildings or trees, or of localised changes in the topography that may not be included in the Digital Terrain Model (DTM). They are thus a worst-case scenario. They do not convey the nature or significance of effects; in particular, it is relevant to note that the mapping depicts the theoretical view of the whole development in the same way as the theoretical view of a small part of the uppermost part of a single building. For this LVIA a ZTV for the Vares Processing Plant has been created based on the landform of the existing site and the site layout (See Chapter 4.15, Drawing 4.15.3), using an assumed maximum building height of 18m above ground level.

5.11.2.7 Selection of Viewpoint Locations

Viewpoints are chosen to illustrate the potential visual effects of a scheme. The principal criterion is that they must be representative of the range of views and viewer types likely to experience the development (paragraphs 6.19 and 6.20 of GLVIA 3). Specific points may also be chosen because they are important existing viewpoints in the landscape. View types can include: viewpoints that may have wide panoramic views or, by contrast, focused views; viewpoints at different distances from the site; viewpoints at different elevations; and viewpoints from different aspects. Viewer types can include views from residences, roads or recreational points where visitors may experience the landscape; and viewpoints where viewers would be likely to be stationary, as well as those where they would be moving through the landscape.

Six representative viewpoints were identified for the Vares Processing Plant and a single representative viewpoint for the Haul Route. These viewpoints are numbered one to seven respectively and are shown on Figures 5.11.1 to 5.11.7. Photographs were taken from these viewpoint locations during fieldwork in April 2021, in order to ensure that the baseline images are up to date.

The photographs were taken with a full frame digital SLR camera with a fixed 50mm lens, mounted on a stable, levelled tripod with a professional panoramic head attached. This positions the focal centre of the camera lens above the pivot of the tripod and allows the photographs to be stitched together accurately using software.

5.11.3 Assessment of Landscape Effects

The nature of the effects would vary during the construction and operation of the Project. Table 5.11.7 addresses the aspects of the operations that have the potential to affect the fabric and character of the landscape. Some of these changes are perceptual, but they may have the potential to have an effect upon landscape character.

It is important to remember that for the Vares Processing Plant this development would take place within the immediate context of the former mining plant site, on an area of (brownfield) land which has already been (largely) demolished and cleared, thus reducing the potential for significant adverse effects on landscape character from the development of the new plant.

Table 5.11.7: Summary of potential changes relating to different aspects of the development

Aspect of development	Potential Change
Vares Processing Plant/TSF	
Construction	Physical Characteristics: Clearance and preparation of development area. Gradual erection of the buildings, structures and associated infrastructure throughout the construction period.
	Perceptual Characteristics: Movement, activity and noise associated with both construction traffic and building work.
Operation	Physical Characteristics: Presence of new processing plant in the landscape of the site and surrounding area. Presence of TSF in the landscape (gradually increasing in size throughout the operational period).
	Perceptual Characteristics: Movement and activity associated with ongoing operation.
Closure	Physical Characteristics: Gradual removal of the buildings, structures and associated mining related infrastructure throughout the closure period.
	Perceptual Characteristics: Movement, activity and noise associated with both construction traffic and demolition work.
Rupice Underground Mine	
Construction	Physical Characteristics: Clearance and preparation of development area. Gradual erection of the buildings, structures and associated infrastructure throughout the construction period.
	Perceptual Characteristics: Movement, activity and noise associated with both construction traffic and building work.
Operation	Physical Characteristics: Presence of new mine infrastructure in the landscape of the site and surrounding area.
	Perceptual Characteristics: Movement and activity associated with ongoing operation.
Closure	Physical Characteristics: Gradual removal of the buildings, structures and associated infrastructure throughout the closure period.

Table 5.11.7: Summary of potential changes relating to different aspects of the development	
Aspect of development	**Potential Change**
	Perceptual Characteristics: Movement, activity and noise associated with both construction traffic and demolition work. Following which the site would be restored.
Haul Route	
Construction	Physical Characteristics: Clearance earthworks and preparation of development area. Gradual progression of completed haul route between the two sites.
	Perceptual Characteristics: Movement, activity and noise associated with both construction traffic and building work.
Operation	Physical Characteristics: Presence of new road and associated earthworks as feature in the landscape.
	Perceptual Characteristics: Movement, activity and noise associated with mine traffic. There will be 4 haul trucks passing any given point during any one hour plus other vehicles associated with supplies and personnel movement.
Closure	Physical Characteristics: Presence of road as feature in the landscape.
	Perceptual Characteristics: Cessation of mine traffic. Movement, activity and noise associated with residual long-term use of the road for access.

5.11.3.1 Vares Processing Plant

As a brownfield site, which has been cleared in part, the key characteristics and qualities of the site and its immediate surroundings are considered to be robust and unlikely to be unduly adversely affected. During construction there would be some disruption and disturbance at a local level. This would derive primarily from continuing site clearance and earthworks. Other effects would result from the presence of construction plant and machinery, temporary compounds and the delivery and storage of materials on the site. Impacts resulting from development on the site are as follows:

- clearance of site;
- creation of development platforms for buildings and structure; and,
- erection of new buildings including grinding facility, main processing building, concentrate buildings, tailings and reagent storage buildings, a laboratory, workshop and warehouse and several other buildings/structures. The tallest building is up to 18m high.

The impacts would be experienced at the site level and in its immediate surroundings, with the addition of features which would be prominent but not necessarily uncharacteristic within the context of the former industrial history and use of the site. Perceptual and aesthetic aspects of the local landscape would change to some extent, particularly during the construction phase, with the movement and noise associated with building work, but this would be short term only. In the medium to long term, there would continue to be activity and noise associated with the plant which would lead to a reduction in levels of tranquillity and the plant buildings and structure would be prominent features in the local landscape. Following closure of the mine it is understood that the fabric of the processing plant buildings would remain, though items related to specific mining activities would be removed. The area would then be used for the development of other industrial or commercial activities.

The Tailings Storage Facility (TSF) is also part of the Vares Processing Plant area and is located in the valley directly south of the plant site. Locally sourced rock will make up the starter embankment at the toe of the facility, with upstream construction of compacted filtered tailings being used to develop the facility. Construction of the facility will necessitate removal of an area of forest and associated earthworks, together with roads/tracks for access. This is an area that is partially regenerating after having been cleared and/or (possibly) previously used for mining activity. Impacts arising from the introduction of the TSF into the landscape would be long-term but mostly felt at the site level. At the site level there would be a noticeable alteration to key features of the baseline (vegetation cover) and the introduction of an artificial landform. Following closure of the mine the TSF would remain in place. In the long term, closure efforts will ensure that the TSF is revegetated and it is assumed that the facility would gradually blend into the surrounding forested landscape.

The landscape of the study area is predominantly rural, with small scale settlements and associated agricultural activity and much of the landscape is forested; however, this contrasts with the remains of former mining activity including the plant area at Tisovci and the historic Veovaca open pit at Daštansko. The sensitivity of the landscape has been assessed as described below.

The landform is relatively complex; however, some of this complexity has resulted from mining with exposed faces and tips being locally prominent. Patterns of land cover are largely simple although disturbed where historical mining operations have occurred. The landscape is large scale but with human scale indicators present in some areas. Along ridge tops and particularly around settlements and within areas which have been cleared for agriculture the landscape has a sense of openness. Within valleys and afforested areas, the sense of enclosure is stronger. Where not disturbed by historical mining activity the landscape is generally intact and in reasonable repair but has few features which could be considered rare. There is some human activity which would reduce the sense of tranquillity, and some lighting associated with settlement. Close proximity to some visible signs of human activity and modern development serve to reduce the sense of remoteness.

Photo 5.11.1: Rural Village of Daštansko close to Vares Processing Plant

In terms of the visual aspects of landscape character, the site of the proposed processing plant has some relationship to the skyline, with the plateau on which it would be situated forming a minor topographical feature in the local landscape; the TSF would not appear on the skyline. It is considered that important landmarks and significant views are limited, although in and around settlements, where forest has been cleared there are views to surrounding areas and from these locations there is a degree of intervisibility, links with neighbouring landscapes, and a sense of openness. Numbers of visual receptors are relatively small, but there would be visibility, primarily of the processing plant, from a number of surrounding settlements. Taking all of these factors together, it is considered that landscape has a medium susceptibility to change of the type associated with the proposed Project.

The landscape is considered to have a medium value. It is not covered by any designations for scenic beauty or landscape quality; however, outside the areas influenced by historical mining activity, it appears to be in reasonably good condition. Combining these two judgements, the sensitivity of the landscape to the proposed Project is therefore assessed as medium.

The potential effects on landscape character resulting from the introduction of the Vares Processing Plant and TSF into the landscape are assessed in Table 5.11.8 as follows:

<table>
<tr><th colspan="3">Table 5.11.8: Summary of Potential Impacts of Vares Processing Plant and TSF on Landscape Character</th></tr>
<tr><th colspan="2">Characteristic</th><th>Potential Impact</th></tr>
<tr><td colspan="3">Vares Processing Plant</td></tr>
<tr><td colspan="2">Mountainous terrain comprising succession of ridges and peaks, high plateau and deep valleys</td><td>No change to landform, the proposed processing plant would occupy the development platform occupied by the former facility</td></tr>
<tr><td colspan="2">Large areas of forest (primarily spruce and fir)</td><td>No change to forest cover; the proposed plant occupies a brownfield site</td></tr>
<tr><td colspan="2">Small-scale settlement along ridges and on plateau</td><td>Buildings would be of an industrial (large) scale, contrasting with the predominantly domestic scale architecture, although occupying a site on which such buildings were previously located (with one – the administration building – retained in the proposals)</td></tr>
<tr><td colspan="2">Grassland and other agricultural land often associated with settlement</td><td>No change to land cover; the proposed plant occupies a brownfield site</td></tr>
<tr><td colspan="2">Evidence of former mining activity throughout the landscape (open pits, infrastructure, etc.)</td><td>Currently derelict site will be brough back into active usage, continuing the influence of mining activity on the landscape</td></tr>
<tr><td colspan="2">Open views across landscape where land does not have a forest cover</td><td>The proposed new infrastructure would feature in localised views across the landscape. In most views it will appear backclothed against the surrounding landscape and not on the skyline</td></tr>
<tr><td>Sensitivity</td><td>Magnitude of change</td><td>Impact</td></tr>
<tr><td>Medium</td><td>The proposed processing plant would be a prominent feature in the landscape but one that is not necessarily uncharacteristic given the past use of the site, and the influence of former mining activity on the landscape. The effects would be long term, but are potentially reversible, with the greatest impacts being felt mostly within the site and the immediately surrounding area (including adjacent ridgelines having visibility of the site). Taking all these factors into consideration the magnitude of change on the landscape would be low.</td><td>Minor adverse (not significant)</td></tr>
<tr><th colspan="2">Characteristic</th><th>Potential Impact</th></tr>
<tr><td colspan="3">TSF</td></tr>
<tr><td colspan="2">Mountainous terrain comprising succession of ridges and peaks, high plateau and deep valleys</td><td>Direct impact on landform of valley to the south of the proposed processing plant with an embankment created across the valley with the area behind the embankment being backfilled</td></tr>
<tr><td colspan="2">Large areas of forest (primarily spruce and fir)</td><td>Direct impact on forest cover within the affected area, which would be cleared</td></tr>
<tr><td colspan="2">Small-scale settlement along ridges and on plateau</td><td>No direct impact on settlements</td></tr>
<tr><td colspan="2">Grassland and other agricultural land often associated with settlement</td><td>No change</td></tr>
</table>

<table>
<tr><th colspan="3">Table 5.11.8: Summary of Potential Impacts of Vares Processing Plant and TSF on Landscape Character</th></tr>
<tr><th colspan="2">Characteristic</th><th colspan="2">Potential Impact</th></tr>
<tr><td colspan="2">Evidence of former mining activity throughout the landscape (open pits, infrastructure, etc.)</td><td colspan="2">The proposed TSF will introduce mining activity into an area of the landscape which has been partially affected by previous activity</td></tr>
<tr><td colspan="2">Open views across landscape where land does not have a forest cover</td><td colspan="2">The TSF may be partially visible in a small number of views</td></tr>
<tr><th>Sensitivity</th><th colspan="2">Magnitude of change</th><th>Impact</th></tr>
<tr><td>Medium</td><td colspan="2">The proposed TSF would be located within a valley landform, limiting its impact on the character of the wider landscape. It would be locally prominent although features of this nature are evident in the wider landscape as artefacts of previous mining activity. Changes to landform would be permanent. Taking all these factors into consideration the magnitude of change on the landscape would be low.</td><td>Minor adverse (not significant)</td></tr>
</table>

5.11.3.2 Rupice Underground Mine complex

The Rupice Underground Mine complex is located within an afforested environment on Zvijezda Mountain, at an altitude of approximately 900 – 1,280m above sea level. The Project affected area (approximately 11ha) is dominated by coniferous forest habitat (spruce and fir) growing on siliceous soils and rocks (Photo 5.11.2). Some areas of rocky slopes and grassland are also present, with several watercourses. Construction of the complex will necessitate removal of an area of forest and associated earthworks to create platforms, together with installation of roads/tracks for access. This an area which is predominantly forest, used for commercial forestry, as well as for occasional recreation activities (e.g., hunting).

Photo 5.11.2: Drilling Rig in Rupice Forested Area

During construction there would be some disruption and disturbance at a local level. This would derive primarily from site clearance and earthworks. Other effects would result from the presence of construction plant and machinery, temporary compounds and the delivery and storage of materials on the site. Impacts resulting from development on the site are as follows:

- clearance of site;
- creation of development platforms for buildings, processing areas and stockpiles, and earthworks associated with construction of access tracks;
- erection of new buildings and facilities including backfill and shotcrete plant, crushing plant, maintenance workshops, refuelling stations and water storage and treatment facilities; and,
- creation of waste rock, ore and run-of-mine stockpiles.

The landscape of the study area is rural, and in the immediately surrounding area the land cover is predominantly coniferous forest with no proximate settlements. The sensitivity of the landscape has been assessed as follows. The landform is relatively complex; but patterns of land cover are simple. The landscape is large scale with but with human scale indicators present in some areas. Within valleys and afforested areas, the sense of enclosure is strong. The landscape is generally intact and in reasonable repair but has few if any features which could be considered rare. There is little human activity which increases the sense of tranquillity. In terms of the visual aspects of landscape character, the site would not appear on the skyline, being located below the adjacent ridgeline. It is considered that important landmarks and significant views are limited. Numbers of visual receptors are very low, and there would be no visibility of the mine complex from any settlements or residential properties. Taking all of these factors together, it is considered that landscape has a medium susceptibility to change of the type associated with the proposed Project.

The landscape is considered to have a medium value. It is not covered by any designations for scenic beauty or landscape quality; however, outside the areas influenced by historical mining activity, it appears to be in reasonably good condition. Combining these two judgements, the sensitivity of the landscape to the proposed Project is therefore assessed as medium.

The potential effects on landscape character resulting from the introduction of the Rupice Mine Complex into the landscape are assessed in Table 5.11.9 as follows:

<table>
<tr><th colspan="3">Table 5.11.9: Summary of Potential Impacts of Rupice Mine Complex on Landscape Character</th></tr>
<tr><th>Characteristic</th><th colspan="2">Potential Impact</th></tr>
<tr><td>Mountainous terrain comprising succession of ridges and peaks, high plateaux and deep valleys</td><td colspan="2">Direct impact on landform with earthworks for the creation of access track and roads, and development platforms for buildings and stockpiles</td></tr>
<tr><td>Large areas of forest (primarily spruce and fir)</td><td colspan="2">Direct impact on forest cover within the affected areas, which would be cleared</td></tr>
<tr><td>Small-scale settlement scattered across study area</td><td colspan="2">No direct impact on settlements</td></tr>
<tr><td>Small areas of grassland and other agricultural land often associated with settlement</td><td colspan="2">No change</td></tr>
<tr><td>Sense of enclosure created by combination of landform with forest cover</td><td colspan="2">Limited impact on sense of enclosure, which will also assist in reducing impacts on surrounding areas</td></tr>
<tr><td>Sensitivity</td><td>Magnitude of change</td><td>Impact</td></tr>
<tr><td>Medium</td><td>The proposed mine complex would be locally prominent and changes to landform would be permanent. However, it would be located below the adjacent ridgeline, within an area of dense forest cover, which would limit its impact on the character of the wider landscape. Taking these factors into consideration the magnitude of change on the landscape would be low.</td><td>Minor adverse (not significant)</td></tr>
</table>

5.11.3.3 Haul Route

The proposed Haul Route connecting the Rupice Mine Complex to the Vares Processing Plant is approximately 24.5km long of which 15.5km is new road and 9km existing. The Project affected area (approximately 28ha) comprises a mix of environments and landscapes ranging from dense coniferous forest to open grassland, with the proposed route also running through areas affected by historical mining activity to the west of Vareš (Photo 5.11.3). Construction of the Haul Route will necessitate both vegetation clearance and earthworks in areas of new road. Whilst such activities may also be required to accommodate the Haul Route on existing roads and tracks, the associated impacts would be lower.

During construction there would be disruption and disturbance at a local level. This would derive from vegetation clearance, earthworks and construction activity (presence of construction plant and machinery primarily, but also temporary compounds for storage of materials and plant, etc). During operation, impacts would result from the presence of the road in the landscape, and the use of it by mine and other traffic (it is intended to be a multipurpose road, accessible for forestry purposes and to the general public).

Photo 5.11.3: Previous Mined Area, Aest of Vareš where a Stretch of Haul Road will be Developed

The landscape of the study area is predominantly rural, with small scale settlement and associated agricultural activity and much of the landscape is forested; however, this contrasts with the remains of former mining activity particularly to the west of Vareš. The sensitivity of the landscape has been assessed as follows. The landform is relatively complex; however, some of this complexity has resulted from mining with exposed faces and tips being locally prominent. Patterns of land cover are largely simple although disturbed where historical mining operations have occurred. The landscape is large scale with but with human scale indicators present in some areas. Around settlements and within areas which have been cleared for agriculture the landscape has a sense of openness. Within valleys and afforested areas, the sense of enclosure is stronger. Where not disturbed by historical mining activity the landscape is generally intact and in reasonable repair but has few if any features which could be considered rare. There is some human activity which would reduce the sense of tranquillity, and some lighting associated with settlement. Close proximity to some visible signs of human activity and modern development serve to reduce the sense of remoteness in places.

In terms of the visual aspects of landscape character, the haul route would have little relationship to skylines being located predominantly along valley sides and bottoms. It is considered that important landmarks and significant views are limited, although around settlements, where forest has been cleared, there are views to surrounding areas and from these locations there is a degree of intervisibility, and a greater sense of openness. Numbers of visual receptors are relatively low, and there would be visibility of the haul route from only a very small number of residential properties. Taking all of these factors together, it is considered that landscape has a medium susceptibility to change of the type associated with the proposed Project.

The landscape is considered to have a medium value. It is not covered by any designations for scenic beauty or landscape quality; however, outside the areas influenced by historical mining activity, it appears to be in reasonably good condition. Combining these two judgements, the sensitivity of the landscape to the proposed Project is therefore assessed as medium.

The potential effects on landscape character resulting from the introduction of the Haul Route into the landscape are assessed in Table 5.11.10 as follows:

Table 5.11.10: Summary of Potential Impacts of Haul Route on Landscape Character

Characteristic	**Potential Impact**
Mountainous terrain comprising succession of ridges and peaks, high plateaux and deep valleys	Direct impact on landform with earthworks for the creation of new sections of road, and widening of existing roads and tracks where necessary
Large areas of forest (primarily spruce and fir)	Direct impact on forest cover within the localised areas, which would be cleared
Small-scale settlement scattered across study area	No direct impact on settlements, the Haul Route will run adjacent to a very small number of residential properties
Small areas of grassland and other agricultural land often associated with settlement	Direct impact on a small area of agricultural land which is crossed by the proposed route
Sense of enclosure created by combination of landform with forest cover. More open views elsewhere, particularly where land has been cleared for settlement and/or agriculture	Limited impact on sense of enclosure, which will also assist in reducing impacts on surrounding areas
Evidence of former mining activity throughout the landscape (open pits, infrastructure, etc.)	Part of the Haul Route will pass through an area of landscape which has been affected by previous mining activity

Table 5.11.10: Summary of Potential Impacts of Haul Route on Landscape Character		
Characteristic		**Potential Impact**
Open views across landscape where land does not have a forest cover		Likely to be some visibility of construction activity and mine traffic from areas having views towards the proposed Haul Route
Sensitivity	***Magnitude of change***	***Impact***
Medium	The proposed Haul Route would be locally prominent and changes to landform would be permanent. However, it would be located below adjacent ridgelines, often within areas of dense forest cover, which would limit its impact on the character of the wider landscape. Some locations are already affected by the presence of historical mining activity and/or existing road infrastructure. Taking these factors into consideration the magnitude of change on the landscape would be low.	Minor adverse (not significant)

5.11.4 Assessment of visual effects

5.11.4.1 Overview

Given the generally mountainous terrain of the study area, it is considered that overall visibility of the various Project areas is likely to be relatively limited; this is particularly so with the Rupice Mine Complex, which is not located in close proximity to any visual receptors. The visual assessment refers to the likely visual impacts at the representative viewpoints, but it is important to note that the viewpoint assessments themselves form only part of the picture. Some of the receptors included in this assessment are people in transit, either recreational users of the landscape, or people travelling through the landscape in vehicles. In these cases, therefore, the visual assessment focuses on the journey and the visual experience of the landscape as people move through it, rather than simply on the effects at one or other fixed location.

5.11.4.2 Rupice Underground Mine complex

The only visual receptors having potential views of the proposed mine complex would be recreational users of the landscape, who in this area are predominantly people using the countryside for hunting. They are considered to have a low sensitivity to change since the activity in which they are engaged does not depend primarily upon appreciation of the landscape or views. Such people are unlikely to come within close proximity of the development area therefore any views which are experienced would be mid-range to longer distance. As hunting would primarily take place in forested locations, these views would be from clearings and therefore typically transient as people move through the landscape. In this case it is considered that the magnitude of change would be up to low, resulting in a **minor visual impact (not significant).**

5.11.4.3 Vares Processing Plant (including TSF)

The views from a total of six representative viewpoints have been assessed as follows.

Viewpoint 1 (Figure 5.11.1)

This viewpoint is located towards the northern end of the main road running through the village of Daštansko. It is situated approximately 1.7km to the north-east of the Vares Processing Plant. It is representative of the view obtained by motorists travelling through the village who are generally considered to have a low sensitivity to changes in the view and visual amenity. It should be noted that these motorists would be the residents of and visitors to Daštansko or Višnjići only, as this is a dead-end road.

The existing view looks south-west along the road, which is lined on either side by detached houses. The surrounding landscape is visible through gaps between individual houses, including views south-west across the valley towards the settlement of Tisovci. However, in this particular view the site of the processing plant is screened by the roof of the adjacent property. Property boundaries are demarcated by a variety of fencing and overhead power lines are situated along the side of the road. Trees and vegetation are scattered around the settlement and the edge of the coniferous forest located above and to the east of the village is just visible beyond the houses located south of the viewpoint (towards the left of the viewpoint photograph).

From this particular location, the site of the Vares Processing Plant and TSF is not visible. The magnitude of change would be negligible and the level of **impact negligible: not significant**.

Photo 5.11.4: General View from Viewpoint 1.

Viewpoint 2 (Figure 5.11.2)

This viewpoint is located within agricultural land on the shoulder of the ridgeline to the north-west of the small hamlet of Višnjići. It is situated approximately 1.15km to the east of the Vares Processing Plant. It is representative of the view obtained by people walking within the locality who are generally considered to have a medium sensitivity to changes in the view and visual amenity.

This is an open view looking west across the valley towards the settlement of Tisovci and the Vares Processing Plant site, which has been largely cleared with few structures and buildings remaining, the most prominent of which is the three-storey administration building (which is to be retained). The view reveals many of the key characteristics of this landscape: the steep-sided, predominantly afforested succession of ridges and valleys; the areas where trees have been cleared to make way for a pastoral landscape of grassy fields interspersed with vegetation, and the scattered settlement, largely located along ridgelines, which is supported by this agricultural (and also formerly mining) activity. Where the land has been cleared of forest, the views from ridge top locations, such as this, are panoramic. The processing plant site therefore occupies a relatively small part of this view. The skyline is largely formed by a distant forested ridgeline.

During construction, there would be middle-distance views of construction operations within the processing plant site. The views would be full and open, but with a short-term duration. Construction operations would be prominent but occupy only a relatively small part of the view. Effects on the visual amenity of walkers in the landscape are assessed as low magnitude, on medium sensitivity receptors: giving rise to **a minor (adverse) level of impact: not significant.**

On completion of the construction works, there would be middle-distance views of the completed processing plant, occupying a small part of the existing field of view and not obstructing any views further to the west, of the wider landscape. Whilst the site is a brownfield site, the buildings and structures which were previously located within the development area have been largely demolished; however, the new buildings would not be seen against the skyline from this location and would be backclothed against the surrounding landscape and areas of settlement. The effects would be long term. In terms of lighting impacts, current lighting levels are likely to be relatively low given the rural location of the site. With the construction and operation of the processing plant there would be an increase in lighting within the site area; however, with effective mitigation it should be possible to limit the associated impacts. Effects on visual amenity are assessed as of low magnitude on medium sensitivity receptors: giving rise to **a minor (adverse) impact: not significant**. The use of colour on buildings and structures will assist in helping to integrate the plant area into the surrounding landscape. In this case it is recommended that a darker green colour may be suitable to clad or paint the buildings, since the plant is seen predominantly backclothed by landscape (wooded) rather than sky. The TSF is located to the west of an intermediary ridgeline and is likely to be mostly screened from view at this location.

On closure it is anticipated that the buildings and stationary mining fleet would be removed. It is not certain at this stage what after-use would be provided on the site, but the removal of the buildings would be likely to have **a minor (beneficial) impact** in the long term (Medium sensitivity receptors combined with a low magnitude of change).

Photo 5.11.5: General View from Viewpoint 2.

Viewpoint 3 (Figure 5.11.3)

This viewpoint is located between Pržići and Tisovci just below the road which connects the two settlements. It is situated approximately 0.37km to the north-east of the Vares Processing Plant at roughly the same elevation. It is representative of the view obtained by motorists travelling on the road who are generally considered to have a low sensitivity to changes in the view and visual amenity. These motorists would be largely residents of and visitors to Pržići, Tisovci, Dastansko and Višnjići. It may also be taken as a proxy of the type of view obtained by nearby residents, with views towards the site similar to the one shown, who are considered in this case to have a medium sensitivity.

This is an open, relatively close-range, view looking south-west over the adjacent woodland vegetation and across an intervening valley to the shoulder of land on which the Vares Processing Plant site is located. The existing site has been largely cleared of buildings although a small number of remaining structures are visible. Located above, and to the north of, the existing site, a number of residential properties within the settlement of Tisovci are prominent features on the ridgeline, seen partly against the skyline. The wider view also reveals many of the key characteristics of this landscape: the steep-sided, predominantly afforested succession of ridges and valleys; the areas where trees have been cleared to make way for a pastoral landscape of grassy fields interspersed with vegetation; and, the scattered settlement, largely located along ridgelines, which is supported by this agricultural (and also formerly mining) activity. Where the land has been cleared of forest, the views from elevated locations, such as this, are panoramic. The processing plant site occupies a relatively large horizontal extent of the view, but due to the elevational similarity with the viewpoint it is not particularly noticeable or prominent. The skyline is largely formed by distant forested ridgelines.

During construction, there would be close range views of construction operations within the processing plant site. The views would be full and open, but with a short-term duration. Construction operations would be seen partially on the skyline and occupying a noticeable part of the view. However, views for motorists would be transient and the corresponding effect on visual amenity is as negligible magnitude, on low sensitivity receptors: giving rise to a negligible level of impact: not significant. For nearby residents, the impacts would be slightly higher, as sensitivity is higher, and the view is fixed not transient. In this case, a low magnitude of change operating on medium sensitivity receptors would give rise to a minor (adverse) level of impact which is also not considered to be significant.

On completion of the construction works, there would be close range views of the completed processing plant, occupying a noticeable part of the existing field of view and screening at least part of the more distant view to the wider landscape. Whilst the site is a brownfield site, the buildings and structures which were previously located within the development area have been largely demolished; however, the new buildings would be seen against the skyline from this location. The effects would be long term. In terms of lighting impacts, current lighting levels are likely to be relatively low given the rural location of the site. With the construction and operation of the processing plant there would be an increase in lighting within the site area; however, with effective mitigation it should be possible to limit the associated impacts. Effects on visual amenity of road users are assessed as of negligible magnitude on low sensitivity receptors (as above): giving rise to **a negligible impact: not significant**. For nearby residents, the impacts would be slightly higher, as described above. In this case, a low magnitude of change operating on medium sensitivity receptors would give rise to **a minor (adverse)** level of impact which is not considered to be significant. The use of colour on buildings and structures will assist in helping to integrate the plant area into the surrounding landscape and may further reduce impacts. Whilst a lighter tones may be more appropriate where buildings are seen against the sky, taking all of the viewpoint assessment together, it is recommended that a darker green colour may be suitable to clad or paint the buildings. This will assist in integrating the plant into the landscape, which is predominantly wooded. From this particular location, the TSF is not visible.

On closure it is anticipated that the buildings and stationary mining fleet would be removed. It is not certain what after-use would be provided on the site, but the removal of the buildings would be likely to have a **minor (beneficial) impact** in the long term. (medium and low sensitivity receptors combined with a low magnitude of change.)

Photo 5.11.6: General View from Viewpoint 3.

Viewpoint 4 (Figure 5.11.4)

This viewpoint is located between the settlements of Stupni Do and Mir. It is situated approximately 2.6km to the south-west of the Vares Processing Plant. It is representative of the view obtained by motorists travelling on the road who are generally considered to have a low sensitivity to changes in the view and visual amenity. It may also be taken as a proxy of the type of view obtained by nearby residents, with views towards the site similar to the one shown.

The existing view looks north-east across the predominantly wooded, mountainous landscape. A number of existing features are visible in the distant view including the former open pit at Veovaca, and the village of Daštansko. The southern extent of the former plant area (and site of the proposed Vares Processing Plant) is just visible above an intervening shoulder of land although from this location the village of Tisovci is predominantly screened from view.

During construction, there would be distant views of construction operations within a small part of the edge of the processing plant site. The views would be full and open, but with a short-term duration. Whilst construction operations would be partially visible they are unlikely to be readily perceptible and would not be seen on the skyline nor occupying a noticeable part of the view. Views for motorists would be transient and the corresponding effect on visual amenity is a negligible magnitude, on low sensitivity receptors: giving rise to a **negligible level of impact: not significant**. For nearby residents, the impacts would be slightly higher, as sensitivity is greater. However, a negligible magnitude of change operating on medium sensitivity receptors would give rise **to a negligible level of impact.**

On completion of the construction works, there would be distant views of the completed processing plant, occupying a very small part of the existing field of view and seen against a more distant backdrop of the former open pit. Whilst the site is a brownfield site, the buildings and structures which were previously located within the development area have been largely demolished. The new buildings would not be seen against the skyline from this location but backclothed against the more distant landscape. The effects would be long term. Effects on visual amenity of road users are assessed as of negligible magnitude on low sensitivity receptors (as above): giving rise again to **a negligible impact**. For nearby residents, the impacts would be greater, as described above. In this case, a negligible magnitude of change operating on medium sensitivity receptors would give rise to a n**egligible level of impact which is considered to be not significant**. The use of colour on buildings and structures will assist in helping to integrate the plant area into the surrounding landscape and may further reduce impacts. In this case, it is recommended that a darker green colour may be suitable to clad or paint the buildings. This will assist in integrating the plant into the landscape, which is predominantly wooded. From this particular location, the site of TSF is not visible.

On closure it is anticipated that the buildings and stationary mining fleet would be removed. It is not certain what after-use would be provided on the site, and the removal of the buildings would be likely to have a **limited beneficial impact** in the long term. (Medium and low sensitivity receptors combined with a negligible magnitude of change.)

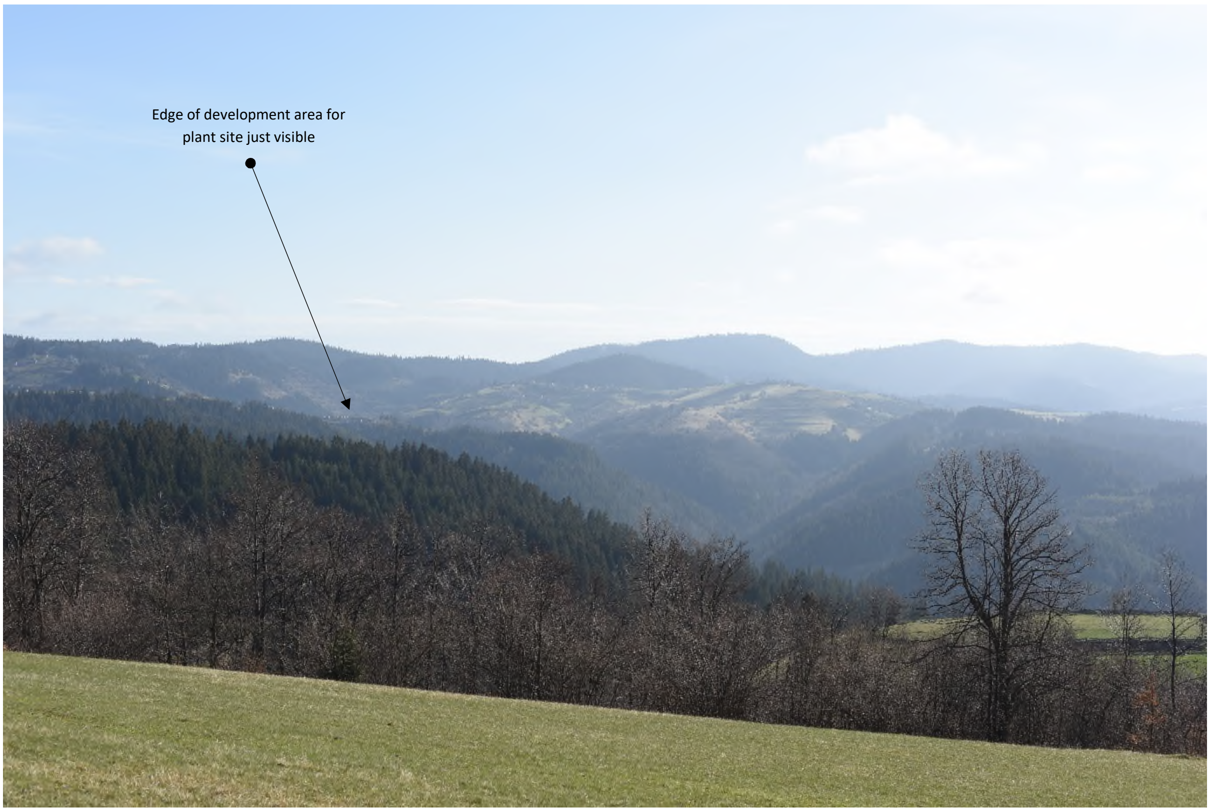

Photo 5.11.7: General View from Viewpoint 4.

Viewpoint 5 (Figure 5.11.5)

This viewpoint is located on the northern edge of Tisovci in an elevated location which has an open view over the settlement, including a view of the former plant site. It is situated approximately 0.6km to the north-west of the proposed Vares Processing Plant. It is representative of the view obtained by motorists travelling through the village who are generally considered to have a low sensitivity to changes in the view and visual amenity. These motorists would be largely residents of and visitors to Tisovci and nearby settlements. It may also be taken as a proxy of the type of view obtained by nearby residents, with views towards the site similar to the one shown. Residential receptors are generally considered to have a medium sensitivity.

This is an open view looking south-east over the village against a backdrop of the distant, forested mountainous landscape with successive peaks and ridgelines receding into the far distance. Once again, the view reveals many of the key characteristics of this landscape: the steep-sided, predominantly afforested topography of ridges and valleys; the areas where trees have been cleared to make way for a pastoral landscape of grassy fields interspersed with vegetation, and the scattered settlement, largely located along ridgelines, which is supported by this agricultural (and also formerly mining) activity. Where the land has been cleared of forest, particularly in and around settlements, the views from elevated locations, such as this, are panoramic. The processing plant occupies a relatively small part of this view, although it is seen backclothed against the surrounding landscape and does not appear on the skyline.

During construction, there would be middle-distance views of construction operations within the processing plant site. The views would be open, but with a short-term duration. Construction operations would be prominent but occupy only a relatively small part of the view and activity on part of the site is likely to be screened from view. Effects on motorists are assessed as negligible magnitude, on low sensitivity receptors: giving rise to a **negligible impact: not significant**. Effects on residents are assessed as low magnitude, on medium sensitivity receptors: giving rise to a **minor (adverse)** level of impact which is also not considered to be significant.

On completion of the construction works, there would be middle-distance views of the completed processing plant, occupying a small part of the existing field of view and not obstructing any views further to the west, of the wider landscape. Whilst the site is a brownfield site, the buildings and structures which were previously located within the development area have been largely demolished; however, the new buildings would not be visible on the skyline from this location and would be seen in the context of the built form of the existing settlement although the buildings would be of a larger size than typical houses and would have an industrial character somewhat contrasting with the surroundings. The effects would be long term. In terms of lighting impacts, current lighting levels are likely to be relatively low given the rural location of the site. With the construction and operation of the processing plant there would be an increase in lighting within the site area; however, with effective mitigation it should be possible to limit the associated impacts. Effects on visual amenity of motorists are assessed as of negligible magnitude on low sensitivity receptors: giving rise to a n**egligible impact: not significant**. For residential receptors the magnitude of change would be low, giving rise to a **minor**

(adverse) not significant impact on medium sensitivity receptors. The use of colour on buildings and structures will assist in helping to integrate the plant area into the surrounding landscape and may further reduce impacts. In this case it is recommended that a darker green colour may be suitable to clad or paint the buildings, since the plant would be seen predominantly backclothed by landscape (wooded) rather than sky. This would assist in softening views of the processing plant but would not fully screen the buildings from view. From this particular location, the site of TSF is not visible.

On closure it is anticipated that the buildings and stationary mining fleet would be removed. It is not certain what after-use would be provided on the site, but the removal of the buildings would be likely to have a up to **a minor (beneficial) impact** in the long term. (Medium sensitivity receptors combined with a low magnitude of change.)

Photo 5.11.8: General View from Viewpoint 5.

Viewpoint 6 (Figure 5.11.6)

This viewpoint is located on the southern edge of Tisovci in an elevated location which has a glimpsed view over the former plant site. It is situated approximately 100m to the north-west of the proposed Vares Processing Plant. It is representative of the view obtained by motorists travelling through the village who are generally considered to have a low sensitivity to changes in the view and visual amenity. These motorists would be largely residents of and visitors to Tisovci and nearby settlements. It may also be taken as a proxy of the type of view obtained by nearby residents, with views towards the site similar to the one shown. Residential receptors in this context are generally considered to have a medium sensitivity.

This is a framed, glimpsed view looking south-east over the edge of the village against an immediate background of the cleared plant site seen against a backdrop of the forested mountainous landscape with successive peaks and ridgelines receding into the distance. The processing plant occupies part of this view, although it is seen backclothed against the surrounding landscape and does not appear on the skyline.

During construction, there would be close range views of construction operations within the processing plant site. For road users, the view would be framed and glimpsed, with a short-term duration; residential receptors with windows facing onto the site would have more open views. Construction operations would be prominent but occupy only part of the view with some activity on the site likely to be screened by adjacent buildings. Effects on motorists are assessed as negligible magnitude, on low sensitivity receptors: giving rise to a negligible impact: not significant. Effects on residents are assessed as medium magnitude, on medium sensitivity receptors: giving rise to a **moderate (adverse)** level of impact which considered to be significant (but short-term).

On completion of the construction works, there would be close range views of the completed processing plant, occupying part of the existing field of view but not obstructing any views further to the south-east, of the wider landscape. Whilst the site is a brownfield site, the buildings and structures which were previously located within the development area have been largely demolished; however, the new buildings would not be visible on the skyline from this location and would be seen in the context of the built form of the existing settlement and remaining buildings on site. Although the buildings would be of a larger size than typical houses, they would be similar to the former administration building (in terms of scale). They would have an industrial character which somewhat contrasts with the settlement but is in keeping with the former industrial use of the site. The effects would be long term. In terms of lighting impacts, current lighting levels are likely to be relatively low given the rural location of the site. With the construction and operation of the processing plant there would be an increase in lighting within the site area; however, with effective mitigation it should be possible to limit the associated impacts. Effects on visual amenity of motorists are assessed as of negligible magnitude on low sensitivity receptors: giving rise to a **negligible impact: not significant**. For residential receptors the magnitude of change would be medium, giving rise to a **moderate (adverse) impact on medium sensitivity receptors**. This would result in a significant adverse effect on visual amenity. However, the use of colour on buildings and structures will assist in helping to integrate the plant area into the surrounding landscape and may further reduce impacts. In this case it is recommended that a darker green colour may be suitable to clad or paint the buildings, since the plant would be seen predominantly backclothed by landscape (wooded) rather than sky. The effect of mitigation combined with habituation to the changes in the view, is likely to result in the level of effect reducing to **minor (adverse)** which would not be considered to be significant. From this particular location, the site of TSF is not visible.

On closure it is anticipated that the buildings and stationary mining fleet would be removed. It is not certain what after-use would be provided on the site, but the removal of the buildings would be likely to have a up to **a minor (beneficial) impact in the long term**. (Medium sensitivity receptors combined with a low magnitude of change.)

Photo 5.11.9: General View from Viewpoint 6.

Overall assessment of visual impacts

Impacts of visual amenity arising from the Vares Processing Plant and TSF are likely to be experienced primarily by residential receptors and users of the local road network, considered to have a medium and low sensitivity to change respectively. Communities most likely to be affected are the surrounding settlements of Tisovci, Daštansko, Pržići and Višnjići. Consideration of the impacts on visual amenity at the representative viewpoints suggests that the level of impact on visual amenity would in most cases be no greater than minor (adverse) which is not considered to be significant. The exception to this would be for short range views over the processing plant from a small number of properties on the edge of Tisovci which overlook the Site. In this case there may be short term impacts of up to moderate (adverse), which is considered to be significant. However, with mitigation to assist in integrating the proposed built forms into the surrounding landscape, the level of impact is likely to reduce to become less than significant. For users of the local road network, views of the processing plant are likely to be intermittent, and mostly glimpsed; impacts are not considered to be significant. The processing plant is located in a rural area and as such current lighting levels are likely to be relatively low. With the construction and operation of plant, the amount of lighting within the site area would increase leading to some adverse impacts; however, with effective mitigation it should be possible to limit the associated impacts to be less than significant. Given the location of the TSF within a valley landform to the south of the proposed processing plant site, visibility from the surrounding area would be limited, and visual impacts are also not considered to be significant.

5.11.4.4 Haul Route

For much of the Haul Route, there would be few, if any, visual receptors. However, there are some locations were the proposed route passes close to adjacent residential properties, and there may also be some more distant views towards the road.

Viewpoint 7 (Figure 5.11.7)

This viewpoint is located to the east of the small settlement of Položac and adjacent to the proposed Haul Route. It is situated approximately 3km to the west of Vareš at an approximate elevation of 1160m above sea level. It is representative of the view obtained by users of the adjacent access track who are generally considered to have a low sensitivity to changes in the view and visual amenity.

This is an enclosed, close-range view looking north across the adjacent area of grassland towards an area of forest. More distant views are prevented by intervening topography and vegetation and the skyline is formed by a distant, forested, ridgeline. The view features a small shed along with fencing and utility line equipment.

During construction, there would be close range views of operations along a short section of the haul route. The views would be full and open, but with a short-term duration. Construction operations would not be seen on the skyline but would occupy a noticeable part of the view. However, views would be transient and the corresponding effect on visual amenity is as low magnitude, on low sensitivity receptors: giving rise to a minor level of impact: not significant.

On completion of the construction works, there would be close range views of the completed haul route, which would remain a noticeable feature in the landscape. Vehicular traffic along the route would also introduce an increased sense of movement and noise into the local landscape with a corresponding reduction in tranquillity. At night time, there may be a possibility for adverse impacts relating to headlights and movement of light beams, although there are no residential receptors adjacent to the road in this location. Overall, a low magnitude of change operating on low sensitivity receptors would give rise to a minor (adverse) level of impact which is not considered to be significant.

On closure of the mine, the haul route would remain in situ to be used for access by local residents and workers in the surrounding landscape.

Photo 5.11.10: General View from Viewpoint 7.

Overall assessment of visual impacts

Impacts on visual amenity arising from the Haul Route are likely to be experienced primarily by a small number of residential receptors and users of the local road network, considered to have a medium and low sensitivity to change respectively. The residential receptors likely to experience the greatest level of impact would be those people living in very close proximity to the route; these are isolated houses rather than settlements as during the iterative design process, the road has been purposefully routed away from settlements in order to avoid adverse impacts. Consideration of the impacts on visual amenity at the representative viewpoint suggests that the level of impact on visual amenity for these small numbers of residential receptors living adjacent to the road could be up to moderate (adverse) during construction (medium sensitivity receptor with medium magnitude of change) which is considered to be a significant, but short-term effect. However, with mitigation to assist in integrating the proposed haul route into the surrounding landscape, the level of impact is likely to reduce to become less than significant once construction is completed. For other residential receptors, views would be more distant and impacts not significant. For users of the local road network, views would be intermittent and transient; as such the level of impact is considered not to be significant.

There may be some limited night time impacts from headlights and the movement of light beams across buildings. Such impacts are most likely to arise for residential receptors located adjacent to the road of which numbers are very limited. The closest residential receptor is located 7m from the haul route, located south west of Vares Processing Plant and in between the villages of Tisovci and Bijelo Borje. This property is not a permanent residence but is a weekend or holiday home. Due to the close proximity of the house to the road, and its location on a sharp bend impact from headlights is anticipated. As discussed in Chapter 5.6 (Noise Impact Assessment) an improved glazing and ventilation system is required to reduce noise levels below the maximum permissible limit. As part of this system, black out blinds or curtains may be required to mitigate potential impact from haul trucks. The need for these should be determined early within the operational stage. By doing this, the impact is anticipated to be minor adverse.

5.11.5 Mitigation Measures

Mitigation measures are required in order to avoid, reduce, remedy or compensate for any adverse effects of the development. The principle of mitigation commences with the design of the development and is an iterative process (see Chapter 6, Alternatives Assessment), in that measures are taken, wherever possible, to adjust the design to minimise adverse effects.

The location, design and integration of the Project-affected area and components into the existing landscape and views was undertaken, where practical, to help reduce the magnitude of potential landscape and visual impacts that will result from the Project. As such the objective is to create final landforms with naturalistic and sympathetically designed landscape profiles as far as is practicable.

The following mitigation measures will be implemented to reduce the potential impacts resulting from the Project and associated workings' during the construction, operation and closure phases of the Project, including the implementation of progressive restoration throughout the life of the Project.

5.11.5.1 Construction Phase Mitigation

The following mitigation measures would typically be implemented throughout the construction phase to ensure landscape and visual impacts are reduced or avoided:

- Construction vehicles will not track across undisturbed areas outside their defined working area and access corridor;
- Materials and machinery will be stored tidily during the works. Machinery will not be left in place for longer than required for construction purposes, in order to minimise its visual impact on views;
- Contractors compounds and storage areas will be located away from sensitive receptors as far as possible;
- Topsoil and subsoil will be carefully stripped from all construction areas and stored in areas where they will not be disturbed or tracked upon, in low uncompacted mounds. Stored soils will be used for the progressive restoration of disturbed areas. Soft materials will be used to grade slopes prior to promotion of natural recolonisation of vegetation or planting;
- Regular looking engineered profiles will be avoided where practical. Irregular concave and convex slopes mimicking existing contours, which match with the scale of the existing hill slopes, will be created as far as possible during construction and restoration of the various elements and necessary ground works for built components of the Project;

- Localised grading of selected sections of track cutting slopes, embankments and sides will be undertaken. Scarred track sides, slopes and tie-ins will be rounded to concave or convex profiles, and where available, topsoil/turves will be placed upon them, to encourage regeneration of vegetation;
- Seeding and planting will be undertaken using locally native species or ecologically appropriate plants, and to tie in with adjacent vegetation types, where considered appropriate and essential to prevent erosion;
- On completion of the construction phase, all equipment and temporary installations, buildings, etc. not required for future operational use will be dismantled and removed;
- Removal of construction waste and its appropriate disposal;
- Filling and compacting of pits, hollows and excavation trenches with the appropriate stockpiled materials;
- Slope regrading activities will be undertaken to provide sustainable and erosion resistant landforms compatible with the post-closure land use and water management strategies;

To mitigate lighting impacts the following measures will be implemented, potentially as part of a Construction Environmental Management Plan:

- Lighting should be switched off when not required specifically for construction activities or required for security or health and safety.
- Glare caused by poorly directed security and floodlighting should be minimised by positioning lighting <70 degrees and directing into the centre of the site/working locations;
- Lighting should be limited to the active working locations; and
- Light spill should be minimised by avoiding poorly sighted lights on the boundary of the development.

5.11.5.2 Operation Phase Mitigation

The following mitigation measures will be implemented throughout the operation phases to ensure landscape and visual impacts are avoided or reduced:

- The mine and processing plant and the surrounding areas will be maintained in a clean and uncluttered state: the management plans developed for the Project will include landscape and habitat management requirements where appropriate;
- Buildings and associated infrastructure should use muted colours appropriate to the natural landscape which will assist in integrating them into their surroundings and which will not contrast or stand out when viewed from distant locations. It is suggested that a darker green colour would be appropriate given the predominantly forested nature of the landscape;
- External clutter will be reduced by enclosing Project components and containing them within simple buildings which fit and respond to the localised topography, as far as practicably possible;
- Non-reflective surfaces will be used wherever feasible; and

- Windows in buildings will, where possible, be shuttered to prevent light spill at night. There will be minimal security lighting in external areas (sensors will be used to ensure it does not get left on).

During the detailed design phase, once the lighting design for the Project is fully understood, the need for an environmental lighting impact assessment will be scoped. This assessment would define the required mitigation, though it is anticipated to include the following:

- Lighting will be located away from sensitive receptors wherever possible;
- Lighting will be directed into the area of use and light overspill outside of the plant site reduced;
- Lighting masts (if required) will be sufficiently high to maximise vertical lighting, which reduces overspill potential;
- Lighting will be designed to avoid reflectance from buildings or surfaces, i.e. using lighting stands or mounts directed to the required area rather than facing building facades. The use of reflective surfaces should be avoided;
- Shields/louvres will be used with fittings;
- Minimise roof lights and windows where practicable;
- Light units will be positioned to avoid light release above the horizontal, ideally maintaining light spread to 70° or below, as a minimum 90° below should be maintained;
- The use of infrared security cameras will be considered where possible to reduce the need for security lighting;
- The impacts of the external lighting willd be minimised by the installation of lighting to the minimum specification required to provide a safe night time environment for outdoor work places;
- Light mitigation will be installed at residential receptors, such as black out blinds or curtains, should the haul route present an issue at these locations. The need for this should be determined as early as possible during operations.

5.11.5.3 Closure Phase Mitigation

Once the operation and production phases of the Project cease, the closure of all Project components will begin with the removal of all temporary Project components and will be followed by the restoration of the Project-affected area. This phase will be carried out in accordance with the detailed proposals outlined in the mine closure plan.

- All defunct machinery, clutter, fencing and man-made objects will be removed from the Project-affected area;
- Progressive rehabilitation of affected areas, where possible, throughout the mine life;
- Removal or redistribution of temporary buildings and structures once their purpose has been fulfilled;

- Re-profiling of the temporary earthworks platforms (used for waste rock stockpile and crushing plant, etc) and access roads when no longer required as part of operations (haul route to remain as a permanent feature);
- Cutting and embankment slopes will be graded to tie in with existing natural slopes, and sharp edges will be avoided;
- The profiled faces of the development platforms, their top surface, as well as any remaining spoil heaps and horizontal breaks (vehicle access berms and more minor footways) at completion of the operational phase will be designed to tie into existing contours, so that slopes match in with surrounding natural contours - using available materials as fill to soften angles and create a natural profile. Shaping and grading of the completed faces will be implemented prior to any vegetation / planting works;
- The edges of slopes will be treated, so that scarred and eroded tie-ins are graded out. Layers of soil will be placed in the correct order back onto the surface to promote recolonization with appropriate native vegetation or planting;
- Surfaces with significant compaction or degradation will be scarified or contour ripped to promote revegetation, and any overburden that was excavated will be pushed, raked or pulled back over the area. Any redundant access tracks will be ripped and windrows backgraded. Stockpiled topsoil and subsoil will be re-spread over the sites and any sumps will be backfilled;
- Storage and removal of hazardous and domestic wastes;
- Engineering and revegetation of slopes to provide erosion resistant and sustainable landforms;
- Revegetation of disturbed areas for compatibility with the selected post-mining land use, prioritising native species and vegetation types that existed before the mining operation began and species which are ecological appropriate; and
- Revegetation will be encouraged so as to soften the appearance of areas of restored land post-demolition and to integrate both the natural and manmade landforms, and the new areas of vegetation.

5.11.5.4 Post-Closure Monitoring Phase Mitigation

Following the implementation of the closure mitigation measures outlined in the mine closure plan ongoing post-closure monitoring should be undertaken for a number of years, from the start of closure activities, to ensure that restoration and rehabilitation of revegetation and enhancement landscape works and planting is successful.

- Monitor restoration and manage according to ongoing landscape and habitat management actions that will be detailed in include landscape and habitat management and mine closure plans, so as to promote complete and successful regeneration.

5.11.6 Residual Impacts

Residual impacts are those that remain after mitigation measures have been implemented. With these mitigation measures in place, it is anticipated that the longer-term effects of the proposed development on the landscape character and visual amenity of the local area would not be significant. There would therefore be no residual effects in relation to the operational underground mine, processing plant and haul route, other than have been assessed in this chapter of the ESIA, in relation to landscape character and visual amenity.

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1130mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	1.75km
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	26/04/2021 17:00	Direction of View	Northwest	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.148236 18.370000		

Viewpoint Description

Daštansko Central

For viewpoint location plan see drawing ZT520182/4.15.3
Photograph used is a composite panoramic image
Refer to main document appendix for methodology statement

Viewpoint VI1	Drg No ZT520182/5.11.1	Date MAY 2021
Drawn By AB	Checked By AC	Approved By HK

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- ☐ EDINBURGH ☐ LEEDS
- ☐ GLASGOW ☐ STOKE ON TRENT

CLIENT	ADRIATIC METALS PLC
PROJECT	VARES PROJECT VEOVACA OPEN PIT
DRAWING TITLE	VIEWPOINT 1 BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1130mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	1.16km
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	26/04/2021 14:40	Direction of View	West	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.138333 18.364444		

Viewpoint Description

Višnjići

For viewpoint location plan see drawing ZT520182/4.15.3
Photograph used is a composite panoramic image
Refer to main document appendix for methodology statement

Viewpoint VI2	Drg No ZT520182/5.11.2	Date MAY 2021
Drawn By AB	Checked By AC	Approved By HK

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CLIENT	ADRIATIC METALS PLC
PROJECT	VARES PROJECT TISOVCI PROCESS PLANT
DRAWING TITLE	VIEWPOINT 2 BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1060mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	430m
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	30/04/2021 09:20	Direction of View	Southwest	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.143333 18.353889		

Viewpoint Description

Pržići South

For viewpoint location plan see drawing ZT520182/4.15.3

Photograph used is a composite panoramic image

Refer to main document appendix for methodology statement

Viewpoint	Drg No	Date
3	ZT520182/5.11.3	MAY 2021
Drawn By	**Checked By**	**Approved By**
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CLIENT
ADRIATIC METALS PLC

PROJECT
VARES PROJECT
TISOVCI PROCESS PLANT

DRAWING TITLE
VIEWPOINT 3
BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1120mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	3km
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	29/04/2021 08:00	Direction of View	Northeast	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.121741 18.327591		

Viewpoint Description

Stupni Do

For viewpoint location plan see drawing ZT520182/4.15.3
Photograph used is a composite panoramic image
Refer to main document appendix for methodology statement

Viewpoint	Drg No	Date
VI4	ZT520182/5.11.4	MAY 2021
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CLIENT: ADRIATIC METALS PLC

PROJECT: VARES PROJECT
TISOVCI PROCESS PLANT

DRAWING TITLE: VIEWPOINT 4
BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1130mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	610m
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	30/04/2021 09:45	Direction of View	South/southeast	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.146389 18.346389		

Viewpoint Description

Tisovci North

For viewpoint location plan see drawing ZT520182/4.15.3

Photograph used is a composite panoramic image

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Viewpoint VI5	Drg No ZT520182/5.11.5	Date MAY 2021
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PROJECT
VARES PROJECT
TOSOVCI PROCESS PLANT

DRAWING TITLE
VIEWPOINT 5
BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1080mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	100m
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	30/04/2021 09:55	Direction of View	Southeast	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.141667 18.348333		

Viewpoint Description

Tisovci

For viewpoint location plan see drawing ZT520182/4.15.3
Photograph used is a composite panoramic image
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Viewpoint VI6	Drg No ZT520182/5.11.6	Date MAY 2021
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CLIENT	ADRIATIC METALS PLC
PROJECT	VARES PROJECT TISOVCI PROCESS PLANT
DRAWING TITLE	VIEWPOINT 6 BASELINE PANORAMA

Visualisation Type	Type 1	Lens Make and Focal Length	Sigma 50mm	Height of Ground	1160mH
Projection	Cylindrical	Horizontal Field of View	90°	Distance to Site Boundary	100m
Enlargement Factor	96%	Vertical Field of View	27°	Height of Camera Lens Above Ground	1.5m
Date and Time of Captured Photography	27/04/2021 14:20	Direction of View	Southeast	Viewing Distance	522mm @ A1
Camera Make, Model and Sensor Format	Nikon D800, FFS	Camera Location (Grid Coordinates)	44.172500 18.289722		

Viewpoint Description

Položac

For viewpoint location plan see drawing ZT520182/4.15.3
Photograph used is a composite panoramic image
Refer to main document appendix for methodology statement

Viewpoint	Drg No	Date
VI7	ZT520182/5.11.7	MAY 2021
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CLIENT	ADRIATIC METALS PLC
PROJECT	VARES PROJECT POLOZAC HAUL ROUTE
DRAWING TITLE	VIEWPOINT 7 BASELINE PANORAMA

5.12 Ecosystem Services and Land Use

5.12.1 Introduction

This chapter provides an assessment of the potential impacts, and the significance of those impacts, from the Vares Project on the ecosystem services, identified in Chapter 4.13, as well as an assessment of the Project's dependence on ecosystem services and how these could be impacted across the life of mine. This assessment uses the findings presented in Chapters 5.2-5.11 and assesses these in relation to identified ecosystem services.

The Project-affected area includes the Project footprint, surface water courses, ecological survey areas, soils and land use area of influence, groundwater resources and the air quality assessment area, together with the surrounding areas of social influence. Ecosystem services can potentially be affected by impacts associated with construction, operation and closure of the mine.

5.12.2 Methodology

5.12.2.1 Overview

The approach taken to the Ecosystem Services Review was based on guidance and tools developed by the World Resources Institute[1,2].

The steps followed in this assessment include:

1. Identify ecosystem services for which the Project might affect supply.
2. Identify the users and beneficiaries of these services.
3. Select "priority ecosystem services" (those on which beneficiaries have high levels of dependence, with limited or no available alternatives amongst other criteria).
4. Establish the baseline for the priority ecosystem services, assuming current levels of use.
5. Predict Project impacts on priority ecosystem services (their supply, use or benefits as appropriate), using current levels as the baseline.
6. Mitigate Project impacts on priority ecosystem services to ensure that benefits are maintained.
7. Assessment of residual impacts.

As well as assessing the impacts of the Project on ecosystem services used or depended on by others, the review also considers the dependence of the Project itself on ecosystem services. The goal in this

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1 Landsberg, F., S. Ozment, M. Stickler, N. Henninger, J. Treweek, O. Venn, and G. Mock. 2011. *Ecosystem Services Review for Impact Assessment: Introduction and Guide to Scoping*. WRI Working Paper. World Resources Institute, Washington DC. Available at http://www.wri.org/publication/ecosystem-services-review-for-impact-assessment.

2 Landsberg, F., J. Treweek, N. Henninger, M. Stickler, and O. Venn. 2013. *Weaving ecosystem services into impact assessment: a step-by-step method.* World Resources Institute, Washington DC. Available at http://www.wri.org/sites/default/files/weaving_ecosystem_services_into_impact_assessment.pdf

case was to ensure that operational performance could be maintained throughout the lifetime of the Project.

5.12.2.2 Prioritisation Process

Project's Impact on Ecosystem Services

Changes to ecosystem services supply as a result of the Project do not all lead to a significant impact on the wellbeing of beneficiaries. The ESIA therefore focuses on "priority" ecosystem services: those most likely to be affected by Project operations, and for which changes could have adverse impacts on the wellbeing of affected communities. The prioritisation of services is done through a decision tree (Figure 5.12.1), the process undertaken for this assessment is shown in Appendix 5.12.1. In summary the following is considered:

- The sensitivity of the ecosystem service (See Table 5.12.1);
- The geographical extent of beneficiaries (local, regional, national);
- Number of beneficiaries, especially within key communities and across Vareš Municipality;
- Level of dependence for beneficiaries determined based on sensitivity and reliance on ecosystem service for income or subsistence;
- Benefits derived from the ecosystem service and their reliance for continued livelihoods and way of life;
- Extent and acceptability of accessible alternatives available for beneficiaries; and
- The impact of the Project on the service and the ability of the Project to influence the ecosystem service.

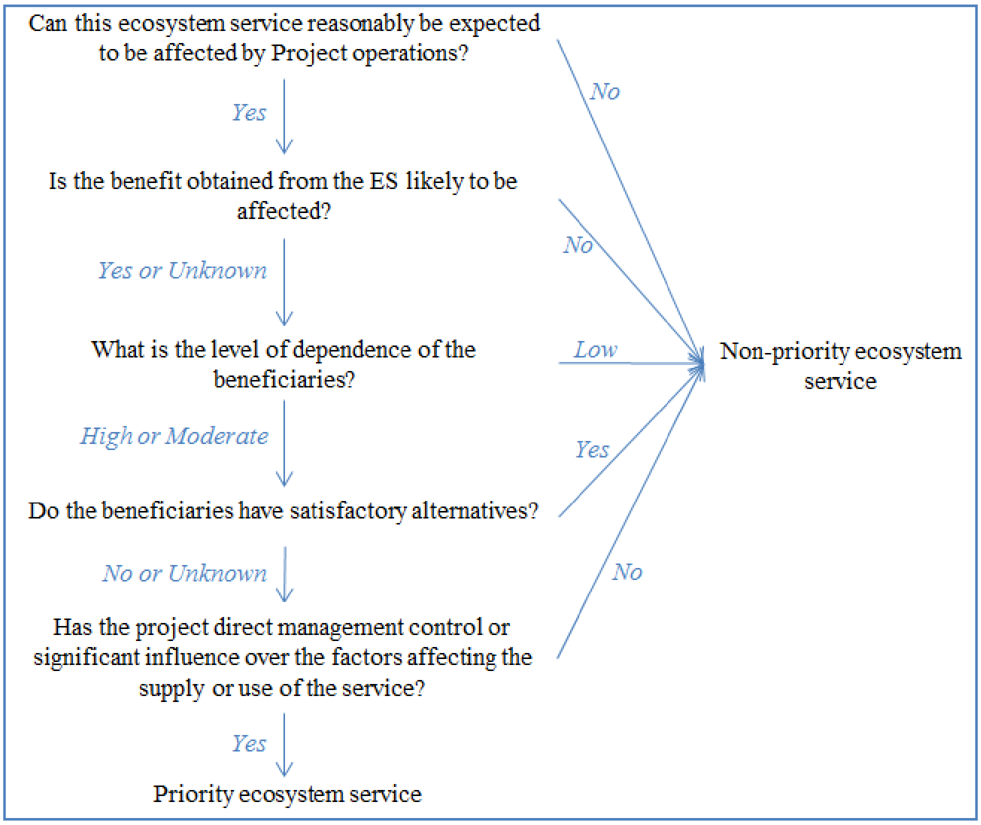


Figure 5.12.1: Prioritisation Decision tree for Project Impact on Ecosystem Services

Prioritisation for Project Dependence

In accordance with EBRD PR6, the impact assessment prioritises and considers "the project's dependence on these ecosystem services". 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 other factors, such as climate change, within the proposed lifetime of the project. The availability and level of supply of services needed by the Project was therefore reviewed. Figure 5.12.2 illustrates the process for identifying priority services with respect to the dependence of the Project on ecosystem services.

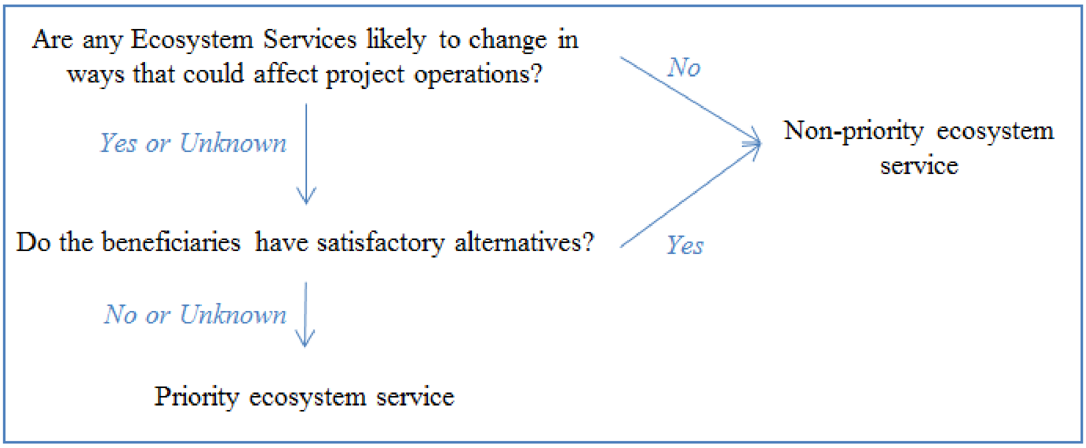


Figure 5.12.2: Prioritisation Decision Tree for Project Dependence on Ecosystem Services

5.12.2.3 Magnitude of Impacts

The impact to each priority ecosystem service from project activities, is determined based on the methodology laid out in Chapter 5.1. The sensitivity scale has been adapted specifically for ecosystem services, combining that for environmental and social receptors, and is shown in Table 5.12.1. The impact assessment for ecosystem services considers both the service itself and the beneficiary of the service. An assessment of the magnitude of change is then made, based on the criteria of Table 5.12.2.

Table 5.12.1: Receptor Sensitivity Scale for Ecosystem Services

Level of Sensitivity	**Description of receptor**
Negligible	Negligible sensitivity; ecosystem service is abundant in the area, beneficiaries have limited use or reliance on the ecosystem service, no commercial or life dependency value and service is resilient to change. Beneficiaries have no shortage of access to adequate resources (material, financial, social) and will have no difficulty in adapting to change.
Low	Low to medium sensitivity; ecosystem service is used by a minority of the local population, with no or limited reliance for income, plenty of alternatives are available. Main use is recreational, or recreational support, relatively abundant and resilient to change. Beneficiaries have a high level of access to resources and have a high capacity to adapt to changes.
Medium	Medium to high sensitivity; some reliance on ecosystem service as a source of income or life dependency, used by majority of local population with some importance on a regional scale. Service is fragile and susceptible to change with limited potential for substitution. Beneficiaries have some access to resources and retain capacity to partially adapt to changes.
High	Very high sensitivity; High reliance on ecosystem service as a primary form of income, or for life dependency, local, regional and/or national population are highly dependent on the service, with very limited alternatives. The ecosystem service may support another ecosystem service which is critical to life and ecosystems in the region. Beneficiaries have very limited access to resources, resulting in multiple levels of vulnerability that limits capacity to adapt to changes.

Table 5.12.2: Magnitude of Change Scale for Ecosystem Services	
Magnitude of change	**Description of change**
Negligible	Minimal detectable changes in baseline resource. Changes are either of short duration or infrequent periodicity, such that direct control is not required to manage potential impact. Impact will not result in any measurable or perceivable changes to beneficiaries.
Low	Detectable change to the baseline conditions or resource. During construction and operations there would be ongoing change in the underlying characteristics or quality of the baseline conditions. Unlikely to have a measurable effect on the wellbeing of beneficiaries.
Medium	Degree of change is such that loss of, or adverse alteration to, the baseline conditions of a specific environmental resource would occur. Post development characteristics or quality would be partially changed during construction and operational phases. Will have an effect on the wellbeing of a small number of beneficiaries and will be spatially localised.
High	Degree of change is such that total loss of, or adverse alteration to, the baseline conditions of a specific resource would occur. Post-development characteristics or quality would be fundamentally and irreversibly changed. Will affect a moderate number of beneficiaries causing livelihood or lifestyle change on a moderate scale.

5.12.3 Sources of Impact

Project activities during the construction, operation, closure and post-closure that could result in an impact to priority ecosystem services are described in Table 5.12.3.

Table 5.12.3: Sources of Impact to Ecosystem Services		
Project Phase	**Project Aspect**	**Description of activity**
Construction	Earthworks	Earthworks, land clearance, tree felling and soil stockpiling will be required during the construction phase. These earthworks will reduce land stability and may result in increased soil loss, erosion and sedimentation in water courses.
Construction/ Operation/ Closure	Land Take	At Rupice 28.5ha of Acidophilic spruce forests of hilly to mountainous belt (*Vaccinio-Piceetea*) will be lost, 33ha lost along the haul road and 16.8ha lost at the VPP/TSF. Land access will be restricted during the construction, operational and closure phases. Once mine closure is complete some access may be restored. Security fencing and personnel will be present.
Operation/ Closure / Post-closure	Haul Road	24.5km multipurpose haul route will be constructed and maintained by the municipality. The haul route will be used by mining traffic, forestry workers and will be accessible to the general public.

Table 5.12.3: Sources of Impact to Ecosystem Services		
Project Phase	**Project Aspect**	**Description of activity**
Construction/Operation	Air Quality emissions	Dust from earthworks and operational activities (crushing, haulage), combustion emissions
Construction/ Operation/ Closure	Greenhouse Gas (GHG) emissions	Vegetation and soil removal, combustion sources.
Operation	Water Supply	Water supply from the Bukovica stream of 7.6l/s (655m^3/d). This is an Associated Facility, with JKP Vares responsible for the permitting and environmental compliance.
Construction/ Operations/ Closure	Hazardous Material Storage and Handling	Spillages or leaks from hazardous materials, particularly during construction before permanent bunding and concrete slabs are in place.
Operation	Water Management	Dewatering of Rupice

Land take is considered specifically in Chapter 5.3 Soils and contaminated land, as well as in Chapter 5.4 Biodiversity. Table 5.12.4 summarises the land take based on land use/vegetation cover for the Project. Land at Rupice is currently being converted from a designation as forestry land to industrial land. During closure, the mine will be fully closed, all surface infrastructure removed, the land surface will be reshaped, stockpiled soil replaced and revegetation will occur. The programme for doing this is outlined in the conceptual Mine Closure Plan and it is anticipated that mixed forestry will be replanted in place of surface infrastructure.

Table 5.12.4: Land Take for Project Development			
Project Component	**Land Use**	**Planned disturbed area**	**Project Implications for Ecosystem Service**
Rupice	Acidophilic spruce forest	28.5ha	Land will be converted from forestry land to industrial land. Felling of trees will be undertaken by Vareš forestry commission.
Haul Route	Acidophilic spruce forest	28ha	Felling of trees required along some of new route and in areas where the existing road requires upgrade.
	Mountain Hay Meadows	2.6ha	No implication to ecosystem services in terms of land take.
	Water courses from plateaus to the mountainous belt (Zargarski Stream)	1km	No implication to ecosystem services in terms of land take.
Vares Processing Plant	Brownfield – industrial land	4.5ha	No implication to ecosystem services in terms of land take.
Tailings Storage Facility	Acidophilic spruce forest	11ha	Land will be converted from forestry land to industrial. Felling of trees will be undertaken by Vareš forestry commission.

5.12.4 Priority Ecosystem Services

Several ecosystem services are utilised across the region, as per Section 5.12.2.2 only those deemed priority have been taken forward to impact assessment. Appendix 5.12.1 describes all ecosystem services in the region and provides the prioritisation process.

Table 5.12.5: Summary of Priority Ecosystem Services

Priority Service	Description and related project aspects
Provisioning	
Food - Foraging for mushrooms, wild berries and medicinal plants, for own consumption.	50% of household survey respondents partake in some form of foraging activities. Carried out adjacent to the existing Veovaca open pit, on banks of the Mala River (south of planned TSF), Zvijezda mountain, Mekuše forest and Dugiratat, Hrida, Bjelovače and around church in Gornja Borovica.
Food - Fishing for Personal Consumption	Vareš Sports Fishing Association has 50 active paying members (2021). To fish in any public waterway in Vareš membership of the association is required.
Food - Trout Farming	A trout farm, restaurant and hotel are present on the Bukovica river, adjacent to the planned pumping station for Project water supply. The trout farm is owned by JKP Vares, and leased to a private company.
Freshwater	Donja Borovica, Gornja Borovica, Osredak, Semizova Ponikva, Polozac and Pogar all have water supply tanks, sourced from a number of springs in the region and shared between multiple houses. King's Spring water bottling factory approx. 1km SW of Donja Borovica.
Regulating	
Water flows and timing	Homes in Donja Borovica, Gornja Borovica and Osredak generally have no waste water management systems and rely on the watercourse to flush away black and grey waters. Borovica River is used to flush sanitary effluent from adjacent communities.
Erosion Control	Forested areas on steep valleys at Rupice and Veovaca TSF area. Forested areas on steep valleys at Rupice and Veovaca TSF area.
Cultural	
Outdoor activities e.g. cycling, walking, hiking	Residents and tourists partake in outdoor activities, mainly hiking and mountain biking. Residents of Vareš partake in walking, largely due to lack of public transportation. Tourism industry has a focus on cycle and hiking trails, including Via Dinarica trail [3]. Two multi day hiking trails travel through Vareš and close to the Project area, including the winter trail from Vareš south to Javorje Mountain Hut (adjacent to planned haul route) and from Vareš east (day 122 of the main Via Dinarica trail). A day hiking route has been established east of Vareš and north of VPP.

[3] https://trail.viadinarica.com/en/

Table 5.12.5: Summary of Priority Ecosystem Services	
Priority Service	**Description and related project aspects**
Recreational Fishing	Undertaken across the project area for recreational purposes (10% of all fishing). Sports fishing competition occurs annually in the Stavinja River, downstream of the Project area between Vareš and Breza.
Landscape & Sense of Place	Rural and natural landscape is appreciated for its value. Residents across Vareš and visitors to Vareš, mainly holiday makers from Sarajevo and other cities who visit Vareš for the rural setting.
For the Project	
Water Supply	5.5l/s average and 7.58l/s maximum water required from Bukovica stream to supply Rupice
Erosion Control	Steep sided valleys around Rupice and the TSF. Stability of these slopes is critical to operational health and safety.

5.12.5 Assessment of Impacts

5.12.5.1 Impacts to Ecosystem Services

Food – Foraged Plants for Consumption by Local Population

Foraging areas are away from the planned project activities, focused predominantly on the Zvijezda Mountain north of Vareš. Downstream of the TSF area, on the Mala Riejka, there is an area of high quality spruce forest (See Chapter 4.5), within this region foraging for mushrooms is undertaken. This area is also away from Project activities. The impact to the Mala Riejka from Project activities is assessed as minor within the hydrology and hydrogeology impact assessment, assuming the implementation of recommended mitigation. Dust emissions from project activities will be managed through the implementation of Good International Industry Practice (GIIP), including dust suppression along the haul route and in the vicinity of the crusher plant. Fugitive dust emissions in the vicinity of the closest residential receptors are assessed as being negligible (Chapter 5.5 Air Quality Impact Assessment), thus impacts to areas used for foraging are not anticipated due to the increased distance to these regions. The local community are assessed as having a medium sensitivity, the impact is of low magnitude giving a **minor impact**.

It is anticipated that the construction of the haul route will improve accessibility to Zvijezda mountain, north of Rupice. As a publicly accessible route some community members may choose to use this road to access areas for foraging activities. This impact would have a **minor beneficial impact**.

Fishing for Food and Recreational Purposes

Fishing is undertaken across the region, in the following rivers: Borovicki, Bukovica, Stavinja and Mala. These rivers will remain accessible to the local community throughout the life of mine. As assessed in Chapter 5.7 Hydrology and Hydrogeology Impact Assessment, impact to the Borovicki is not anticipated due to the lack of connectivity from the Project catchment to this river. The Bukovica will be used for water consumption requirements, however the supply is assessed as having sufficient quantity to maintain ecological flow. The Mala River, a tributary to the Stavinja, is in close proximity to VPP. The plant will be a zero-discharge operation and the impact from VPP effluents on the surrounding water environment is expected to be minor (Chapter 5.7).

The local communities undertaking fishing in the region have a low sensitivity and the magnitude is anticipated to be low, giving a **minor impact**. Mitigation laid out in the Hydrology and Hydrogeology Impact Assessment (Chapter 5.7) will be implemented, including the Water and WasteWater Management Plan.

A trout farm is located adjacent to the water supply point on the Bukovica River. The impact from withdrawal is not anticipated to impede upon system capacity, other users or downstream receptors. However, further study work is underway to confirm this, and will be incorporated into the Final ESIA. At present, the trout farm is not anticipated to be impacted by the abstraction point as there is sufficient flow in the river to accommodate the planned abstraction. The trout farm has a medium sensitivity, the magnitude is low, giving a **minor impact**.

Freshwater as a potable resource

The impact to the underlying aquifer in the region of Rupice, and the residual impact to residential beneficiaries of groundwater and the King's Spring bottling plant is assessed in Chapter 5.7 Hydrology and Hydrogeology. In summary it is unlikely that there is linkage between the mine groundwater, the King's spring, residential springs and the Bukovica water supply. The receptors and beneficiaries have a medium sensitivity; with a low magnitude of change the impact to freshwater resources is of **minor impact**.

Water Flows and Timing

The Borovicki river flows through the community of Donja Borovica and is used to flush sanitary effluent from residential properties in the area. There are existing water abstractions on this river, which have been used during drilling. Currently this pump and pipeline systems is sized to provide a maximum of 4 l/s intermittently and 0.4 l/s continuously. Due to problems encountered in 2020 with the Borovicki stream experiencing low flow, these sources can only be used selectively. The Buckovica abstraction is sufficient for Project operations and the Borovicki supply will be scarcely used. The Borovicki River and its' beneficiaries are assessed as high sensitivity, the magnitude is low giving a **moderate impact.** Abstraction from the Borovicki will be minimised across project life. Implementation of the Water and Wastewater Management Plan and associated ongoing monitoring will ensure ecological flow is maintained and impact to the Borovicki is minimised. The residual magnitude is negligible giving a **minor impact**.

Erosion Control

The felling of trees on valley slopes at Rupice and within the TSF valley will increase the susceptibility of soils to erosion from wind and water. Soil erosion can contaminate water courses through sedimentation, namely the Mala River (TSF) and the Vruci Potok (Rupice). The Mala River and the downstream Stavinja River are critical to fishing activities in the region and a reduction in water quality from sedimentation could impact the fish population. A sedimentation pond is to be installed during construction of the TSF to capture sediment prior to its' entrance to the Mala River. Design mitigation has also been implemented at Rupice, to minimise sedimentation to the Vruci Potok (See Chapter 5.7 hydrology and hydrogeology impact assessment).

The Vruci Potok and Mala River and their associated fish populations are assessed as medium sensitivity in regards to ecosystem services. The magnitude of the impact is low, with the integrated design mitigation, giving a **minor impact**. The implementation of the Soils, Contaminated Land and Erosion Control Management Plan will include monitoring of water resources to ensure this remains a minor impact.

Outdoor Activities (cycling, walking, hiking)

Local people and tourists increasingly use the land around Vares for outdoor activities, mainly hiking and mountain biking. The tourist information centre in Vares, established in 2017, is promoting Vares as a holiday destination, a rural mountainous setting easily accessible from Sarajevo. Tourist numbers have slowly increased since the opening of the centre.

Dedicated hiking trails as part of the Via Dinarica routes have or are being developed around the town. The winter hike from Javorje Mountain Hut passes the haul route north of Vares Majdan for a short distance of approximately 1km. The road is not shared, though pedestrians may need to cross the haul route in places presenting a possible community health & safety risk.

The Rupice project area is not crossed by hiking or walking trails. Whilst hunters have previously used this land for organised recreational activities, these have not occurred in this region since the initiation of exploration works. Consultation with the hunting society showed that sufficient land for hunting activities is present outside of this area.

The beneficiaries of this ecosystem service, tourists and local residents who partake in outdoor activities, are considered low sensitivity, the magnitude of this impact is low, resulting in a **minor impact**. Through the implementation of the traffic management plan which stipulates the responsibility of haulage contractors to avoid collisions, particularly in places where pedestrians might be present, the residual magnitude is considered negligible. The residual impact is therefore **negligible**.

Landscape and Sense of Place

The Project area is in a rural setting with numerous permanent residences and holiday homes, (many owned by families who used to live locally) scattered across the region. The Rupice mine is in a secluded valley and the infrastructure itself will not impact the landscape (See Chapter 5.11 Landscape and Visual Impact Assessment). The movement of trucks on the haul route (estimated at 4 per hour) directly passes residential and holiday home properties, at the closest point within 7m. Consultation has been undertaken by the Eastern Mining Community Team with these property owners, all of whom have expressed support of the Project development. A small number of tourists and day visitors from cities in BiH do visit Vareš to experience a more rural and quiet setting.

Mining is a fundamental part of the history of Vareš, and the derelict VPP site remains from the former operation of the Veovaca Open Pit. It is evident, through consultation, that many of the community members have a strong affiliation with mining having previously worked in the iron ore foundry or Veovaca mine. These community members are supportive of the reinvigoration of mining in the region, and it is expected that the opening of Rupice and VPP will have a positive impact to many in this regard.

Construction impacts arising from earthworks such as noise and disturbance would have a short term impact on the rural tranquillity of the area. Once operational, there would be some disturbance to the current sense of place due to the increased traffic and population, associated with those moving to the area in search of direct and indirect economic opportunities. Whilst existing residents will experience a change, consultation shows that the majority are supportive of this change and the initiation of mining activities. Local residents and holiday property owners have a medium sensitivity, whilst tourists visiting the area have a low sensitivity. The magnitude of this impact is low, giving a **minor impact** for all beneficiaries. Whilst mitigation isn't explicitly required, the implementation of noise reduction methods (Chapter 5.6), landscape and visual mitigation measures (Chapter 5.11) and construction and operational management plans will ensure this impact remains as **minor**.

5.12.5.2 Impacts to Project

Achieving planned project operational performance depends on three ecosystem services: provision and regulation of freshwater and erosion control. Changes to these ecosystem services across the life-of-mine could have residual impacts on the Vares Project and the planned operation. Changes could occur through either project related activities, through activities of the local community or through changes to the natural environment, such as those caused by climate change.

Regarding water supply for Rupice, the Vares Project plans to abstract 5.5l/s average and 7.58l/s maximum from the Bukovica River through the upgrade of an existing water abstraction point, to be undertaken and managed by municipality contractors, JKP Vareš. Several alternatives have been considered throughout the Project design before this option was selected as the most cost effective and least impactful water source. Assessments are ongoing, however it is deemed that the Bukovica river will have sufficient flows for abstraction even during low periods of flow. As stated in Chapter 5.2, Climate Change Impact Assessment, winter precipitations are not expected to decrease, and if anything may result in increased rainfall, suggesting the projects reliance on this natural water supply will not be compromised.

Felling of trees and removal of topsoils in steep sided valleys for the construction of the mine and the TSF may reduce land stability in these regions. Vulnerable steep slopes which have greater exposure will be at risk of erosion and landslips. These will be difficult and potentially costly to manage. The safe operation of the Project means land slides and slumping in these areas should be avoided. Several mitigations are in place to minimise to potential impact:

- Drainage ditches and settlement ponds have been designed to surround disturbed areas across the site to reduce contact water run off and minimise release of sediments;
- The overall site perimeter will be bermed and minimal run-off from the up gradient areas should enter the site;
- Development and implementation of the Soils, Contaminated Land and Erosion Control Management Plan.

5.12.6 Mitigation

Impacts to and from ecosystem services are largely avoided, mitigated and managed through mitigation methods implemented for other environmental disciplines. Specific mitigation for each priority ecosystem service is presented in Table 5.12.6. These can be summarised as follows:

- Implementation of construction and operational management plans, namely:
  - Air Quality Management Plan;
  - Water and Wastewater Management Plan;
  - Soils, Contaminated Land and Erosion Control Management Plan; and
  - Traffic Management Plan.
- Ongoing environmental monitoring throughout construction, operation and closure periods:
  - Air Quality monitoring;
  - Water flows, levels and quality monitoring particularly in the Borovici and Mala Rivers;
  - Noise monitoring during construction and operation;
- Minimise requirement for tree felling to limit potential risk from erosion and land stability, particularly in steep sided valleys.
- Ongoing stakeholder engagement, particularly with vulnerable groups, to monitor the perception to altered sense of place for current residents.
- Ensure the grievance mechanism is fully implemented and operational. This should be regularly disclosed, and the communities reminded of the mechanism to ensure it is functional.

5.12.7 Summary of Impacts

A Summary of the impacts, mitigation and residual impact for priority ecosystem services is presented in Table 5.12.6.

Table 5.12.6: Assessment of Impacts and Residual Impacts for Ecosystem Services								
Priority Ecosystem Service	**Impact**	**Receptor and Beneficiary**	**Sensitivity**	**Magnitude**	**Significance**	**Mitigation**	**Residual Magnitude**	**Residual Significance**
Food	Possible dust emissions and air quality on haul route and from VPP could deteriorate current status.	Foraged Plants for personal consumption by local Community.	Medium	Low	Minor	GIIP for air quality management, implementation of the Air Quality Management Plan and dust control measures. See Chapter 5.5.	Negligible	Negligible
	Haul Route will improve access to northern forested land for foraging and gathering.	Foraged plants for personal consumption by local community.	Medium	Low	Minor	None required (positive impact)	Low	Minor
Fishing (Food and Recreational purposes)	Possible reduced water quality in Borovicki, Bukovica, Stavinja and Mala Rivers.	Trout Farming in Bukovica steam	Medium	Low	Minor	As stated in the hydrology impact assessment, Chapter 5.7, implementation of the Water and Waste Water Management Plan.	Low	Minor
		Local Residents and members of Vareš Sports Fishing Association.	Low	Low	Minor		Low	
Freshwater	Depletion or contamination of groundwater in the vicinity of Rupice	Springs and Groundwater as a potable resource for local residents. King's Spring Bottling Factory and the Bukovica water supply point.	Medium	Low	Minor	Implementation of construction environmental management plans to manage any spills. Monitoring of	Low	Minor

Table 5.12.6: Assessment of Impacts and Residual Impacts for Ecosystem Services								
Priority Ecosystem Service	**Impact**	**Receptor and Beneficiary**	**Sensitivity**	**Magnitude**	**Significance**	**Mitigation**	**Residual Magnitude**	**Residual Significance**
						groundwater in springs and wells.		
Water Flows and Timing	Abstraction of water from Bukovica and Borovicki Stream will reduce flows.	Borovicki stream is used to flush sanitary effluent from residential properties.	High	Low	Moderate	Abstraction from the Borovicki will be minimised across project life. Implementation of the Water and Waste Water Management Plan and associated ongoing monitoring will ensure ecological flow is maintained.	Negligible	Minor
Erosion Control	Tree felling and soil removal for construction of Rupice, Haul Route and TSF	Run off and sedimentation into the Vruci Potok and Mala River, and associated fishing activities.	Medium	Low	Minor	Implementation of the Soils, Contaminated Land and Erosion Control Management Plan	Low	Minor
Outdoor activities e.g. cycling, walking, hiking	Land access restrictions around Rupice and Haul route. Community Health and Safety risk along haul route.	Local communities and tourists partaking in walking and hiking	Low	Low	Minor	Implementation of the traffic management plan, which considers pedestrians who may be crossing the haul route.	Negligible	Negligible

Table 5.12.6: Assessment of Impacts and Residual Impacts for Ecosystem Services								
Priority Ecosystem Service	**Impact**	**Receptor and Beneficiary**	**Sensitivity**	**Magnitude**	**Significance**	**Mitigation**	**Residual Magnitude**	**Residual Significance**
Landscape and Sense of Place	Industrialisation of a rural, largely undisturbed area.	Residents and holiday property owners in vicinity of VPP and on haul route who rely on the tranquillity of the area.	Medium	Low	Minor	Implementation of mitigation as defined in Chapters 5.6 (Noise), 5.9 (Social), 5.10 (Archaeology and Cultural Heritage) and 5.11 (LVIA). Ongoing monitoring of grievance mechanism and regular disclosure/reminders to communities to ensure it is fully effective.	Low	Minor
		Tourists visiting a rural and quiet area, away from larger cities	Low	Low	Minor			

5.13 Cumulative Impact Assessment

5.13.1 Introduction

5.13.1.1 Definitions

This chapter details the cumulative impacts identified for the Vares Project. As per EBRD Performance Requirement 1, it considers "*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.*"

Many environmental and social management challenges arise as a result of cumulative impacts from several activities, either project related, other projects, or by third parties. Individually, these impacts are typically insignificant however, cumulatively they can have regional or even global repercussions[1].

Cumulative impacts can be both positive and negative and can vary in intensity as well as spatial and temporal extent. The chapter identifies projects and activities potentially leading to cumulative impacts, and then assesses the magnitude of the impact on identified receptors.

5.13.1.2 Methodology

The Cumulative Impact Assessment (CIA) has drawn on the baseline data and impact assessment undertaken for all environmental and social disciplines as well as data gathered during site visits and consultations undertaken by WAI.

Other projects that are active, planned or proposed have been considered and their operations assessed to determine the potential shared environmental and social receptors with the Vares Project. Environmental and Social Receptors used in this CIA, includes the following:

- Physical features, habitats, wildlife populations;
- Ecosystem services;
- Natural processes;
- Social conditions; and
- Cultural aspects.

The study areas and project affected areas identified in this ESIA for different environmental and social topics were used to define the limits for cumulative impacts. Existing baseline conditions, as defined in Chapter 4, were used to inform the CIA.

[1] IFC Good Practice Handbook on Cumulative Impact Assessment: http://www.ifc.org/wps/wcm/connect/3aebf50041c11f8383ba8700caa2aa08/IFC_GoodPracticeHandbook_CumulativeImpactAssessment.pdf?MOD=AJPERES

An assessment has been undertaken to evaluate whether the Project would interact with other planned developments that would lead to cumulative impacts. For this CIA, the assessment only considers the residual impacts arising from the Project, according to Chapters 5.2-5.12, which could contribute to cumulative effects.

5.13.2 Other Projects in the Region

Other active Projects in the region have been identified and shared environmental and social receptors reviewed, see Table 5.13.1.

Table 5.13.1: Identified Projects in the Region

Project	Description	Environmental and Social Receptors
Olovo Mine	Lead mine located close to the town of Olovo, approximately 30km east of Vares. The mine is currently owned by Mineco who obtained their exploitation permit in 2018. The process facility was commissioned in 2019 and the mine is now working towards target production. Currently 120 personnel are employed by the Project[2].	Economically active population and job seekers in BiH, supply chain,
Breza Coal Mine	Underground brown coal mine located in Breza, approximately 20km south of Vareš. The mine is used to supply the Kakanj Thermal Power Plant. The town of Breza has developed with the coal mine and the population in this area is largely dependent on the operation of the mine. A drop in production is anticipated due to national plans to reduce greenhouse gas emissions, with redundancies anticipated as a result. The mine is currently operated by the State company Elektroprivreda.	Economically active population
Aggregate quarry west of Vareš	Basalt Aggregate quarry, active west of Vareš and adjacent to the Smreka Iron Ore pit.	Economically active population, surrounding environment, supply chain providers
Railway extension	Plans exist from the Government of BiH to extend the railway line from Vareš northwards to Tuzla to connect it to the main Balkans rail network.	Local and national population, meaning Vareš is better connected to the wider Balkan region.

[2] https://www.minecogroup.com/olovo

Table 5.13.1: Identified Projects in the Region		
Project	**Description**	**Environmental and Social Receptors**
Expansion of Tourism in region	Development of the Via Dinarica Hiking Trail which will traverse through Vareš and pass onto the medieval site of Bobovac.	Tourists and visitors to the area are likely to increase, having an impact on local population and local services.
Proposed development of Zvijezda-Tajan-Konjuh National Park	Proposed designation for its ecosystem biodiversity, landscapes and valuable natural resources.	At the most sensitive point this national park is located 3km to the northeast of the Project footprint. The proposed buffer zone lies 1.1km northeast of Vares Processing Plant.
Forestry practices within the Ecological Appropriate Area of Analysis (EAAA) and associated industries	Forestry activities are ongoing in the region, and will continue throughout the life of the Project. Forestry activities are undertaken by the Vareš Forestry Commission and through their dedicated contractors. The haul route to be developed for the Project will be used by forestry contractors to carry out work. Timber processing yards are present across the municipality. There is one located in the village of Daštansko, close to VPP and another in Vareš Majdan.	Potential biodiversity receptors across the EAAA. Road users in the region. Key communities, namely Daštansko and Višnjići.

5.13.3 Assessment of Cumulative Impacts

5.13.3.1 Identification of Impacts

Cumulative Impacts are shown in Table 5.13.2, with receptors identified and the spatial and temporal extend of the impact shown. These are further described in the proceeding sections.

Table 5.13.2: Cumulative Impacts, Spatial and Temporal extent		
Impact	**Receptors and Spatial Extent**	**Temporal Extent**
Environmental pollution (air quality, noise)	Local area, key communities (Tisovci, Pržići, Daštansko, Višnjići, Brezik, Vareš, Vareš Majdan, Položac, Semizova Ponikva, Gornja Borovica, Donja Borovica, Pogar, Osredak)	Mid-term (construction and operational phase)
Impacts to water resources	Several water courses are located locally: Mala River, Stavinja river, Borovički Stream, Bukovica River and Vrucki Potok. The Mala River and Stavinja are part of the Stavnja basin, a sub-basin	Mid-long term (Construction, operation, closure and post-closure)

Table 5.13.2: Cumulative Impacts, Spatial and Temporal extent		
Impact	**Receptors and Spatial Extent**	**Temporal Extent**
	of the River Bosna. The Borovički, Bukovica and Vrucki Potok form part of the Bosna River catchment.	
Impacts to Biodiversity	Ecological Appropriate Areas of Analysis (see Chapter 4.5), extending to cover the footprint of the Project. Further assessment to national parks in relatively close proximity has been undertaken, namely: • Tajan Natural monument – 6km from Rupice; • Proposed Zvijezda-Tajan-Konjuh National Park – located 3km at the most sensitive part from VPP, and the buffer zone is 1.1km from VPP. Identified Priority Biodiversity Features identified in the study area that may be potentially vulnerable to cumulative impacts includes: • Acidophilic spruce forests (*Vaccinio-Piceetea);* • Alpine rivers (*Salix elaeagnos);* • Water courses from plateaus to the mountainous belt (with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation); • Mountain hay meadows; • Hydrophilous tall herb fringe communities.	Long term (construction, operation, closure and post-closure)
Greenhouse Gas Emissions and Climate Change	National and Global reaches.	Long term
Socioeconomics and Employment	Local, regional and national levels of receptors. The extent of these impacts could cover Vareš Municipality, Zenica-Doboj Canton, as well as the Federation of BiH. Consideration has been given to location of other Projects (namely Olovo and Breza).	Long term
Accommodation	Vareš Municipality.	Mid-long term (construction, operation)
Tourism Industry	Vareš Municipality.	Long term

Table 5.13.2: Cumulative Impacts, Spatial and Temporal extent		
Impact	**Receptors and Spatial Extent**	**Temporal Extent**
Community Health, Safety and Human Rights	Vulnerable groups, key community members and existing residents located in the villages of Tisovci, Pržići, Daštansko, Višnjići, Brezik, Položac, Semizova Ponikva, Gornja Borovica, Donja Borovica, Pogar, Osredak.	
Road Traffic Network	Main route R444 from Sarajevo to Vareš, local routes traversing through Vareš and towards Rupice and VPP. New Haul route to extend from Rupice, northwards and to VPP.	Mid-term (construction and operation)

5.13.3.2 Environmental Pollution

Other active Projects in the region will lead to increased emissions of pollutants such as particulate matter, gaseous emissions and noise. With the ESIA study areas (See Chapter 5.1), these will predominantly be associated with the existing and active quarry west of Vareš, as well as the planned construction of the rail route. The Sawmill located in Daštansko causes increased dust levels, far exceeding maximum permissible standards. These elevated levels of dust were detected by the ESIA baseline monitoring programme and necessitated a sampling location being moved away from the processing plant.

Impacts to air quality and the noise baseline at sensitive residential receptors from the active quarry have been considered within the baseline for this ESIA and are therefore included when addressing the potential impacts from the Vares Project (Chapter 5.5 and 5.6). Any emissions from the quarry are considered insignificant in terms of cumulative impacts from the Project.

The development of the rail line may be undertaken by the Government of BiH, in line with local legislation. At present, there is no indication of when the rail line might be built. During construction of the rail extension it is possible that increased air quality and noise emissions would occur in the centre of Vareš and Vareš Majdan. These impacts would be short lived and would be unlikely to add significantly to emissions from the Vares Project, given the distance from Project activities and Vareš town itself.

5.13.3.3 Impact to Water Resources

Current and planned projects in the region that may have an impact on hydrology include the planned railway development northwards from Vareš and ongoing forestry activities.

The Vruci Potok is currently subject to frequent heavy sedimentation and turbidity from non-project related forestry activities. The Rupice site will have integrated drainage and sedimentation ponds to avoid additional impacts to the Vruci Potok. Haul road construction and operation, to be used by both mining trucks and forestry trucks, may result in sedimentation to select watercourses, namely, the Borovicki stream, Bukovica, Stavinja River and Zargarski stream. The haul road will be constructed and maintained by the municipality, and heavy use by forestry trucks could in time degrade the road, resulting in increased sedimentation at river crossings.

Abstraction of water from the Bukovica River is not anticipated to have an impact on downstream users, thus cumulative impacts are considered to be **negligible**. Should ongoing monitoring or further analysis currently underway reveal any possible or monitored changes to the water course then the cumulative impacts associated with this abstraction would need to be considered.

Impacts from the Vares Project on the Stavinja River are considered to be negligible. Some run off may occur as result of haul road construction, this is anticipated to be short lived. The development of the rail route may have further impact on this river; whilst a full assessment has not been carried out for this, as it outside of the scope of this ESIA, it would be expected that impacts are again short term during the construction period.

5.13.3.4 Biodiversity

Biodiversity Impacts from the Vares Project will be managed through the actions laid out in the Biodiversity Action Plan (BAP)[3], as part of the overall Environmental and Social Management System (ESMS). Based on the study area for biodiversity, as detailed in Chapters 4.5 and 5.6, additional planned and current projects that may share receptors include the existing aggregate quarry, the proposed development of Zvijezda-Tajan-Konjuh National Park, and ongoing forestry activities.

The Spruce forest, in which the Rupice site and much of the haul route are located, is considered a Priority Biodiversity Feature under EBRD's PR6 on Biodiversity. The Project will result in some permanent loss (along the haul route) and some temporary loss (Rupice Infrastructure, until post-closure rehabilitation is complete, and habitat is re-established). The ongoing development of the aggregate quarry is not anticipated to further encroach on this habitat.

Forestry activities in the area are undertaken and managed by the Vareš Forestry Commission. The land on which Rupice is planned has been transferred to industrial land, permitting the development of the mine and associated infrastructure. Forestry activities will continue outside of the concession area where there is sufficient capacity to maintain the current industry. There are not deemed to be any additional significant impacts on biodiversity from the two industries working simultaneously. Adriatic Metals are in discussion with the forestry commission to potentially find an area of forested land that could be rented and or managed in line with the activities detailed in the BAP. The two industries working together to implement best practice in terms of forest management will have an overall positive biodiversity impact. The improvements to existing forestry tracks will make them less susceptible to erosion, thus reducing sedimentation as a result of forestry truck movements.

[3] Current copy V0.1_R001_August 2021

The planned development of the Zvijezda-Tajan-Konjuh National Park has been taken into consideration in the biodiversity assessment of this ESIA. Topographic barriers means that the impact to the planned national park from the mine is anticipated to be negligible.

5.13.3.5 Greenhouse Gas Emissions and Climate Change

The total scope 1 and scope 2 GHG emissions across construction and operation for the Vares Project are anticipated to be approximately 575,357.22 tonnes CO_2e (See Chapter 5.2). The main impact associated with GHG emissions is their contribution to climate change. The Vares Project is one of a myriad of human sources impacting the emissions of GHGs and contributing to climate change, and projected changes in local, regional, and global climate cannot be attributed in isolation to the proposed Project.

All other current and planned Projects in the region will also produce GHG emissions to varying scales. Cumulatively these projects will all contribute towards GHG emissions and associated climate change. However, it should be noted that the relative emissions associated with the Vares Project per unit of metal recovered are not considered significant, when assessed against comparable Projects globally. This cumulative impact is assessed as being **minor.**

5.13.3.6 Socioeconomics and Employment

As identified in Chapter 5.9, social impact assessment, the Vares Project will result in impacts in the socioeconomic setting and characteristic of the region. The Project area has a predominantly elderly and depleting population, with many young people moving away from the area in search of economic opportunities. The Project is anticipated to cause in-migration of those looking for both direct and indirect opportunities associated with the Project. This influx to the region will likely be further influenced by other projects and opportunities, and several cumulative positive impacts may be realised, namely:

- Supply chain opportunities associated with service and equipment providers;
- Opportunity for services and industries, particularly the hospitality industry, to grow due to in-migration;
- Potential training and capacity building opportunities;
- Improvements to the existing transport network, including an increase in public transport and road improvements;

In-migration can also lead to some negative social impacts namely associated with the clash of cultures and increased pressure of local services and road networks, as assessed for the Vares Project in Chapter 5.9. The potential development of the railway line will add to both the positive and negative impacts. Management of in-migration, especially employees, and assisting them in adapting to the way of life in Vareš will be critical to ensuring the mutual success of all Projects.

The Breza coal mine is due to reduce operations in the coming years, likely to result in the redundancy of economically active persons with experience in the extractive industry. Located only 20km from Vareš, there is high potential that workers from Breza will search economic opportunities in Vareš and with the Vares Project. This provides an active and willing workforce with some transferable skills and knowledge to the Project. Training will be required to ensure all workers adhere to the adopted corporate policies and employee code of conduct for Adriatic Metals. To ensure successful integration of all workers to the Adriatic Metals corporate culture and the way of life in Vareš training programmes and the implementation of policies should be monitored regularly. The implementation of the staff grievance procedure will assist in this regard.

The Olovo Project is currently a large employer in the region, with 120 employees (2019). The opening of the Vares Project may put strain on the economically active workforce who are interested and willing to work in the mining industry. The focus of Adriatic Metals is on employing locally (within Vareš), where possible and dependant on capacity building in the region. The development of a specific mining engineering course at the local high school will have future benefits for the Vares Project and the Olovo Project by bringing skilled young people into the mining workforce in the region.

Adriatic Metals are committed to developing a local and sustainable supply chain in the region. With several existing and potential future mining operations in the region, significant positive economic impacts could occur. Planned services are transferable across different mining operations, giving local people further opportunity for sales.

Overall, the cumulative impacts to socioeconomics are considered to be positive, assuming the implementation and monitoring of corporate social and human resources policies.

5.13.3.7 Accommodation

The Project will lead to in-migration associated with people looking for direct and indirect opportunities. Currently in Vareš there is an abundance of empty accommodation, with the population having decreased from 22,203 in 1991 to 8,892 in 2013. Workers will be encouraged to live in Vareš town and accommodation will be renovated, where required, to ensure it meets applicable standards[4].

The rise in demand for accommodation in the region may lead to increased property and rental prices across Vareš municipality, as well as increased demand for building maintenance services and materials. Overall, this cumulative impact is **minor positive**.

[4] Workers' accommodation processes and standards: a guidance note by IFC and the EBRD, 2009. https://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf

5.13.3.8 Tourism Industry

Alongside anticipated in-migration to Vareš it is expected that services and businesses in Vareš town will expand, such as hotels, restaurants, bars, cafes and shops. The increased capacity across the hospitality industry, combined with the development of the Via Dinarica Trail and the proposed Zvijezda-Tajan-Konjuh National Park, could result in increased numbers of tourists visiting the region. The combined impact from these industries and projects will result in further economic opportunities for Vareš Municipality. Overall, this cumulative impact is anticipated to be **minor positive**.

5.13.3.9 Community Health, Safety and Human Rights

As discussed, in-migration associated with the Vares Project will lead to a range of positive and adverse impacts. Community health, safety and human rights impacts to communities and vulnerable groups are anticipated and may be further exacerbated due to other Projects in the region. Cumulative impacts may include:

- Exacerbation of communicable and non-communicable diseases associated with industrial pollution in the region and in-migration leading to a larger population living in close proximity;
- Inequity, particularly between those employed (directly or in-directly by projects) and those who are either elderly or vulnerable and unable to work. Future developments would lead to a greater disparity;
- Increases in tourism, population and income may lead to potential cases of gender based violence and harassment. As potential future operations start up in the region, these aspects will be more difficult to identify and manage; and
- Increased Road traffic incidents.

Adriatic Metals have developed and are implementing a number of corporate policies and procedures to reduce to the risk of community health, safety and human rights impacts. The implementation and, importantly, the monitoring of these mitigation measures will be critical in ensuring these potential risks are not exacerbated by either the development of the Vares Project or other activities in the region. Local services and supply chain providers will be required to comply with Adriatic Metals Procurement policy, which states that all suppliers will be assessed with regard to anti-bribery and corruption; environmental, social and governance aspects; supplier code of conduct (in line with that of Adriatic's); Human Rights and Modern Slavery and Health & Safety. By requiring the implementation of international best practice through these policies, there will be a greater understanding in the region of what is acceptable regarding human rights. Overall, these cumulative impacts are anticipated to be **minor**, assuming the implementation of mitigation as laid out in Chapter 5.9.

5.13.3.10 Road Network and Traffic

Community health & safety risks arising from the Vares Project are assessed in the separate health impact assessment, as well as in Chapter 5.9 Social Impact Assessment. The key cumulative risk arising from the development of the Project is linked to an increased number of vehicles using the existing road network. There will be deliveries to site, predominantly on the R444 from Sarajevo during construction and operations. Further increase in the number of vehicle movements due to transport of mine workers and in-migration to the region, is anticipated. The following cumulative impacts may occur:

- Increased number and severity of road traffic incidents, both directly and indirectly associated with mining traffic;
- Degradation to the existing road network due to heavy use, particularly during the construction period;
- Risk associated with the transportation of hazardous materials;
- Potential increased pollution in adjacent water ways, namely the Stavinja river located next to the R444;
- Increased exhaust emissions and greenhouse gases associated with increase in traffic.

Ongoing forestry activities will utilise the newly constructed road alongside mining vehicles, and the road will also be available for public use. Traffic management will be required, particularly at passing points, and Adriatic Metals will need to liaise with the municipality to ensure mutual safe use of the planned haul route.

Noise associated with mining vehicles passing sensitive receptors on the haul route is assessed in Chapter 5.6. Overall, with the planned mitigation (noise bunds and improved glazing schemes), noise impacts from mining vehicles will be effectively controlled. The movement of forestry vehicles on the same roads will add to the general disturbance and potential noise. It is anticipated that these vehicles will be comparable to those used for mining haulage and will pass less frequently than the four per hour for movement of ore and tailings. The planned mitigation will therefore be sufficient to deal with noise impacts, though it should be noted that forestry trucks do not currently pass residential properties in Položac and these will therefore further add to the disturbance of the current rural way of life.

Whilst some cumulative impacts to the road network and traffic are anticipated, there is sufficient capacity in the existing network to deal with the increased traffic load. With the implementation of the Traffic Management Plan and through liaison with the municipality, the impact is considered to be **minor**.

5.13.4 Management and Mitigation

The Vares Project is relatively remote with limited industry in the region. As such, the cumulative impacts associated with the Project are not expected to significantly hinder either the development of the Project itself or other planned or ongoing Projects in the region. The in-migration anticipated due to the Project will likely have a large impact on demographics and socioeconomic characteristics of the area, which will in turn assist with ongoing developments in the region.

Supply chain development and local procurement is an aspect strongly supported by Adriatic Metals who have committed to working with local businesses and services to strengthen their offering in the region. Again, this would have beneficial impacts to other industries and operations in the area.

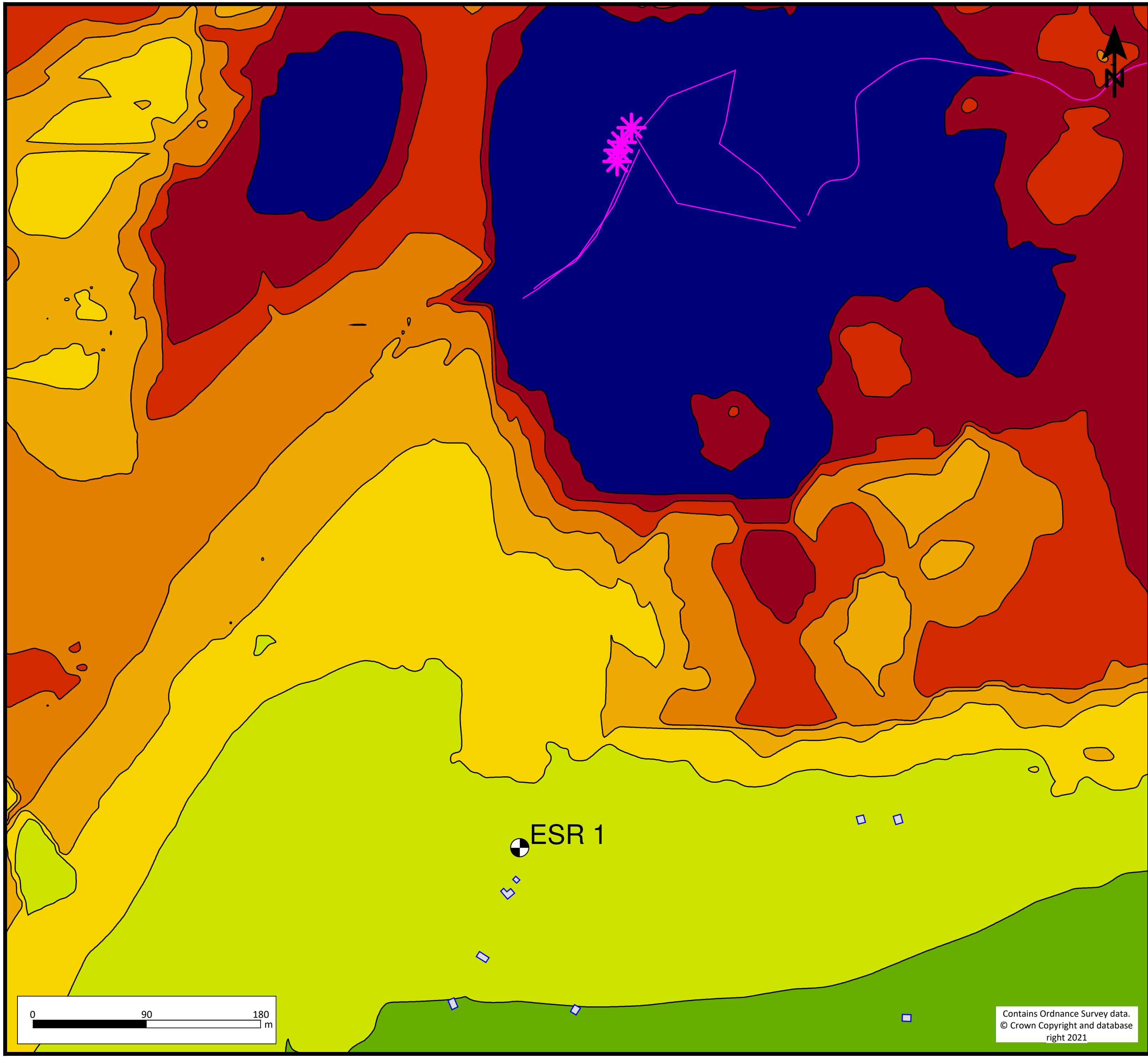
Management and mitigation for cumulative impacts is covered in topic specific management plans and the Environmental and Social Management System (ESMS). Specific requirements regarding cumulative impacts are considered within the Biodiversity Action Plan, Water Management Plan and the Conceptual Mine Closure Plan. The BAP is a live document and will be monitored and updated annually. Should additional impacts be identified that require offsets, these will need to be considered within the BAP.

The Conceptual mine closure plan considers the retrenchment of employees; as part of this a capacity building and training programme is considered. This will provide not only benefits to employees themselves but all to other developments and industries in the region.

The Stakeholder Engagement Plan includes for consultation with municipal, cantonal, and federal governments. As part of this ongoing consultation Adriatic Metals personnel will need to consider proposed and planned future projects that may arise during the life of the mine. Both the impact of these Projects on the Vares Project, as well as any potential obstacles the Vares Project might pose to future operations will need consideration. Adriatic Metals, and the Adriatic Foundation, will work with legal institutions to ensure a mutually beneficial future for both the Vares Project and the local area.

DRAFT

APPENDIX 5.6.1: Noise Prediction Figures



Key

	Existing Buildings
	Haul Road
	Point source
	Receiver
	Industrial building
	Facade as source
	Roof as source
	Acoustic Barrier

Daytime L_{Aeq} dB

	<= 30.0
	30.0 - 35.0
	35.0 - 40.0
	40.0 - 45.0
	45.0 - 50.0
	50.0 - 55.0
	55.0 - 60.0
	60.0 - 65.0
	> 65.0

CLIENT: Adriatic Metals PLC

PROJECT: Vares Project ESIA

TITLE: Figure 5.6.2 - Noise Contours At ESR 1 Pre-Mitigation

DRG NO:		REV:
ZT520782/Figure - 5.6.2		A
DRG SIZE: A3	SCALE: 1:3000	DATE: 26/07/2021
DRAWN BY: LW	CHECKED BY: RC	APPROVED BY: MD

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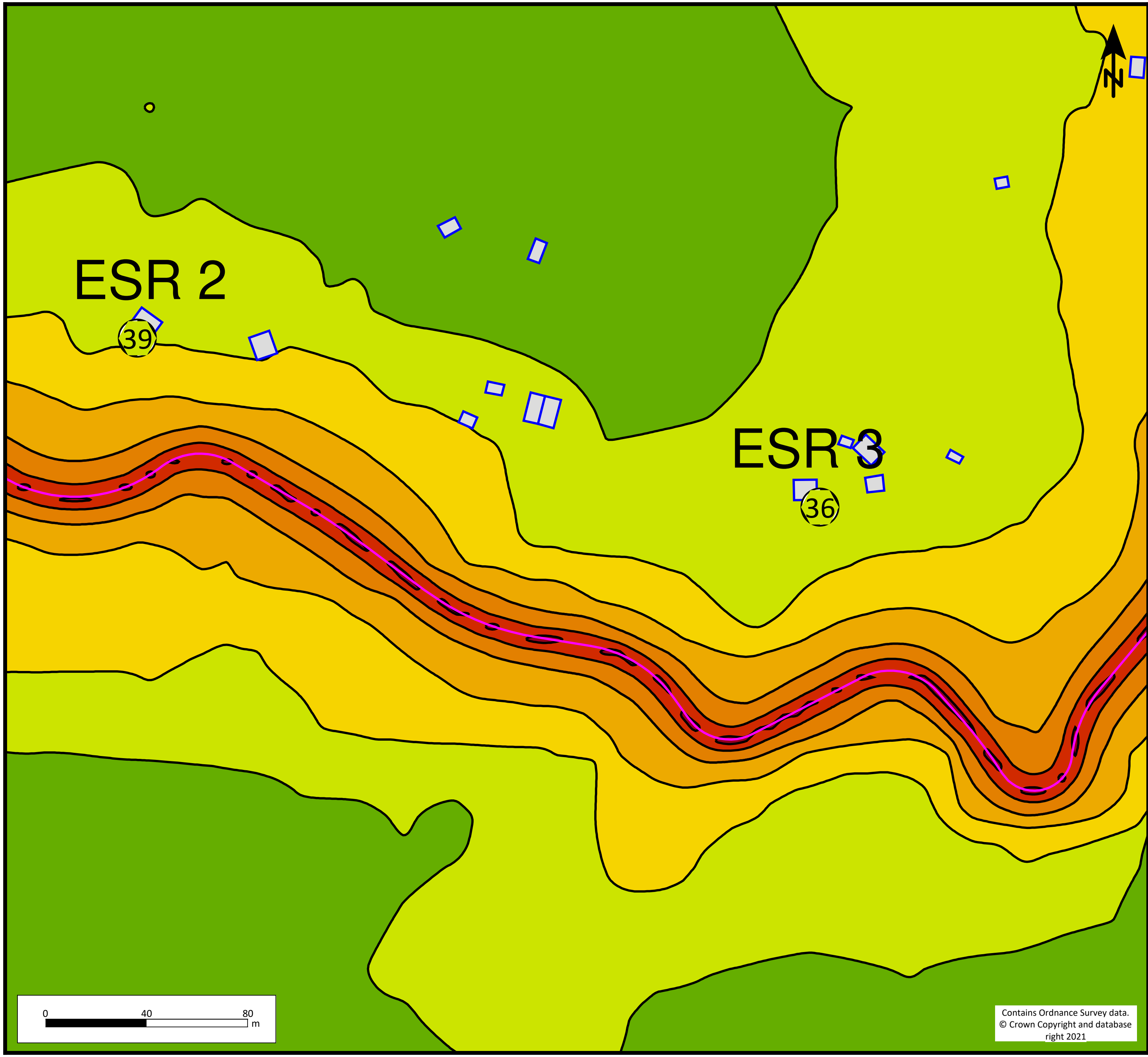

Key

Existing Buildings	
Haul Road	
Point source	
Receiver	
Industrial building	
Facade as source	
Roof as source	
Acoustic Barrier	

Daytime L_{Aeq} dB

	<=	30.0
30.0	-	35.0
35.0	-	40.0
40.0	-	45.0
45.0	-	50.0
50.0	-	55.0
55.0	-	60.0
60.0	-	65.0
	>	65.0

CLIENT: Adriatic Metals PLC

PROJECT: Vares Project ESIA

TITLE: Figure 5.6.3 - Noise Contours At ESR 2 and ESR 3 Pre-mitigation

DRG NO: ZT520782/Figure - 5.6.3		REV: A
DRG SIZE: A3	SCALE: 1:1500	DATE: 26/07/2021
DRAWN BY: LW	CHECKED BY: RC	APPROVED BY: MD

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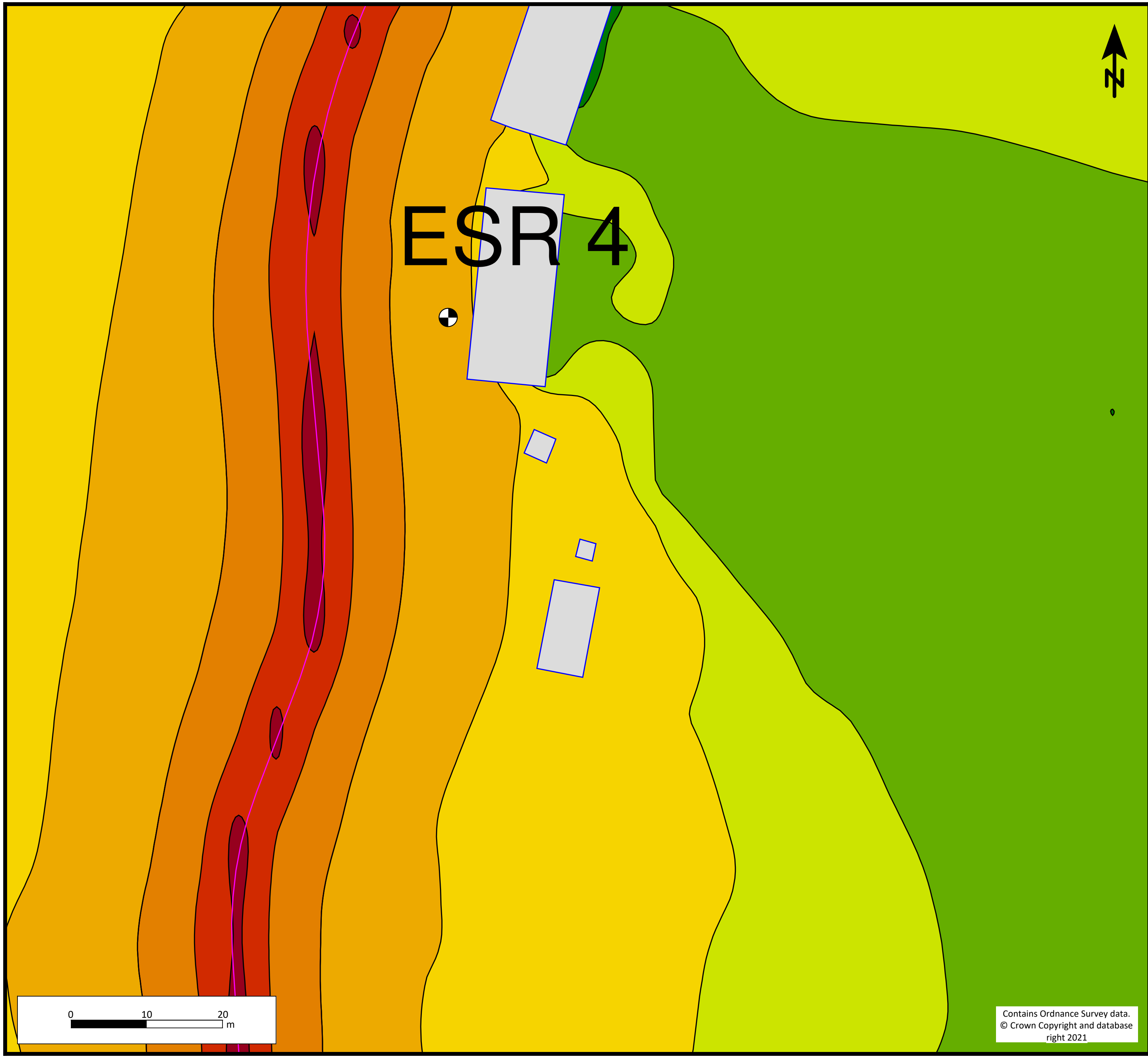

Key

- Existing Buildings
- Haul Road
- Point source
- Receiver
- Industrial building
- Facade as source
- Roof as source
- Acoustic Barrier

Daytime L_{Aeq} dB

<=	30.0
30.0 -	35.0
35.0 -	40.0
40.0 -	45.0
45.0 -	50.0
50.0 -	55.0
55.0 -	60.0
60.0 -	65.0
>	65.0

CLIENT: Adriatic Metals PLC

PROJECT: Vares Project ESIA

TITLE: Figure 5.6.4 - Noise Contours At ESR 4 Pre-Mitigation

DRG NO:		REV:
ZT520782/Figure - 5.6.4		A
DRG SIZE: A3	**SCALE:** 1:500	**DATE:** 26/07/2021
DRAWN BY LW	**CHECKED BY** RC	**APPROVED BY** MD

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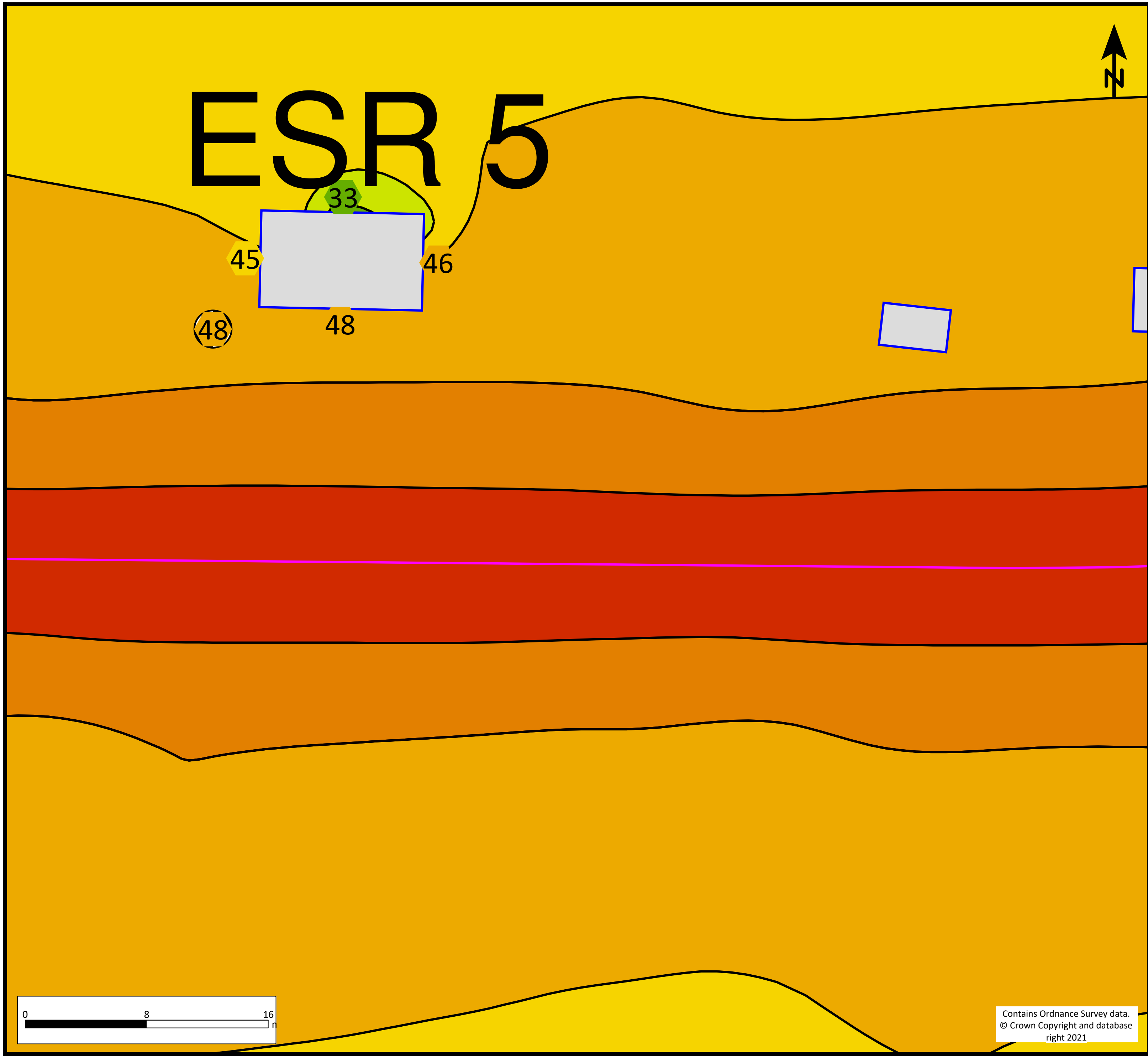

Key

- Existing Buildings
- Haul Road
- Point source
- Receiver
- Industrial building
- Facade as source
- Roof as source
- Acoustic Barrier

Daytime L_{Aeq} dB

<=	30.0
30.0 -	35.0
35.0 -	40.0
40.0 -	45.0
45.0 -	50.0
50.0 -	55.0
55.0 -	60.0
60.0 -	65.0
>	65.0

CLIENT: Adriatic Metals PLC		
PROJECT: Vares Project ESIA		
TITLE: Figure 5.6.5 - Noise Contours At ESR 5 Pre- Mitigation		
DRG NO: ZT520782/Figure - 5.6.5		REV: A
DRG SIZE: A3	SCALE: 1:250	DATE: 26/07/2021
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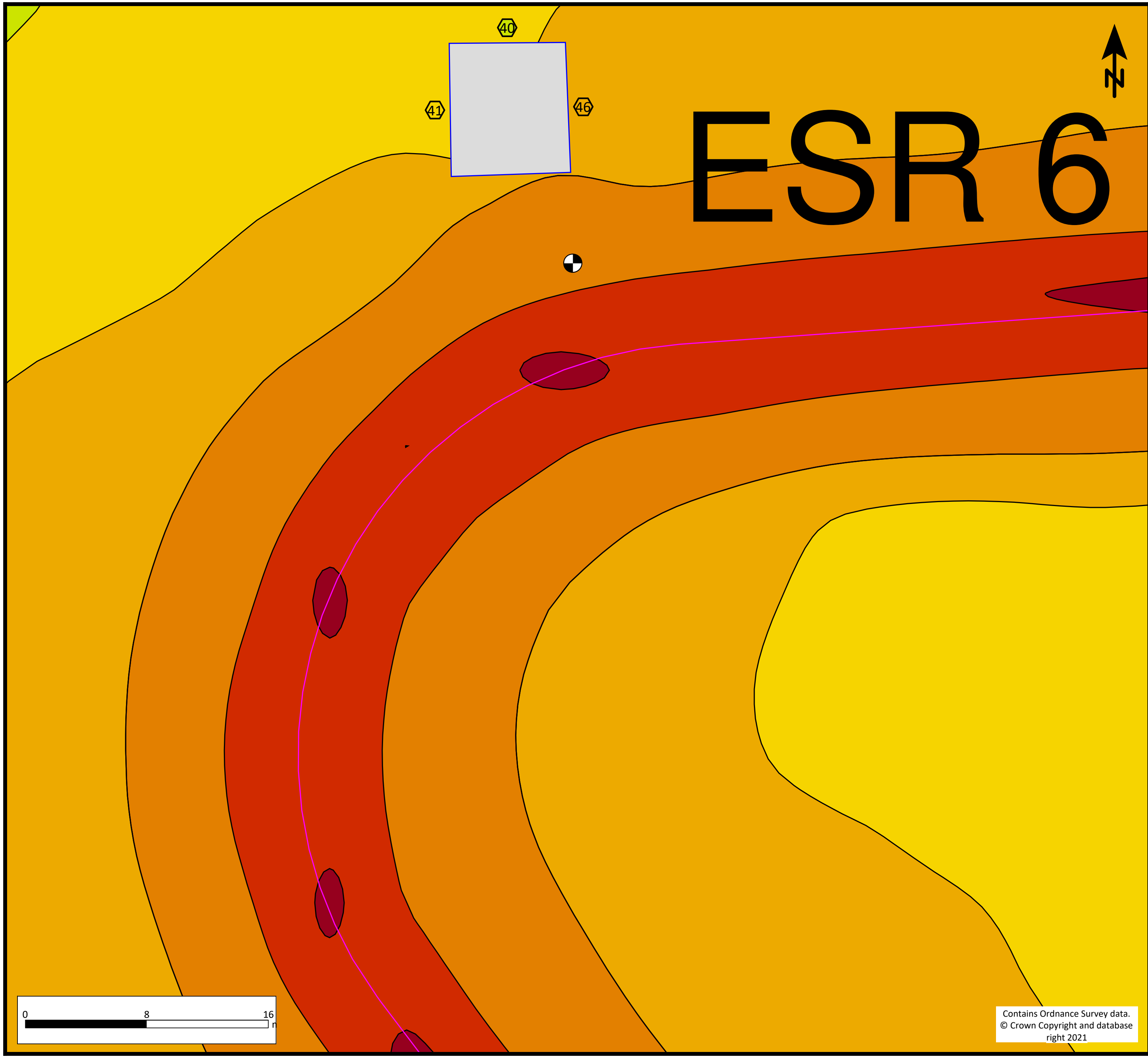

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Key

- Existing Buildings
- Haul Road
- Point source
- Receiver
- Industrial building
- Facade as source
- Roof as source
- Acoustic Barrier

Daytime L_{Aeq} dB

	<= 30.0
30.0	- 35.0
35.0	- 40.0
40.0	- 45.0
45.0	- 50.0
50.0	- 55.0
55.0	- 60.0
60.0	- 65.0
	> 65.0

CLIENT: Adriatic Metals PLC

PROJECT: Vares Project ESIA

TITLE: Figure 5.6.6 - Noise Contours At ESR 6 Pre-Mitigation

DRG NO: ZT520782/Figure - 5.6.6		REV: A
DRG SIZE: A3	SCALE: 1:250	DATE: 26/07/2021
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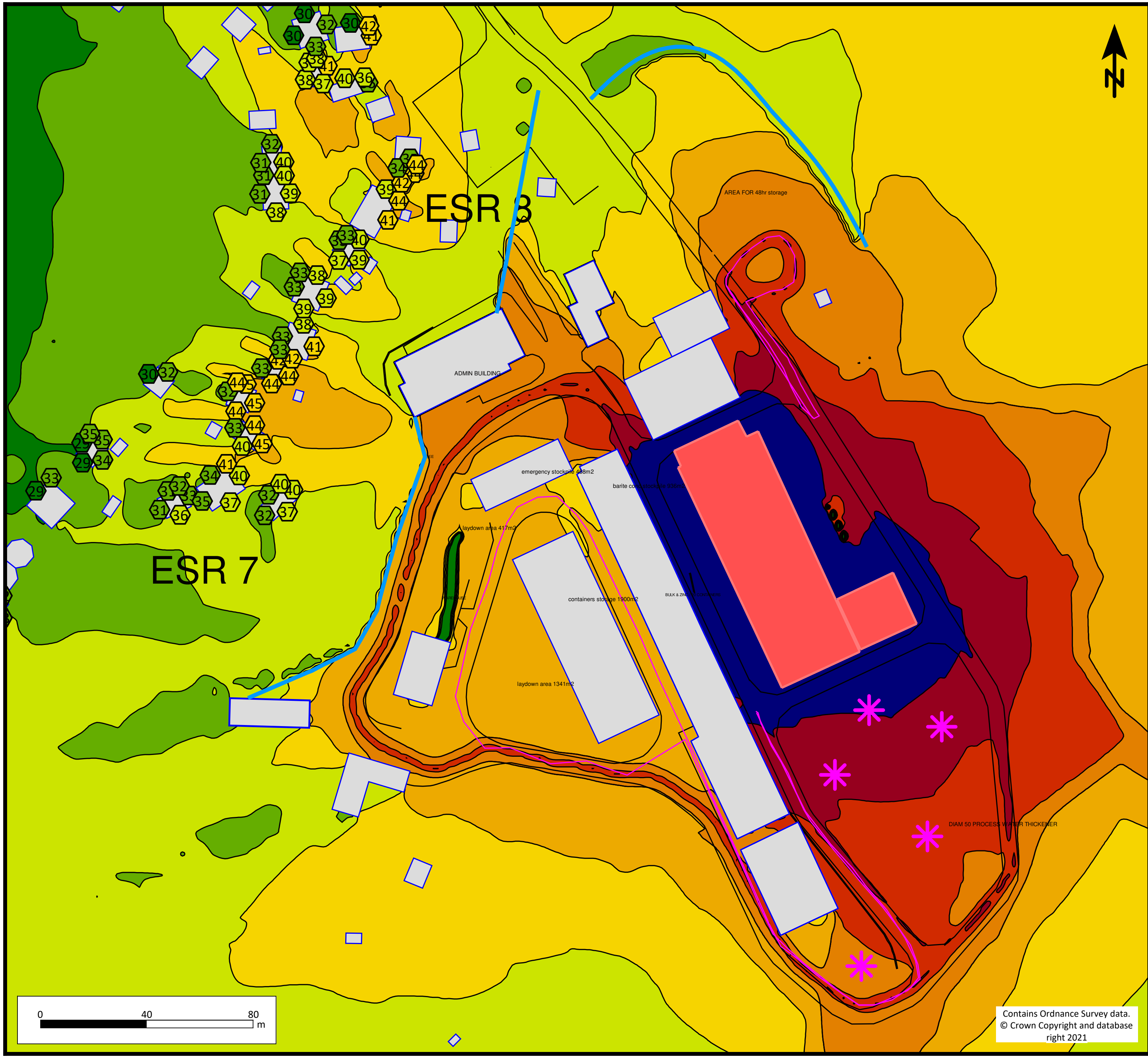

Key

	Existing Buildings
	Haul Road
	Point source
	Receiver
	Industrial building
	Facade as source
	Roof as source
	5.12m Acoustic Barrier

Daytime L_{Aeq} dB

<= 30.0
30.0 - 35.0
35.0 - 40.0
40.0 - 45.0
45.0 - 50.0
50.0 - 55.0
55.0 - 60.0
60.0 - 65.0
> 65.0

CLIENT: Adriatic Metals PLC		
PROJECT: Vares Project ESIA		
TITLE: Figure 5.6.7 - Noise Contours At ESR 7 and ESR 8 Pre- Mitigation		
DRG NO: ZT520782/Figure - 5.6.7		REV: A
DRG SIZE: A3	SCALE: 1:1426	DATE: 22/09/2021
DRAWN BY: LW	CHECKED BY: RC	APPROVED BY: MD

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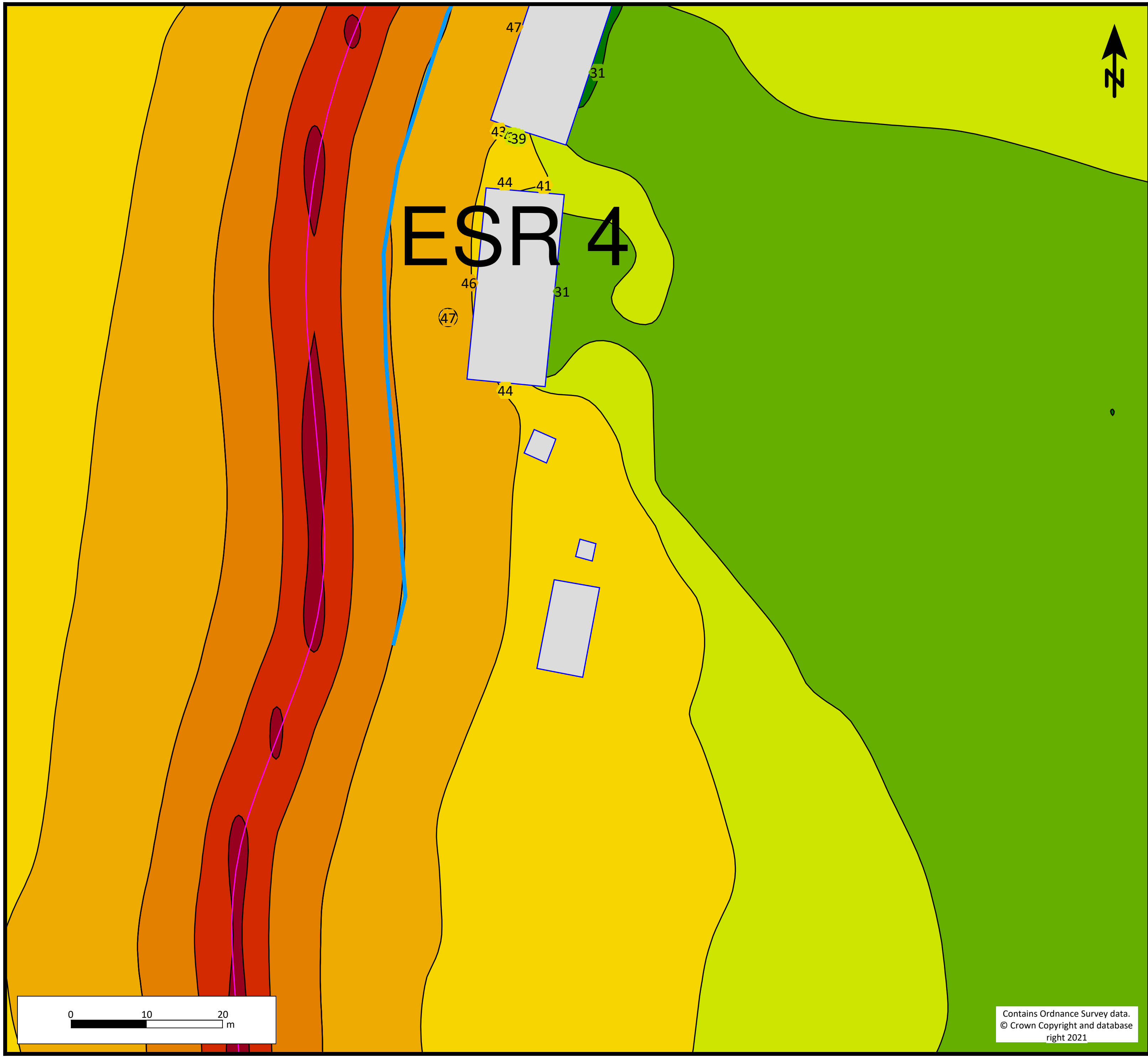

Key

- Existing Buildings
- Haul Road
- Point source
- Receiver
- Industrial building
- Facade as source
- Roof as source
- Acoustic Barrier

Daytime L_{Aeq} dB

	<= 30.0
30.0	- 35.0
35.0	- 40.0
40.0	- 45.0
45.0	- 50.0
50.0	- 55.0
55.0	- 60.0
60.0	- 65.0
	> 65.0

CLIENT: Adriatic Metals PLC

PROJECT: Vares Project ESIA

TITLE: Figure 5.6.8 - Noise Contours At ESR 4 Post-Mitigation

DRG NO:		REV:
ZT520782/Figure - 5.6.8		A
DRG SIZE: A3	SCALE: 1:500	DATE: 26/07/2021
DRAWN BY: LW	CHECKED BY: RC	APPROVED BY: MD

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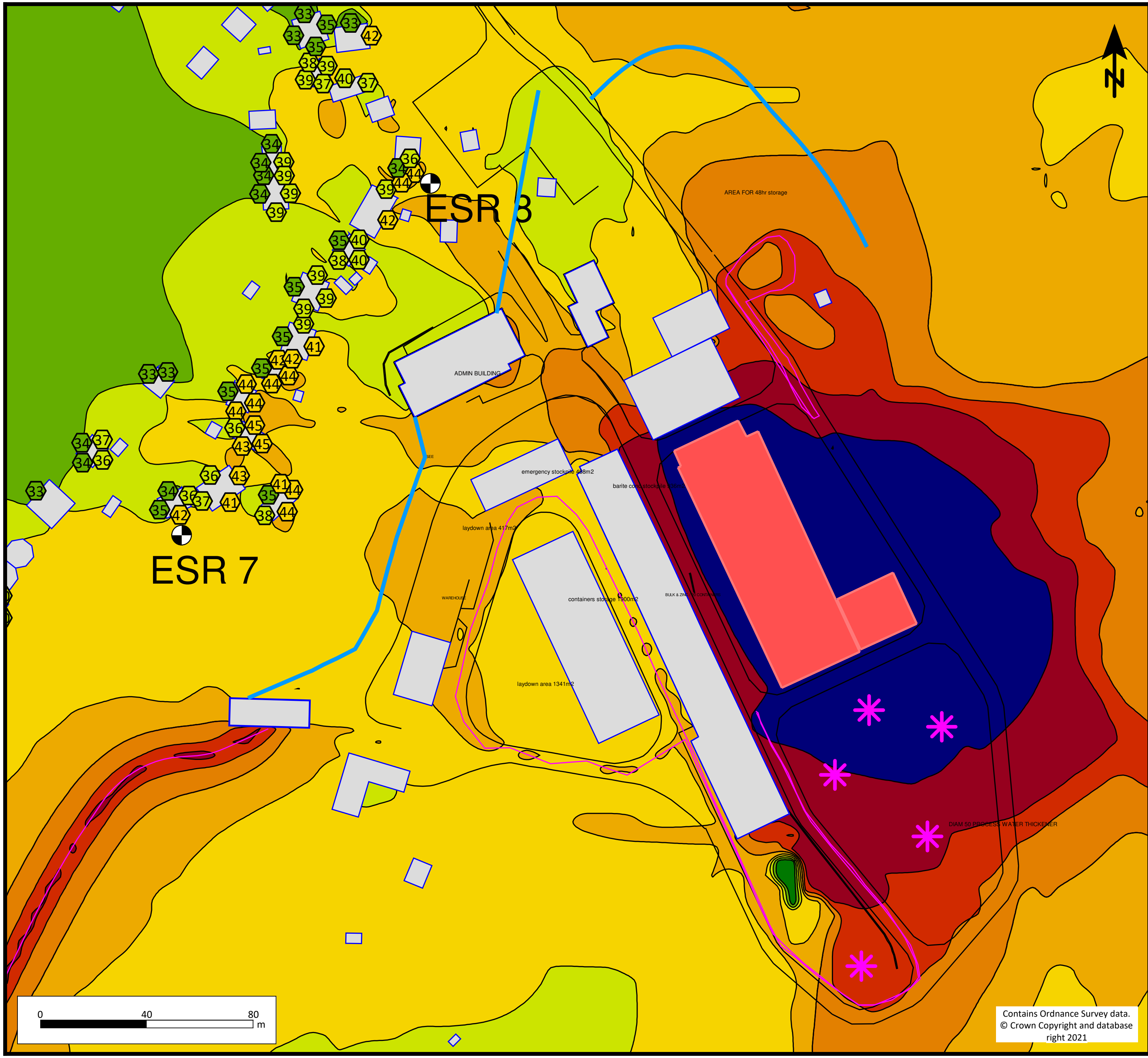

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Key

- Existing Buildings
- Haul Road
- Point source
- Receiver
- Industrial building
- Facade as source
- Roof as source
- 5.12m Acoustic Barrier

Daytime L_{Aeq} dB

<=	30.0
30.0 -	35.0
35.0 -	40.0
40.0 -	45.0
45.0 -	50.0
50.0 -	55.0
55.0 -	60.0
60.0 -	65.0
>	65.0

CLIENT: Adriatic Metals PLC		
PROJECT: Vares Project ESIA		
TITLE: Figure 5.6.9 - Noise Contours At ESR 7 and ESR 8 Post- Mitigation		
DRG NO: ZT520782/Figure - 5.6.9		REV: A
DRG SIZE: A3	SCALE: 1:1426	DATE: 13/08/2021
DRAWN BY: LW	CHECKED BY: RC	APPROVED BY: MD

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APPENDIX 5.9.1 – TRAFFIC ASSESSMENT

APPENDIX 5.9.1 – TRAFFIC ASSESSMENT

1 METHODOLOGY

1.1 Introduction

Transport Impact Assessment (TIA) methodology conforms to current good practice and in the absence of appropriate standards for Bosnia, traffic impacts are assessed in line with international guidance for impact assessment. In this case, it has been based on the following published UK guidance:

- Institute of Environmental Management and Assessment (IEMA) Guidelines for the Environmental Assessment of Road Traffic (1991); and
- Chartered Institution of Highway and Transportation (CIHT) Guidelines for Traffic Impact Assessment (1994).

In taking account of this guidance, the methodology has been specifically tailored to address the requirements of the Project and ESIA methodology (Chapter 5.1) to establish the significance of potential impacts on the highway network.

1.2 Impact Assessment Process

The technical approach for the assessment of traffic impact associated with the Project has the following stages:

- Establishment of baseline conditions (see Chapter 4.11, and Appendix 4.11.1 of the ESIA);
- Characterisation of the transportation aspects of the Project (See Project Description Chapter 3 of ESIA);
- Assessment of impacts in construction and operation;
- Identification of the effects of the closure phase (quantitative, as these are significantly less than the construction and operational phase); and
- Identification of mitigation measures for the operational phase.

1.3 Significance Criteria

Two broad principles outlined within the IEMA guidelines advise on the screening process to limit the scale and extent of the assessment. These are to:

- *"Include highways links where traffic flows will increase by more than 30% (or the number of heavy goods vehicles will increase by more than 30%); and*
- *Include any other specific sensitive areas, including communities, ecological and areas of significant heritage value where traffic flows will increase by 10% or more."*

In considering thresholds for significance, the assessment takes account of the difference between variations in traffic activity that constitute a highway impact, for example congestion or delay at junctions, and those that would constitute an environmental impact (in terms of communities, cultural heritage, or biodiversity).

A key characteristic for this assessment is that for certain effects, specific criteria should be applied to define thresholds of significance within an environmental impact assessment. Whether an impact is considered significant will depend on the level of development of traffic activity, compared to design of the network, the base load of traffic already on the surrounding network, the level of traffic congestion in the area and the environmental setting within which the Project and its associated traffic is located. There is, therefore, a need for interpretation and judgement, informed by appropriate, secondary data and expert opinion to determine whether further studies are required through the ESAP and management plans. This approach has been taken for this assessment.

The methodology used has been based on appropriate internationally recognised criteria set out in the IEMA guidance. Table 1.3.1 provides a summary of the attributes, based on the methodology set out previously, and made specific to assessment of transport and the highways network.

Table 1.3.1: Classification of Transport Impacts

Criteria	Scale	General definition	Application to transport assessment for the Project Affected routes
Direction	Positive	Impact provides a net benefit to the affected person(s).	Improvements in road infrastructure, public transport and reduction in traffic generation in communities
	Negative	Impact results in a net loss to the affected persons(s).	Reduction in public transport, increase in traffic and congestion at road junctions, increase in risk of accident and reduction in road safety.
	Mixed	Impact may be positive or negative but requires an intervention to demonstrate net benefit.	Combinations of the examples given above
	Neutral	No net benefit or loss to the affect person(s).	No net change in traffic, or the change would not be significant given the nature of the A2 expressway.
Magnitude	Negligible	No noticeable change anticipated.	No net change in traffic; or the change would not be significant given the nature of the A2 expressway.
	Low	Result predicted to be different from baseline conditions, but not to impair or change quality of life of the affected person(s).	Small change in capacity of junctions. Transport flow limited to major roads, with minimal or no change in roads serving communities and residential properties.
	Moderate	Result predicted to impair or benefit quality of life of the affected persons(s).	Noticeable change to capacity of junction to accept additional traffic. Wear to road surface sufficient to affect other road users. Increase in volume of traffic through communities or near residential properties.
	High	Result predicted to seriously	Inability of junctions to cope with level of

Table 1.3.1: Classification of Transport Impacts

Criteria	Scale	General definition	Application to transport assessment for the Project Affected routes
		impair or substantially improve quality of life.	traffic generated, resulting in driver delay and reduced safety. Major wear of road surfaces to cause a reduction in safety of the road for other users. Congestion and heavy goods traffic through communities or near residential properties.
Geographic Extent	Individual	Confined to individuals or individual households	Traffic generation is restricted to main or strategic highways, no properties impacted.
	Local	Confined to the local area of influence.	Traffic generation is restricted to main or strategic highways, no communities impacted.
	Regional	Confined to the regional area of influence.	Traffic generation extends to communities on the highway network
	National	Extends to national level.	Traffic generation such that impacted communities extend to a national level.
	Trans-boundary	Results impact neighbouring countries in the region.	Traffic generation affects impacts trans-boundary routes.
Duration	Short-term	Construction and prior to operations.	Includes: employees, deliveries of construction material, plant and equipment and other services
	Medium-term	Operations	Includes: employees, deliveries of material and export of products, services and repairs
	Long-term	Through decommissioning and closure.	Includes: employees, deliveries of material, export of redundant plant and equipment.

2 PROJECT ACTIVITIES AND BASELINE

2.1 Overview of Transport for the Project

An overview of all identified roads, routes, and vehicles utilising the routes are detailed below:

- The Project is accessed via sealed road R444;
- 24.5km of dedicated haul road to the Vares Processing Plant that will be situated at Tisovci (9km of existing road, 15.5km of new road);
- 4 trucks per hour will be on the haul route at any given point;
- Haul road will also be used to transport ore concentrate to the rail loadout;
- One 50-seater bus per shift will be required for travel to and from Rupice and VPP. It will depart from Zenica, to Kakanj and Breza (drop off location Vareš park and ride); and
- One a 20-seater bus will arrive at Vareš park and ride from Sarajevo each shift;

The 24.5km haul road will be owned, built, and managed by the Vareš municipality. It will predominantly be used for mining, however; it will be a publicly accessible road and therefore can be used by other industries and the public. The road is currently going through detailed design with finalised designs to be complete by the end of 2021.

2.2 Base turning Counts

Turning counts were undertake at the following junctions on 4 different dates each lasting 24hrs (06:00 – 06:00). The dates represented a weekday and weekend during the summer and winter months. Results of the turning accounts are provided in Appendix 4.11.2.

2.2.1 Junctions

- Vareš (18°19'18.74"E, 44° 9'16.25"N) TS3;
- Semizova Ponikva (18°16'56.36"E, 44°10'19.28"N) TS2;
- Borovica Gornja (18°13'54.00"E, 44°11'10.45"N) TS1; and
- Tisovci (18°20'53.28"E, 44° 8'36.08"N) TS4.

2.2.2 Dates

- Thursday 23rd – 24th July & 30th – 31st July 2020
- Saturday 25th – 26th July & 1st – 2nd August 2020
- Thursday 22nd – 23rd October 2020
- Saturday 24th – 25th October 2020

3 TRAFFIC ESTIMATES

3.1 Construction phase

Traffic volumes will increase during construction due to:

- Transport of construction materials, mine equipment and fleet vehicles;
- Transport of materials sourced internationally to the Project site;
- Transport of construction workers from their place of residence to site;
- Local supplies that are sourced from local communities; and
- Supplies that are sourced from greater distances, but within Bosnia.

<u>Materials</u>

The Applicant is estimating 20 HGVs per 10 hours day (40 movements, i.e. 20 arrivals and 20 departures = 4 movements per hour) delivering the following construction material include:

- Aggregates and construction fill;
- Concrete;
- Structural steel;
- Additional materials, including items such as piping, wiring, cables, rebar, cable tray

and pipe supports;
- Fuel delivery; and
- Potable water

3.2 Operational phase

Traffic volumes on the local road network will also increase during the operational phase due to the continued employment, after the construction phase and provision of goods and services required for the operation of the mine, including:

- Transport of materials, equipment parts and fuel transported by road to site;
- Transport of materials sourced internationally to site;
- Transport of employees from their place of residence to site;
- Local supplies that are sourced from local communities to site; and
- Supplies that are sourced from greater distances, but within Bosnia.

Materials

Heavy vehicle deliveries are anticipated throughout the operational phase of the Project. Deliveries will be required for equipment spare parts, miscellaneous materials, building supplies and fuel. In addition, a variety of process materials, chemicals and reagents will be needed for input into process operations. Maintenance and service vehicles can also be expected to access the site at regular intervals during the operational phase.

Fuel will be sourced locally from nearby local communities.

A total of 10 HGVs per day, 20 movements is anticipated taking place over a period of 10 hours, i.e. 4 HGV movements per hour, plus adhoc movements for the delivery of consumables (estimated 1 to 2 per week).

3.3 Mine closure

Traffic volumes during the closure phase will result from the following:

- Transport of materials, equipment parts and fuel required for mine closure works;
- Export of redundant plant and equipment some will be sold within Bosnia and others internationally; and
- Export of oversize plant and materials, generally by low loaders.
- Transport of employees from their place of residence to site; and
- Supplies sourced from local communities.

Materials

Heavy vehicle deliveries are anticipated throughout the closure phase of the Project and assumed at 10HGVs per 10 hours day = 20 movements = 2 movements per hour.

Workforce

To generate the workforce traffic estimates for the construction and operational phases, the Applicant provided 529 members of staff (in total) working over 2 shifts as follows:

- 365 working days per year;
- 11 underground hours of shift duration; and
- 7.8 hrs Effective hours per shift

The closure workforce would reduce to a maximum of approximately 20% of that predicted during operations (i.e. 127 members of staff) and although it is difficult to predict at this stage, the majority of this work force are likely to live on-site. Assuming this workforce operates on a similar rota and shift basis as the operational phase, this is equivalent to 43 members of staff per shift = maximum 2 coaches arriving and 2 coaches departing.

3.4 Summary

- Construction Phase — 4 materials HGVs + 4 movements of staff coaches
- Operational Phase — 4 materials HGVs + 4 movements of staff coaches
- Closure Phase — 2 materials HGVs + 4 movements of staff coaches

4 IMPACT ASSESSMENT

4.1 Calculations

The Rupice – Veovaca route is estimated to be 6.1m wide hence, using an internationally recognised design criteria such as UK's Design Manual for Roads and Bridges (DMRB) TA 79/99, v5, s1, pt3, a road of this design is capable of accommodating at least 1020 vehicles per hour (Table 2).

		Two-way Single Carriageway- Busiest direction flow (Assumes a 60/40 directional split)									Dual Carriageway			
		Total number of Lanes									Number of Lanes in each direction			
		2				2-3	3	3-4	4	4+	2		3	4
Carriageway width		6.1m	6.75m	7.3m	9.0m	10.0m	12.3m	13.5m	14.6m	18.0m	6.75m	7.3m	11.0m	14.6m
Road type	**UM**	**Not applicable**										4000	5600	7200
	UAP1	1020	1320	1590	1860	2010	2550	2800	3050	3300	3350	3600	5200	*
	UAP2	1020	1260	1470	1550	1650	1700	1900	2100	2700	2950	3200	4800	*
	UAP3	900	1110	1300	1530	1620	*	*	*	*	2300	2600	3300	*
	UAP4	750	900	1140	1320	1410	*	*	*	*	*	*	*	*

Table 2: Extract from (DMRB) TA 79/99, v5, s1, pt3

DMRB TA 46/97 identifies that capacity for existing links not currently experiencing congestion can be estimated from the following relationship:

CAPACITY **[A - B * Pk%H]**

Where: A = 1380 (for single lane carriageway)

B = 15 (for single lane carriageway)

Pk%H is the percentage of heavy vehicles in the hour

Capacities of the junctions listed in 14.11.1 have been calculated using the above equation. Site observations suggested that:

- TS1 and 2 are rarely used;
- TS4 is lightly used; and
- T3 is the busiest junction.

4.2 Junctions Capacity

Potential impacts to TS1-TS4 junctions were assessed and summarised in Table 2. As capacity is the issue, the highest counts at each junction were used; this assessment assumes a worst-case scenario where traffic is modelled for shift changeovers. This assumption has been applied for all phases.

The daily flows were provided by the Applicant based on actual junction counts; in the following

Tables, these flows were converted to PCUs (Passenger Car Unit) where each HGV is equivalent to 2.5 PCUs

To obtain the peak hour flows, a rule of thumb of 15% was applied.

4.3 Construction phase

Error! Reference source not found., provides the junction impact assessment for:

- Construction traffic relative to the base flows (red font); and
- Ratio of flow to capacity (RFC – blue font) which assesses the capacity of the junction based on the cumulative flows (base flows + construction flows).

Table 4.3.1: Construction Phase - Junction Capacity Assessment

Junction	Baseline 2020 (PCU/day)	Baseline 2020 (PCU/hr)	Baseline Vehicles/hr	Baseline HGVs	Link Capacity	Construction Traffic (PCU/hr)	% impact (Construction phase)	RFC
TS1	40	6	6	0	1380	20	333%	2%
TS2	29	4	4	1	1005	20	500%	2%
TS3	3292	494	475	7	1358	20	4%	38%
TS4	308	46	43	2	1310	20	43%	5%

NOTE: The mine's vehicular directional flows are not known hence, the impact is assessed based on junction capacity as opposed to Link capacity

The findings in Table 3 should be considered in context; if a junction has low flows and additional traffic is added to it, the impact will be more severe in percentage terms than a junction which is heavily used hence, the key consideration is the RFC which details what capacity a junction has as that is a measure of how much traffic a junction can cope with before becoming congested with queues and delays.

Note: queues and delays start to form when the capacity exceeds 85% and most certainly when the RFC is over 100%.

To put the findings of Table 3 in simple terms, and as an illustrative example, junctions TS2 and TS3 for construction phase are considered:

- TS2: Impact 500%. This is due to the fact that the base flow is 4 vehicle per hour using the junction and construction traffic is adding 20 HGVs and buses (per hour) hence, the impact is severe. However, when the RFC is considered, the utilised capacity of the link is 2% which means it has a remaining capacity of 98% before queues and delays start forming.

- TS3*:* Impact 4%. This is due to the fact that the base flows are 475 vehicle per hour using the link and construction traffic is adding only 20 HGVs and buses (per hour) hence, the impact is negligible. When the RFC is considered, the utilised capacity of the link is 38% which means it has a remaining capacity of 62% before queues and delays start forming.

In Highways and Transportation terms, the construction traffic will have negligible impact on the capacity, queuing and delays of TS1-TS4 junctions

Table 4.3.2: Significance of impacts – **Construction** Phase

Link	Direction	Magnitude	Geographic	Duration
TS1	Neutral	Low	Local	Short
TS2		Low		
TS3		Negligible		
TS4		Low		

4.4 Operational phase

Error! Reference source not found.5, provides the junction impact assessment for:

- Operational phase traffic relative to the base flows (red font); and
- Ratio of flow to capacity (RFC – blue font) which assesses the capacity of the junction based on the cumulative flows (base flows + operational flows).

Table 4.4.1: Operational Phase - Junction Capacity Assessment

Junction	Baseline 2020 (PCU/day)	Baseline 2020 (PCU/hr)	Baseline Vehicles/hr	Baseline HGVs	Link Capacity	Operational Traffic (PCU/hr)	% impact (Operational phase)	RFC
TS1	40	6	6	0	1380	20	333%	2%
TS2	29	4	4	1	1005	20	500%	2%
TS3	3292	494	475	7	1358	23	5%	38%
TS4	308	46	43	2	1310	20	43%	5%

NOTE: The mine's vehicular directional flows are not known hence, the impact is assessed based on junction capacity as opposed to Link capacity

As discussed in the Construction Phase assessment, if a junction has low flows and additional traffic is added to it, the impact will be more severe in percentage terms than a junction which is heavily used hence, the key consideration is the RFC which details what capacity a junction has as that is a measure of how much traffic a junction can cope with before becoming congested with queues and delays.

In Highways and Transportation terms, the construction traffic will have negligible impact on the capacity, queuing and delays of TS1-TS4 junctions

Table 4.4.2: Significance of impacts – **Operational** Phase

Link	Direction	Magnitude	Geographic	Duration
TS1	Neutral	Low	Local	Short
TS2		Low		
TS3		Negligible		
TS4		Low		

4.5 Closure phase

As would be expected, the vehicular flows associated with the Closure phase are minimal hence, the impact is overall negligible

Table 4.5.1: Closure Phase - Junction Capacity Assessment

Junction	Baseline 2020 (PCU/day)	Baseline 2020 (PCU/hr)	Baseline Vehicles/hr	Baseline HGVs	Link Capacity	Closure Traffic (PCU/hr)	% impact (Closure phase)	RFC
TS1	40	6	6	0	1380	15	250%	2%
TS2	29	4	4	1	1005	15	375%	2%
TS3	3292	494	475	7	1358	15	3%	37%
TS4	308	46	43	2	1310	15	33%	5%

Table 4.5.2: Significance of impacts – **Closure** Phase

Link	Direction	Magnitude	Geographic	Duration
TS1	Neutral	Low	Local	Short
TS2		Low		
TS3		Negligible		
TS4		Low		

5 MITIGATION

The following good practice measures have been identified, including:

- The potential to reduce Project vehicular impact by developing logistics so that HGVs travel loaded in both directions will be included as an item to be considered in the annual transport improvement programme;
- Annual review of the roads network leading to the proposed mine access points

is to be undertaken to assess the ability of HGV and low loaders to the enter / egress the road network safely;

- Provide the findings of the above to all drivers as part of the driver awareness, routine briefing and training programme;
- Maintain all internal road infrastructure to maintain all transport and other plant in a good condition, whilst using internal project roads. Any existing gravel surfaced site access roads leading to the mine will be widened over its entire length and maintained for all weather operation, providing the means of access to the mine site and associated infrastructure;
- Formal road signage to alert general traffic to the possibility of vehicles turning into and out of the site access junction; and
- For deliveries of oversize HGVs warrant it, other traffic can be diverted, and road diversions would be signed and if necessary staffed to ensure that reasons for the diversion were communicated appropriately.

A Transport Management Plan (TMP) should be prepared to include the formal arrangements to minimise and mitigate the impact on the local communities. The TMP will describe the measures that would be undertaken to reduce disruption, inconvenience and delay to road users, without compromising safety. The TMP requires the details for temporary traffic management and the period over which they will be in place.

6 CONCLUSION

A Traffic Impact Assessment has been undertaken to assess the effects of the Project by consideration of the construction, operation and closure phases of the mine.The findings of the assessment are:

- The predicted impact to junctions TS1 – TS4 is negligible - Low and not significant during the construction, operation and closure phases of the Project;
- Good practice measures have been defined that result in minor and not significant predicted impacts on communities close to the strategic highway network; and
- A Transport Management Plan should be prepared for construction, operations and closure phases with a focus on community health and safety.

In conclusion the potential impacts of Project related traffic on the highway during construction, operation and closures phases is predominantly negligible and the residual effects are not significant.

DRAFT

APPENDIX 5.12.1: Prioritisation of Ecosystem Services

Appendix 5.12.1: Prioritisation Process for Ecosystem Services						
Ecosystem Service	**Identified activity**	**Beneficiaries and use of ES**	**Will the Project affect the benefits?**	**What is the level of dependence?**	**Do the beneficiaries have alternatives?**	**Prioritisation**
Provisioning						
Food	Subsistence farming of crops (potatoes, onions, carrots cabbages, mainly).	40% household respondents partake in some form of subsidence farming. Daštansko has the highest number of residents carrying out these activities.	**UNLIKELY** Air Quality impacts if there is a high emission of dust or particulate matter. Most relevant in rural settlements along haul route and Tisovci, adjacent to VPP.	**MODERATE**	**UNCERTAIN**	**NOT PRIORITY** Project likely to have some impact. The remote setting, limited income and limited public transport means some community members rely on producing crops for their own food consumption.
	Commercial farming of crops	40% household survey respondents sell a proportion of their crops for income. The amount is small, and generally comprises of any excess that cannot be consumed. Some utilise orchards to make jams for sale. This activity is most popular in Pogar.	**UNLIKELY** Pogar village, where these activities take place, does not lie close to Project infrastructure likely to cause Air Quality impacts.	**LOW**	**UNCERTAIN**	**NOT PRIORITY** As most of these activities occur away from Project infrastructure impact is not anticipated. Commercial farming is not widely practiced and dependency is low.
	Keeping of livestock (chickens, goats, cows and pigs) for own consumption and commercial purposes, and keeping of bees.	Poultry farm – Pržići Stockbreeding – Daštansko, Pogar. Pig breeding - Pogar Bee Keeping (own consumption) – Breza, Donja Borovica	**UNLIKELY** Air Quality impacts if there is a high emission of dust or particulate matter.	**MODERATE**	**UNCERTAIN**	**NOT PRIORITY** Project likely to have some impact in Pržići and Daštansko, though receptors are minimal. Dependency on income will be determined in next phase.
	Foraging for mushrooms, wild berries and herbs, for own consumption. Foraging of rosehip to make tea and jam, to sell in small quantities.	50% of household survey respondents partake in some form of foraging activities. Carried out adjacent to the existing Veovaca open pit, Mala Rijeka downstream of the TSF (Hight quality spruce forest for mushroom picking, Zvijezda, Mekuše forest and Dugiratat, Hrida, Bjelovače and around church in Gornja Borovica (Drawing 4.13.1).	**POSSIBLE** Development of the project will not restrict access to land used for foraging activities. In case of spillages or degraded water quality to Mala, this could have a secondary impact on the mushroom picking area on the banks of Mala Rijeka.	**MODERATE**	**UNKNOWN**	**PRIORITY** Most foraging activities occur away from the Project affected area and dependency is low. Mapping of these activities will occur to determine extent within footprint of Veovaca open pit.
	Trout Farming	Undertaken north of Vares adjacent to the Stavnja River and in the Bukovica River	**POSSIBLE** Trout farming occurs adjacent to the Project's water abstraction point in Bukovica River.	**MODERATE**	**NO**	**PRIORITY** The Trout farm is relied on for income. The impact of the project abstraction will need to be assessed.
Biomass Fuel	Tree logging for heating and cooking fuel, carried out by official contractors and managed by the Forestry administration. Some unregulated activity does occur by local community members. This is not done on large scale and is illegal.	Across the municipality of Vares wood is used as the main source of fuel for heating and cooking. Gas connections in homes are not common. Forestry commission owned land at both Rupice and Vares Processing Plant.	**CERTAIN** Development of Rupice mine, haul route and the TSF, will result in the reclassification of forested land to industrial land. Trees here will be felled by the forestry commission. The haul route to be developed for Project use will be multipurpose providing improved access for forestry trucks.	**LOW**	**YES**	**NON-PRIORITY** Forestry commission own and manage land, whilst trees will be felled likely that these will be able to fall into the product line.

Appendix 5.12.1: Prioritisation Process for Ecosystem Services						
Ecosystem Service	**Identified activity**	**Beneficiaries and use of ES**	**Will the Project affect the benefits?**	**What is the level of dependence?**	**Do the beneficiaries have alternatives?**	**Prioritisation**
Freshwater	Springs and groundwater wells used for household consumption.	Donja Borovica, Gornja Borovica, Osredak, Semizova Ponikva, Polozac and Pogar. King's water bottling factory approx. 1km SW of Donja Borovica.	**POSSIBLE** Dewatering of Rupice could lower overall water table impacting spring flow. Springs and groundwater systems are comparable in regard to water type and quality, suggesting there are potential linkages between the two for contaminant transport potential for this would be need to be assessed. A hydrocensus should be undertaken to determine water resources for households.	**HIGH**	**NO**	**PRIORITY** Main source of household water supply in Rupice area, thus dependency is high as no municipal source is present.
	Rivers used for watering of livestock	Mala River utilised south of Veovaca open pit and north of existing TSF.	**UNLIKELY** Veovaca open pit not due to be mined, therefore no impact anticipated.	**MODERATE**	**YES**	**NOT PRIORITY** Extent and dependency will be determined in proceeding phase, though anticipated to be low.
	Borovica River is used to flush sanitary effluent from adjacent communities.	Donja Borovica, Gornja Borovica, Osredak.	**POSSIBLE** Sufficient environmental flow in Borovica river in order to flush sanitary effluent away is required. During drilling the water level dropped raising complaints and concerns from residents. If used as a water source at any point then impact is likely.	**HIGH**	**NO**	**PRIORITY** Dependency in named villages is high, with no alternative at present. Project impact could be high, based on experiences during drilling. Full assessment is required.
Foraging for natural medicines	Foraging and use of natural medicines for personal consumption.	Zvijezda mountain	**UNLIKELY** None determined.	**MODERATE**	**YES**	**NON-PRIORITY** Activities occur away from Project area, with low dependency from community stakeholders.
Regulating						
Regulating of Air Quality and Climate	Forestry land provides an air pollutant trap and carbon sink.	Around Veovaca plant site – Tisovci and Pržići and at Greenfield Rupice Site	**LIKELY** Land take for Project infrastructure will result in felling of trees currently providing these aspects.	**LOW**	**N/A**	**NOT PRIORITY** Project land take is relatively low with no immediate sensitive receptors located adjacent to forested areas. Further analysis to determine carbon sink potential will be carried out. Forestry commission to be consulted regarding forestry programme and planting of new trees.
Water flows and timing	Borovica River is utilised by residents to flush away sanitary effluence.	Donja Borovica, Gornja Borovica, Osredak.	**POSSIBLY** Use of water from the Borovica river for the Project will impact the flow regime and water levels. This has occurred during exploration activities, with concerns raised from residents.	**HIGH**	**NO**	**PRIORITY** Dependency in named villages is high, with no alternative at present. Project impact could be high, based on experiences during drilling. Full assessment is required.

Appendix 5.12.1: Prioritisation Process for Ecosystem Services						
Ecosystem Service	**Identified activity**	**Beneficiaries and use of ES**	**Will the Project affect the benefits?**	**What is the level of dependence?**	**Do the beneficiaries have alternatives?**	**Prioritisation**
Erosion Control	Forested areas on steep valleys at Rupice and Veovaca TSF area.	Vegetation cover provides stabilisation, this will be cleared at Rupice for the development of surface infrastructure and at VPP for developed of TSF.	**LIKELY** TSF footprint area requiring removal of trees. Erosion of soil may lead to increased sedimentation in river. Rupice infrastructure footprint requires removal of trees.	**HIGH**	**NO**	**PRIORITY** Mala River down from valleys to be utilised for tailings and waste rock storage. Assessment will be required during design of TSF to determine impact on this river.
Cultural						
Outdoor activities e.g. cycling, walking, hiking	Residents partake in walking and hiking. Tourism activities relating to outdoor activities – hiking and mountain biking being key. The Via Dinarica hiking trail is currently being developed and will go through the town of Vareš and onto Bobovac.	Residents of Vareš partake in walking, largely due to lack of public transportation. Tourism industry has a focus on cycle and hiking trails, including Via Dinarica trail (under development).	**YES** Hiking and mountain biking are not undertaken in the footprint of the Project, thus the impact from the mine will be minimal. Increased traffic on roads may lead to increased accident risk in Vareš town. Visual impacts are anticipated.	**LOW-MODERATE**	**UNKNOWN**	**PRIORITY** Whilst popular activities, they are not undertaken within or adjacent to Project footprints. Increased economic opportunity may positively impact services available in Vareš for tourism.
Fishing	Fishing for leisure purposes occurs. One trout farm is also present North of Vareš.	Undertaken across the project area, 6 household respondents stated they partake in fishing activities in the Mala River.	**LIKELY** In rivers around Borovica, Mala River Further assessment is required to determine location and extent of fishing. Consultation with fishing association to be carried out so that mapping can be done.	**LOW-MODERATE** No commercial fishing, and numerous water ways in the region.	**UNKNOWN**	**PRIOROITY** Dependency is not anticipated to be high with few people partaking in activities. Activities are undertaken across Vares municipality.
Hunting	Hunting of wild boar, rabbits, foxes.	10 household survey respondents partake in hunting activities. Undertaken in the Zvijezda Mountain. 5-6 residents of Borovica, and about 40 people in total, partake in recreational hunting activities around the vicinity of the Rupice mine. Recreational hunting previously ocurred in the area of Rupice.	**CERTAIN** Hunting activities in the area of Rupice have been minimised in recent years due to exploration activities of Adriatic Metals. However, sufficient land is available outside of the Project area for activities to continue, as determined through conversation with Hunting Society.	**LOW**	**YES**	**NON-PRIORITY** Hunting is done for recreational purposes rather than for subsistence, so dependency is low. Sufficient land is available for hunting to continue.
Landscape and Sense of Place	Rural and natural landscape is appreciated for its value.	Residents across Vareš and visitors to Vareš, mainly holiday makers from Sarajevo and other cities who visit Vareš for the rural setting. Several holiday homes are present, particularly in the area around VPP.	**LIKELY** Industrialisation of landscape will have some impact. However, Vares Processing Plant will both be repurposed with only some exasperation of visual impact, whilst improving the existing visual impact of the dilapidated process building.	**MODERATE**	**UNKNOWN**	**PRIORITY** Change to the landscape should be determined as this can be detrimental to the character of the area. Tourism in Vareš is largely dependent on the rural setting and associated perceived “clean air” of the municipality.
Supporting						
Role of ecosystems in supplying habitat	Forestry land	Provision of food and shelter for different animals within the forestry habitat	**LOW** Managed spruce forest where trees are not left to mature and provide good habitat.			**NON-PRIORITY** No protected areas or areas of habitat that will be completely removed (see Chapter 6 – Biodiversity)

Appendix 5.12.1: Prioritisation Process for Ecosystem Services						
Ecosystem Service	**Identified activity**	**Beneficiaries and use of ES**	**Will the Project affect the benefits?**	**What is the level of dependence?**	**Do the beneficiaries have alternatives?**	**Prioritisation**
	Fish Spawning	Fish spawning occurs in the eastern branch of the Mala River on an annual basis.	**LOW** Project will not impact the eastern branch of the Mala River.			**NON-PRIORITY**
Nutrient cycling	Beneficiaries from all other services		N/A			**NON-PRIORITY** Affected area is not critical to the levels of nutrient cycling in the region.
Primary production	Beneficiaries of those who keep livestock for milk, meat and animal products.	Residents across key communities who keep livestock.	N/A			**NON-PRIORITY** Dependency on this is low, with no respondents stating this is their only or main supply of these products.
Water cycle	Beneficiaries of water related services	Key communities around Rupice Site.	**UNKNOWN** Change in landform may affect surface water run off and groundwater. Dewatering of Rupice will have impact on groundwater levels with some potential linkage to springs and wells used in Villages around Rupice, indirectly impacting water quality.	**NOT APPLICABLE**		**NON-PRIORITY** As water is key resource in the region, this will be assessed as part of aforementioned assessment and future water studies.