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KYZYL ESIA

December 2015

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EXECUTIVE SUMMARY

Polymetal's proposed Kyzyl Gold Project comprises the extraction, via open pit (Phase 1, 2016-2024) and underground (Phase 2, 2025-2039) mining, of ore from a deposit located adjacent to the village of Auezov and surrounded by the municipality of Shalabay within Zharminsky District in East Kazakhstan Oblast. The deposit, which has been mined intermittently since 1956, has been operating under Care & Maintenance since 1997.

The Project environmental and social impact assessment (ESIA) has been undertaken in compliance with the standards of the International Finance Corporation and the European Bank for Reconstruction and Development. It is designed to meet best international practice as exemplified by the standards of development banks and Equator Principles financial institutions.

The Project site area is in a rural area characterised by hilly grassland terrain and an extreme continental climate. It occupies 839 ha. Agriculture is the primary source of livelihood in the communities surrounding the Project. Grassland areas surrounding the Project are used by seasonal animal herders, tasked with keeping livestock belonging to residents of Auezov and Shalabay. Grasslands and local lakes and rivers are also used by residents for collecting berries, fishing, and hunting. While most agricultural produce is for home consumption, the village of Shalabay is home to the Shalabay LLP cattle farm, which also grows crops and cultivates bees for honey. As with many rural areas in Kazakhstan, and especially in Auezov since the Project fell into Care & Maintenance, the local communities are experiencing low-level out-migration at present, as residents seek employment opportunities elsewhere.

The Project will employ roughly 1,000 workers, including 608 for the first and 1,084 for the second operation phases. Polymetal will prioritise local recruitment and will aim for most operations jobs to go to residents of the local and nearby settlements.

While Project employment is expected to benefit local communities, it may also represent a transition away from traditional lifestyles for some residents of Auezov and Shalabay. Access to areas used to graze animals and collect berries and mushrooms will be partly restricted by the presence of Project infrastructure, in particular at and around the site of the future tailings storage facility (TSF) and processing plant to the south-east of Auezov.

The direct and indirect employment opportunities presented by the Project may serve as an attraction to in-migrants, potentially raising the local population and increasing the demand for goods and services. Increased demand, coupled with increased disposable income from mining wages, could generate localised inflation. Polymetal will work with local communities and government to minimise and manage the potential negative social impacts of the Project, through regular monitoring, information dissemination and awareness training, stakeholder engagement, and the administration of a community grievance mechanism.

With the current Project design, noise impacts at residential receptors in Auezov have been identified as significant during the night over the first few years of operations, and moderate over the longer term. Further mitigation measures will need to be developed at the detailed design stage. The distances between Project infrastructure and the local communities are such that most sources of air pollution are not expected to significantly affect local people, with the exception of SO_2 emissions under the worst case scenario. More detailed air dispersion modelling of emissions from boilerhouse stacks is required to accurately assess the air quality impact. Traffic impacts will be controlled to the extent possible, including by Polymetal constructing new roads allowing for the transportation of ores in isolation from the village's regular traffic.

Potable water for the Project is supplied from a surface water intake at the Kyzylsu River water reservoir (1,400m^3/day) and from a wellfield constructed in the Kyzyltu River valley (100m^3/day). Water from both sources is treated and decontaminated for use by Project workers and Auezov settlement. Process water is sourced from open pit and underground mine drainage water, which is first pumped into the mine settling sump (Open Pit No 2) and then to the water tanks of the process plant. The groundwater from the Kyzyltu wellfield serves as a backup source of process water. Mine site and domestic household effluents are transported by gravity flow sewers to the sewage pumping station and then pumped to the biological treatment facility, which has a capacity of 3,500m^3/day.

The project will have no significant residual adverse impact on the surface water and groundwater resources utilised by the project. Although additional studies are required to confirm the significance of some potential impacts, which may occur during the phase of underground mining (dewatering, stream flow) and the closure phase (contaminants potentially remaining in the aquifer around the open it). In addition, there may be associated potential ecological impacts resulting from the loss of flows in nearby streams, in particular at Akbastaubulak.

The majority of the Project will be located on 'brownfield' areas, where exploration and mining activities have already taken place for decades. As a result, the Project will have little impact on regional biodiversity and no impact on rare or threatened animal and plant species. However, the Project's activity will reduce the quality of immediately surrounding habitats as a result of noise and dust deposition. Potential impacts on biodiversity will be reduced to the extent possible by the implementation of management measures and by post-mining restoration.

After the planned life of the mine has expired, a complete mine closure will be carried out, which will include rehabilitation and restoration of disturbed land. Polymetal will ensure that public health and safety is not compromised and that any residual environmental impacts are minimised as a result of the Project activities, including ensuring that environmental resources will not be subjected to long-term physical or chemical deterioration as a result of the Project. Polymetal will also ensure that any adverse impacts on local communities are minimised and that socioeconomic benefits are maximised.

Surveys have identified no sites of archaeological significance within the Project area. A "chance finds procedure" will be in place at all times to ensure that any significant new site or artefact discovered

during Project implementation can be recorded, investigated and removed or excavated as appropriate.

Stakeholder engagement is a core value of Polymetal. Throughout the Project's life cycle, the main aim of stakeholder engagement is to establish, develop, and maintain two-way communication between Polymetal and stakeholders at national, regional and local levels to ensure stakeholder views are incorporated into the ESIA and Project design. Good relationships with local communities have supported the development of Polymetal's activities on site thus far.

The Project will implement a comprehensive Environmental and Social Management Plan (ESMP) to govern the implementation, management and monitoring of the mitigation measures that the ESIA has identified as being necessary to control the environmental and social impacts of the Project. A total of 14 management plans have been developed as initial documentation for the ESMP. A comprehensive Environmental and Social Management System is being developed to properly implement the commitments made in the ESIA, during construction as well as during operations.

1 INTRODUCTION

Wardell Armstrong International (WAI) has been engaged by Polymetal to undertake an Environmental and Social Impact Assessment (ESIA) for the Kyzyl gold deposit (the Project) in the Republic of Kazakhstan (RoK). The ESIA should be read in conjunction with the Feasibility Study (BFS) report (prepared by Polymetal in July 2015) for a full appreciation of the scope of the Project.

The term 'Bakyrchik', which is derived from the name of the deposit's discoverer and still commonly used by local residents to describe the town of Auezov, is used here to describe the mine up to and including its period of operation under Care & Maintenance. The term 'Kyzyl' is used here to describe the current and future gold deposit at the Project, in particular its status under Polymetal's operation.

The ESIA includes the following aspects:

- Summarising and presenting the applicable national and international policy, legal and administrative framework under which the assessment was carried out.
- The Project Description, covering geographical, ecological, environmental, social and temporal aspects, influences and effects.
- Analysing baseline data, describing the environmental, socio-economic and community conditions which have been assessed against the Project plans given in the Feasibility Study (FS).
- Review of alternatives for siting various Project facilities, taking into account regulatory, environmental, biodiversity, cultural heritage, social, and community/employee health and safety issues.
- Defining the environmental and social impacts associated with Project construction, operation, mine closure and reclamation.
- Incorporating mitigation measures into detailed design to eliminate or minimise impacts to an acceptable level and identify appropriate alternatives.
- Development of key Framework Management Plans with input to the site-specific Environmental and Social Action Plan (ESAP) for the delivery of the Project, outlining time bound actions. The ESAP will become an evolving document throughout construction, operation and closure.
- Development of a Framework Mine Closure Plan and measures for post-mining management.

1.1 Project Location and Setting

The Kyzyl deposit is located within Zharminsky District in Eastern Kazakhstan Oblast. The area of the deposit is approximately 839ha with central geographical co-ordinates of 81 34' 48"E; 49 43' 16"N. The project is located in steppe terrain, generally undulating with shallow ravines. Within and adjacent to the mine concession boundary, land is mostly uncultivated but is currently used by herders and

local residents for berry picking and hunting. Rivers and lakes in the surrounding area are used for fishing and recreational activities.

The closest settlement to the Project is the village of Auezov, which is adjacent to the site. Auezov and the Project area are surrounded by territory belonging to Shalabay municipality. Shalabay village, which hosts the nearest railway station, is located 6km to the west of Auezov. The Project is roughly 100km south-west of Ust-Kamenogorsk, the region's administrative capital and closest urban centre. Ust-Kameongorsk is an industrial city heavily reliant on non-ferrous metallurgy (lead, zinc, titanium and magnesium), food processing and machine building. It has a population of around 303,720 people.

1.2 Scope and Objectives of the ESIA

Overview of the Project

The details of the geology as well as the extent and characteristics of the Kyzyl ore body, together with the mining methods proposed for the extraction of ore are described in Chapter 3 of this ESIA.

The Kyzyl deposit will be extracted using both conventional open pit and underground mining methods (Drawing 1.3 illustrates the layout of the open pits in the context of the infrastructure required to extract and process the ore deposit). The extracted ore will be crushed and processed before being transported by road and rail to Russia for processing. The duration of the Project's two operational phases is 8 years and 14 years, respectively. Phase 1 (2016-2024) comprises open pit mining and will employ 417 shift and 608 full-time workers. Phase 2 (2025-2039) comprises underground mining and will employ 533 shift and 1,084 full-time workers.

Although the Kyzyl Project has the potential to incur some moderate environmental and social impacts, these are manageable to prevent or to minimise. The Project would be considered as a Category A Project under the EP and accordingly the ESIA examines the potential environmental measures needed to prevent, negate, minimise, mitigate or compensate for adverse effects and to improve environmental and social performance, whilst seeking to maximise the positive benefits that the Project may accrue.

Screening and Scoping

The ESIA process commenced with a scoping study and progressed to the collection of baseline data to develop a detailed understanding of the social and environmental aspects that have the potential to be affected by the Project. The impact assessment and mitigation design, together with the social and environmental management plans, are based on the baseline conditions and take account of the releases and effects associated with the Project.

The Project was initially screened against applicable environmental laws, regulations and standards to determine the requirement for an ESIA. Subsequently, a scoping study was undertaken to identify

potential impacts, engage with the local communities, and define the Terms of Reference for baseline data collection thus informing the onward progression of the ESIA. Stakeholder consultation and public disclosure have been prioritised since the beginning of the ESIA process in order to explain the project and gain local support. WAI prepared the 'Bakyrchik Environmental and Social Scoping Report' in September 2013 (WAI Report No. ZT52-0141).

The initial assessment based on the Scoping Study identified that the risks listed in the study were amenable to appropriate mitigation and management measures being designed into the scope of the project. The study also confirmed that there were no social or environmental concerns which would prevent the project from being advanced to the full ESIA study. The study defined the key priorities in relation to characterisation of the baseline environmental and social data, as listed below:

- climate;
- topography and land coverage;
- air quality:
- noise and vibration;
- geology and seismicity;
- soils and land capacity;
- water resources;
- biodiversity;
- ecosystems services;
- archaeology and cultural heritage;
- traffic and transportation;
- governance, demography and culture;
- social infrastructure, health and education; and
- economy, livelihoods, incomes and vulnerable groups.

These environmental and social aspects identified for further evaluation have been the subject of a focussed programme of baseline data collection in order to define the baseline social and environmental aspects of importance to the Project.

The purpose of the ESIA is to identify and assess potential environmental and social impacts that could be a consequence of the Project. Through such identification, potentially significant adverse impacts can be avoided, reduced, offset or managed to the extent feasible, as part of the Project design. This is an iterative process that has taken place during the Project design phase and has required close collaboration between the engineering, mining, environmental and social specialists involved in the Project. Throughout the preparation of the ESIA, the layout of the mining operations has undergone review and refinement. The process of revision has been maintained during the ESIA preparation up to October 2015, when the ESIA was publically disclosed.

Presentation and Structure of the ESIA

The ESIA contains the policy, legal and administrative framework providing the context in which the assessment was undertaken as well as a description of the Project covering geographical, ecological, social and temporal aspects. It includes baseline data describing the physical, biological, cultural and historical conditions and the environmental and social impacts associated with Project implementation. Mitigation measures needed to minimise impacts to an acceptable level are presented, as well as an analysis of feasible alternatives. Plans covering environmental, social and community development have been formulated and presented, together with an Environmental and Social Action Plan for the delivery of the Project from construction to operation and eventual closure.

ESIA Purpose

The purpose of the ESIA is to document the existing environmental and social conditions, describe the proposed operation, identify impacts, develop implementation measures to reduce or minimise the impact of the operation and the actions needed to ensure their performance. The ESIA addresses the planned activities at the Kyzyl Project including construction, mining, ore processing, developing support infrastructure, decommissioning and reclamation. The impact assessment subject areas are often interlinked.

Polymetal will make the ESIA available to the appropriate government agencies and relevant financial institutions. It will also be available for public view and comment. To that end, public input and two-way communication between Polymetal and stakeholders is encouraged, not least because highly recommended by relevant international financial institutions and the Government of the Republic of Kazakhstan. In this regard, the findings of this study will be used in the compilation of the final OVOS documentation submitted for approval by the government authorities.

The structure and content of this report is closely aligned with the requirements of an international standard ESIA. Importantly, the International Finance Corporation Performance Standards (IFC PS) have been applied to this Project on the basis of relevance and applicability of baseline data and issues raised throughout the Project's proposed lifespan.

ESIA structure

The ESIA is presented in three parts:

Part A: Introduction, which includes the background to the Project including the regulatory framework and Project description. In addition, various alternatives that have been considered are described, with a rationale for the selected option.

Part B: Baseline and Impact Assessment, which includes the baseline conditions and a detailed impact assessment, considering each impact area (baseline chapters have been listed above in Section 1.3.2). Impact assessment chapters have been completed where impacts were identified on:

- climate;
- air quality;
- noise and vibration;
- geology and seismicity;
- soils and land capacity;
- water resources;
- biodiversity;
- ecosystems services;
- cultural heritage;
- traffic and transportation;
- governance, demography and culture;
- social infrastructure, health and education; and
- economy, livelihoods, incomes and vulnerable groups.

Part C: Conclusions and Management Plans, including Environmental, health, safety and social management for the project, together with Framework Management Plans which incorporate operational mitigation measures, together with mine closure objectives. Based on key 'Red Flag' issues identified within the Scoping Study and developed further in the impact assessments for the purpose of ensuring mitigation measures are adequately developed to facilitate responsible progression of this project, key framework management plans being developed for Kyzyl are included in the appendices.

1.3 Project Design

The collection and interpretation of environmental and social baseline data commenced during the early exploration period, and from 2015 the programme was specifically tailored to concentrate on baseline surveying within the Project-affected area. The Project-affected area varies according to different elements of the baseline; for example, the area of social impact of the Project is broader than the area of its environmental impact.

The project design includes development in two stages. Stage 1 will include development of the open pit, waste dumps and ore stockpile from 2016 – 2026. Stage 2 is scheduled from 2026 to 2039 and includes development of underground facilities from the base of the open pit, starting in the central and western areas, and followed by development in the eastern area. Open pit mining will be carried out using conventional drill, blast, load, and haul methods. Underground mining will be carried out using the underhand cut and fill method, and will incorporate cement paste backfill. The backfill material will be sourced from the processing plant's tailings storage facility (TSF).

The design production rate for open pit mining is 1.8Mtpa of ore, with average feed gold grade of 6.90g/t. Underground mining will take place at 1.2Mtpa of ore, with an average feed grade of 8.5g/t Au. The processing plant will involve crushing, milling, and a complex flotation circuit that includes a ball-mill regrind, carbon flotation, flash flotation, and more conventional sulphide flotation. The product from the processing plant will be a sulphide flotation concentration at a gold grade of about 99.2g/t. The concentrate will be dried and packed into 1.5t bags which will be transported to Shalabay railway station via road, before loading on a freight railway car destined for further processing in Amursk.

1.4 Domestic and International Processes

In Kazakhstan, environmental, health and safety management and the impact assessment process are regulated by a number of national laws, resolutions and decrees, which are considered in Chapter 2 of the ESIA.

Kazakh OVOS Process

According to the legislation in Kazakhstan, all pre-planned, planned, pre-designed and designed documentation are subject to state ecological expertise (review). Economic activity cannot be implemented until the positive conclusion of the expertise has been received and permission for biodiversity management is issued. The existing environmental legislation requires OVOS implementation on all stages of economic activity from the initial plans through design, construction, and exploitation until facility closure.

The OVOS reports have been prepared by in-country consultancies, including: State Research and Production Association of industrial Ecology, Kazmekhanobr. The OVOS process is broadly compatible with the International ESIA process; however, it differs in many of the procedures, methods and presentation. Much of the baseline data that is required for a Kazakhstan OVOS is also suitable for an ESIA, with the difference being that the Social Impact Assessment section of the ESIA is more comprehensive and defined. The Impact Assessment section within the ESIA fully overlaps with the same sections of the Kazakhstan OVOS. The two processes have been undertaken independently but follow parallel paths and also utilise the same baseline data and Project parameters.

International ESIA Guidelines and Recommendations

In addition to compliance with national mining and environmental legislation, the Project is committed to meet the expectations of good international industry practice, including recommendations set out by the International Finance Corporation Performance Standards (IFC PSs [1]). The IFC PS generally form the basis for internationally funded projects and are considered to be an international benchmark for

[1] IFC Performance Standards on Environmental and Social Sustainability, 2012 http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_handbook_pps

industry best practice for environmental and social management. The IFC PS also form the basis for the Equator Principles (Version III, June 20135), an internationally recognised credit risk management framework for determining, assessing and managing environmental and social risk in project finance transactions, to which many commercial lending banks are signatories. Other leading industry standards and codes of good practice have been considered during the ESIA and are taken into account in the formulation of management plans.[2] Further details on performance standards and requirements have been provided in Chapter 2.

Consultation and engagement with all stakeholders, including communities, forms an essential part of the ESIA process, ensuring that the project development takes into account the priority issues as identified by those affected through the Project development. A programme of formal and informal public consultation has been prepared to support the OVOS and ESIA activities and is presented in the Stakeholder Engagement Plan (SEP) with activities carried out to date summarised in Chapter 8. This is supplemented by formal stakeholder consultation events to communicate key aspects of the ESIA process. A significant output of the ESIA is an Implementation Plan that will include an ESAP which draws on the conclusions of the ESIA and identifies priority areas for action in accordance with international best practice and mining standards. These include modification and/or expansion of baseline monitoring, modifications to Project design, framework management plans, recommendations for subordinate action and management systems, risk management measures, implementation schedules and identification of fundamental training initiatives. The ESAP will be the key document of the Implementation Plan.

This internationally compliant ESIA addresses the impacts of the entire Project lifecycle, with due consideration for cumulative impacts which may be generated. The assessment considers the social and environmental issues, and includes the assessment of ecosystem services as a bridging tool between the two aspects. The ESIA has drawn on a consultative, participative process and includes the development of management plans to manage impacts generated by the Project as it is developed.

1.5 Stakeholder Engagement

A critical component of the impact assessment process is consultation with all stakeholders; principally the local communities and interested parties (e.g. Non-governmental Organizations [NGOs]), to ensure that the ESIA takes account of issues identified as priorities by those affected as a consequence of the Project and people living nearby. Discussions are also held regularly with relevant statutory authorities.

Stakeholder engagement for the Project has been ongoing as the Project has developed. Polymetal has established a Community Liaison Officer (CLO) as a means of ensuring consistent and on-going communication with communities, NGOs and other interested organisations and individuals. They

[2] EBRD Performance Requirements and Guidance for Clients, 2012. http://www.ebrd.com/pages/about/principles/sustainability/requirements.shtml

have also established a grievance mechanism, which enables the local community to communicate complaints and questions to the company.

In addition, Polymetal has established a stakeholder engagement log. The log is used to keep a record of all meetings with stakeholders, including information on Project meetings, public hearings and community liaison meetings. The log forms part of a broader stakeholder management system, which maintains a record of all meetings, demonstrating frequency of interaction with stakeholders, and providing a database of the participants involved in the engagement process together with questions or issues raised by specific people.

1.6 ESIA Contributors and Roles

WAI has provided overall project management and responsibility for compilation of the ESIA. The individuals principally involved in this ESIA are detailed in Table 1.1 below.

Table 1.1: ESIA Team		
Name	**Role**	**WAI role, Qualifications**
David Brignall	Project director, Biodiversity and soil lead	Technical Director - BSc, PhD, CSci, CBio, MIEnvSci
Julia Boiko	Coordinator of contractual arrangements and client liaison	General Director WAI Russia - BSc, Dip, MBA
Ruslan Sevostyanov	Contract administration	General Director WAI Kazakhstan and Mining Engineer - MEng
Alison Allen	Project manager	Associate Director Environmental and Social – BSc, MSc, MIEMA, CEnv, MIEEM, FIMMM
Neil Robinson	Environmental specialist, contribution to air quality, noise and vibrations	Senior Environmental Specialist – BSc(Eng), MIMMM, CSci, CEnv
Alex Gallagher	Water resources lead	Associate Director – BSc, MSc, FGS
Bertrand Burnet	Water resources specialist	Principal Hydrogeologist - Kazakhstan - BSc, MSc, FGS, MIAH
Elizabeth Adey	Social and community lead	Principal Social Specialist - BSc, MSc, PhD, PG Cert, MIEnvSci, CSci, FIMMM
Edvard Glücksman	Social and community specialist, public consultation, cultural heritage assessment and management	Senior Social Specialist - BA, BSc, MSc, PhD, MIEnvSci
Narina Shorland	Project description chapter	Mining Engineer - BSc
Simon Allen	Energy and climate specialist	Principal Energy Specialist – BSc, BSc
Scott Sleight	Drawings, climate change specialist	Climate Change and GIS Specialist – BSc, MSc
Malcolm Walton	Air quality, noise and vibration lead	Technical Director - Dip, BSc, AIOA, MIEH
Jakub Olewski	Soils and land capacity	Senior Soil Scientist – BEng, MSc, MSc, PhD
Helen Simpson	Ecosystems services lead, biodiversity management plan	Principal Environmental Scientist –BSc, PhD, AIEMA
Adrian Lea	Waste management plan	Technical Director – BA, DipTP (Eng), MRTPI, MCIWM, FIQ
Richard Newman	Archaeology lead and review of Chance Finds Procedure	Assistant project manager - BA, PhD, MCifA,

WAI support staff and specialists have been involved as required for specific topics. The following third party consultants have been engaged to provide technical input into the ESIA (Table 1.2).

Table 1.2: Associate Contributors		
Name	**Role**	**Qualifications**
Sue Struthers	ARD Specialist	MSc, PhD, ACSM
Amer Waheed Halabi	Traffic Assessment	BEng, PhD, MBA, FCIHT, FAPM, MIoD, FFB

2 REGULATORY FRAMEWORK

The Project will be subject to laws, regulations, guidelines and standards of the Republic of Kazakhstan (RoK). These will include those which promote good operational practice and govern the sustainable use of resources, discharge of substances into the environment, the management and disposal of wastes, together with aspects of land regeneration. Furthermore, the Company will also seek to operate the Project in accordance with Good International Industry Practice (GIIP) and the standards and guidelines of international finance institutions. This Section of the ESIA provides a description of the relevant legislative, regulatory and administrative framework, together with targets for environmental and regulatory compliance and a summary of the current status of Project permitting.

2.1 Administration and Governance

Administration of the Mining Industry

Depending on the category of minerals, there are three "Competent Authorities" administering the mining industry in RoK. Firstly, this is carried out by the Ministry of Investments and Development (MID, formerly the Ministry of Energy and Mineral Resources [pre-2010] and Ministry of Industry and New Technologies [2010-2014]), which regulates solid minerals contracts. Secondly, the Ministry of Energy (previously the Ministry of Oil and Gas [2010-2014] and the Ministry of Energy and Mineral Resources [pre-2010]) regulates oil and gas projects. The third Competent Authority are the regional akimats, which regulate commonly occurring minerals.

The MID also supervises the mining industry through its subordinate, the Committee on Geology and Subsoil Use (the "Geology Committee"), which has regional departments called TsentrKazNedra (for central territories), ZapKazNedra (western territories), SevKazNedra (northern territories), VostKazNedra (eastern territories), and YuzhKazNedra (southern territories).

Issues of local content in goods, works, services, and staff, as well as procurement of hard minerals subsoil users, are resolved by the MID taking into consideration the view of the National Agency on Development of Local Content JSC ("NADLoC").

National environmental protection in Kazakhstan is governed by the Ministry of Energy – Committee for Environmental Regulation, Control and State Inspection in the Oil & Gas Sector; on the Oblast level by the Republican State Institution "Department of Ecology of East-Kazakhstan Oblast of the Committee for Environmental Regulation, Control and State Inspection in Oil & Gas Sector of the Republic of Kazakhstan"; in the area of sanitary and epidemiologic well-being by the Department for Protection of Consumers' Rights of the Ministry of Economy of the Republic of Kazakhstan; in the area of occupational safety - Ministry of Emergency of the Republic of Kazakhstan.

Kazakhstan exercises State, departmental, industrial and public control in the field of environmental protection. Environmental control is performed at all stages of industrial activity, such as conception, construction, commissioning, operation, conservation and closure of an enterprise.

Issues of environmental protection in Kazakhstan are governed the "Environmental Code" (2007; amended 2011 and 2015). The Project requirements under the Code are detailed in the following Section.

The mining sector is governed by the Ministry for Investments and Development of the Republic of Kazakhstan, chiefly under the auspices of the 'Law of Subsoil and Subsoil Use' (2010, #291-IV). There are also a number of Decrees issued by the RoK Government, which regulate specific issues in subsoil use.

Mining activities are regulated through the issuing of mining contracts (until August 1999 this was by license followed by a further conclusion of a mining contract), which are obtained either through competitive procedures or through direct negotiation for certain RoK national companies or holders of the exploration right, those making the commercial discovery and assessed it as confirmed by state expertise.

Mining regulations can be categorised by reference to specific minerals, namely to solid minerals (gold, silver, coal); oil and gas; and, commonly occurring minerals (sand, clay etc.).

Rights required to Conduct Mining in the RoK

There is no legal notion of "mining" enshrined in Kazakh law; rather, the terms "production" or "extraction" are used to define the commercial development of the deposits and extraction of minerals. In order to conduct mining operations, you need: (a) a subsoil use contract for both production and/or exploration/production; (b) the allocation of a mining allotment; (c) a production project elaborated upon and approved by the authorities; and, (d) to obtain a license on exploitation of mining activities.

2.2 The Environmental Code

The overarching environmental law of the RoK the Environmental Code (Jan 2007, amended 17.11.2015), was amended in Aug 2011 to replace, consolidate and align several subordinate environmental laws into a single national law which is more closely allied with international standards of environmental stewardship. The Code incorporates extensive environmental requirements for different types of development and is aimed at allowing greater transparency and public scrutiny. The Code was further amended in Dec 2014.

The Environmental Code establishes:

- general principles of environmental legislation, such as sustainable development, duty of care to the environment and free access to ecological information;
- procedures for mandatory environmental impact assessments (EIA) for certain activities, such as any business or other activity which may have a direct or indirect impact on human and/or environmental health; and
- general principles of greenhouse gas (GHG) emissions' reduction and carbon trading.

At the heart of the Code remains the establishment of a system whereby fines are imposed for instances of environmental pollution in excess of established thresholds for the project. To enact this, the Code establishes an integrated permitting regime for all types of emission and solid waste disposal. The Code is detailed and prescriptive, and although this provides for a comprehensive regulatory base, constituent laws are often interpreted literally as opposed to being adopted in spirit.

Project Requirements

The Code states that when developing mineral resources, companies must:

- maintain already occupied land plots in a condition suitable for their future use;
- remove, store and re-use fertile topsoil during land disturbance operations; and
- rehabilitate disturbed land upon completion of the project.

If the land area is to be used to place, bury or store industrial waste, then the site must meet the following requirements:

- be located on the downstream side of groundwater flow if there is a settlement nearby;
- not be located on land that is subject to inundation;
- have an impervious base, be fenced and planted with vegetation and have hard surface runways; and
- ensure that surface and groundwater run-off does not discharge to open water bodies.

Specific requirements of this Code in relation to subsoil use are:

- preventing subsoil pollution, particularly at underground storage of oil, gas and other substances and materials;
- ensuring compliance with environmental and sanitary requirements at waste storage sites;
- preventing groundwater pollution and depletion;

- prohibiting the discharge to the sub-soil of waste water that has not been treated to the required standard; discharging industrial waste water only if in accordance with the water code (2003);
- compliance with the standards of maximum allowable content of pollutants in groundwater set by the relevant environmental agency; and
- monitoring the quality of discharged water through an accredited laboratory.

Specific requirements of this Code in relation to water use are:

- no discharge of waste water is permitted to surface water bodies and subsoil unless the company has a discharge permit to do so; and
- a company may not exceed the established standards of the concentration of pollutants found in the waste water or have new pollutants within waste water not stipulated in the original permit.

The Environmental Code requires that pre-project and project development works that may have an impact on the environment are subject to an Environmental Impact Assessment (EIA, nationally termed 'OVOS'). In particular, an EIA is required for the construction of new, or reconstruction of existing, facilities as well as the exploration and production of minerals. An OVOS is required for the Kyzyl Project, and was undertaken in 2012. Under the Code, the Project will be required to develop certain sector-specific procedures and plans, such as those which relate to the management of land, waste and industrial emissions. These are outlined further below.

Permission and Notification

Development activities requiring licensing are set forth in RoK Law 202-V entitled "About permissions and notifications (May 2014, amended Jan 2015). The Act contains general provisions relating to issuing of licenses, validity of licenses, and permissions.

Reconnaissance and Exploration

There is no notion of "reconnaissance" within RoK law; instead, the term "exploration" is used. This term encompasses prospecting and the assessment of commercial discoveries. In order to conduct exploration, an individual or entity must have secured the rights to use subsoil. In addition, interested parties may require a number of licenses, such as a license on drilling works, handling explosives, construction, or the application of chemicals and other agents.

Subsoil users (as dictated by the Subsoil Law), are obliged to submit all (i) preliminary project documentation, and (ii) project documentation for State ecological and sanitary-health examinations.

The documents shall include an assessment of the impact of the proposed activity on the environment and contain an "Environmental Protection" section[1].

Processing and Beneficiation of Mined Minerals

The Subsoil Law differentiates between primary processing (beneficiation) and processing of raw minerals. The processing of raw minerals does not require obtaining a subsoil use right, but does require a license for the exploitation of mining activities.

2.3 RoK Environmental, Health, Safety & Community Legislation and Regulations

Environmental legislation provides the mechanism to establish regulatory and economic measures to remedy existing environmental problems and ensure protection of the environment by preventing new ones from occurring. There are a significant number of laws relating to the protection and management of natural resources, however, there is a lack of specific legal measures in the field of industrial environmental management.

Other relevant Kazakh legislation or processes governed by laws for the Project will include:

- Kazakhstan State Ecological (SEE) approval of "normative projects" for Maximum Permissible Emissions (MPE) of potential pollutants released to the environment on an annual basis.
- Kazakhstan State Ecological (SEE) approval of "normative projects" for Maximum Permissible Discharge (MPD) of potentially polluting matter to land and water on an annual basis.
- State approved "normative projects" for the location, formation, rate and volumes of waste production. Wastes have to be classified in accordance with the waste classifier prescribed by the Order of the Environmental Protection Minister.
- Kazakhstan, No. 169 – (from 31/05/07) and the methodological instructions for completion of a waste certificate, approved by the Order of Environmental Protection Minister, No.162-p, from 23/05/06 and Management of Hazardous Waste, Order of the Environmental Protection Minister –Kazakhstan 30/04/07 No. 128-p. According to the Kazakhstan legislation wastes can be divided in 5 (five) hazard classes: I – very hazardous waste (10000 or > summary index of components); II – hazardous waste (1000-10000); III – middle hazardous waste (100-1000); IV – low hazard waste (10-100); and V – non-hazardous waste (<10).
- The environmental monitoring has to be performed in accordance with the requirements of "Typical Rules of Organization and Introduction of Production Monitoring" approved by Order of the Environment Protection Minister of the Republic of Kazakhstan № 217 dated 4.08.2005, "Methodical Instruction for

[1] Article 8.1 in http://www.iclg.co.uk/practice-areas/mining-law/mining-law-2015/kazakhstan

Determination of Level of Environment Component Pollution by Toxic Substances of Production and Consumption Wastes" (RND 03.3.0.4.01-96), "Methodical Instruction for Estimation of Impact on Environment of Located Collectors of Production Wastes" (RND 03.3.04.01-95). The sampling, sample storage, transportation and preparation for the analysis have to be performed in accordance with the approved standards.

In addition, various national guidance documents ('GOSTs'), which provide guidance on nationally recognised best practice, will apply to the project and will include the following:

Soils

- GOST 17.4.4.02 – 84 "Nature Protection. Soils. Methods of Sampling and Sample Preparation for Chemical, Bacteriological and Helminthological Analysis";
- GOST 17.4.2.01 – 81 "Nature Protection. Soils. Factors to be Controlled";
- GOST 17.4.3.01 – 83 "Nature Protection. Soils. Location of Sample Areas"; and
- GOST 17.4.3.06 – 86 « Nature Protection. Soils. Resistance of Soil to Pollution".

Air

- GOST 17.2.4.02 – 81 "Nature Protection. Atmosphere. General Requirements for Methods of Determination of Contaminants in Air of Conglomerations";
- "Collection of Methods for Determination of Contaminant Concentrations in Industrial Wastes" L.: Hydrometeoizdat, 1987; and
- GOST 17.2.3.01 – 77 "Air Sampling and Sample Preparation".

Surface and Underground Waters

- GOST 17.1.3.07 – 82 "Nature Protection. Hydrosphere. Rules for Control of Water Quality in Ponds and Water Courses";
- GOST 17.1.5.04 – 84 "Nature Protection. Hydrosphere. Instruments and Devices for Sampling, Initial Processing and Storage of Natural Water Samples. General Technical Conditions";
- GOST 17.1.5.05 – 85 "Nature Protection. Hydrosphere. General Requirements for Sampling of Surface and Sea Waters, Ice and Precipitation"; and
- GOST 17.1.5.01 – 81 "Nature Protection. Hydrosphere. General requirements for Sampling of Bottom Deposits of Water Bodies for Pollution Level Analysis".

Water

Water pollution is regulated by both the Environmental Code and the Water Code (July 2003, 481-II, amended Dec 2014 and Dec 2015). The purpose of the code is to prevent an imbalance in the

ecological stability of water bodies that may impact on the health of the population and/or reduce the reserves of fisheries and other wildlife resources.

National legislation relating to water use is based on the principle of prevention of water pollution. Environmental users must perform activities aimed at the minimisation of water pollution, including mandatory water treatment before industrial discharge of sewage. Permits for water pollution are issued within an integrated permitting regime.

Project Requirements

The Project will be required under the Water Code to:

- observe established water use limits;
- carry out water protection measures;
- not allow discharge of harmful substances which exceed established standards;
- obtain the required environmental permits when discharging to the environment in accordance with the Environmental Code (2007); and
- protect water bodies from contamination from harmful and dangerous chemical and toxic substances and their compounds; and Contamination from solid or insoluble production or other wastes.

Areas used as collection points for industrial effluents are required to have appropriate measures in place to reduce contaminants to acceptable levels, render them inactive and carry out rehabilitation of the land used by those collectors when the collection points are no longer required.

Waste

The regulatory regime for waste is generally outlined in the Environmental Code. In addition, waste falls into three general categories with different regulatory regimes:

- hazardous waste - waste containing radioactive, poisonous or toxic materials or substances that threaten the environment and/or human health;
- non-hazardous waste - waste not falling under the categories of hazardous or inactive waste is considered as non-hazardous waste; and
- inactive (inert) waste, which is waste that does not undergo changes and does not threaten the environment and/or human health.

The treatment of hazardous waste is highly regulated. No special permits or licenses are required for treatment of non-hazardous or inactive waste. However, rules of waste disposal apply equally to all types of waste including non-hazardous and inactive.

Kazakhstan's parliament in October 2011 in acted further legislation protecting ecological interests that is expected to increase the costs of treating mine waste. Fines are already a feature of mine waste regulation, however the new bill introduces the requirement for mining companies to develop a 10 year, waste utilisation programme. The Ministry can revoke a permit for waste disposal if the programme is not respected.

Project Requirements

The Project will produce diverse and hazardous waste streams which should be classified and managed in accordance with the Environmental Code. For hazardous wastes the Company must develop and maintain a "passport of wastes" that:

- outlines the types, contents, quantity and requirements for the treatment and transportation of waste; and
- is registered with the Ministry's local departments.

This would be GIIP and will be developed by the Company as part of an integrated approach to Project waste management.

Land

Land use and protection is regulated by the:

- environmental Code;
- RoK Land Code 2003 (Land Code, June 2013 and amended Dec 2014 and Nov 2015); and
- rules of Land Preservation approved by the Decree of the Kazakhstani Government dated 29 September 2003 (refer to subsoil section).

According to the Land Code all land is considered to be owned by the RoK unless it has been granted for use by private entities via a lease agreement. The Law also makes provisions for the setting of maximum allowable concentrations of harmful substances in soil. Limits of permitted polluting substances are set out in the permits for environmental emissions. The compliance with these limits is verified by inspections carried out by the Ministry and other state authorities on a regular basis.

The RoK Law 242-II (16 July 2001, amended Dec 2014 and 03.12.2015) 'On Architectural City Planning and Construction Activities in the RoK' regulates relations arising from the construction, capital repairs, and refurbishment of business facilities, including the procedure for the approval of design documents and the execution of the state construction supervision. This Law states that a state expert reviews design documents and engineering surveys in order to assess them for meeting technical requirements. These requirements pertain to, among other things, sanitary health conditions, the environment, protection of cultural sites, fire, nuclear radiation, and general health and safety.

Project Requirements

The Company is required to apply for Subsoil use rights to use the land, and, as per the 'Law on Subsoil and Subsoil Use', the Land Code will require the Company to rehabilitate the land after operations have finished, as well as retain, store and re-use the fertile topsoil layer. These requirements can be managed through a mine closure plan for the project.

The Land Code will require the Company to establish and implement measures to protect the land in relation to the construction and operation of new buildings (such as the new processing plant and TSF) and other items which have the potential to negatively impact the condition of the land.

Atmospheric Air Protection

Air pollution is regulated by the Environmental Code. Permits for air pollution are issued within the integrated permitting regime. Limits for discharge of pollutants into the air are defined in the permits for environmental emissions, issued by the Ministry and Akimats. Discharge of pollutants into the air without a permit is prohibited and may result in administrative penalties.

The basic principles of the government's policy on climate change matters are set out in the Environmental Code and underlying regulations such as the Rules of Trade of Quotas and Undertakings for the Reduction of Emissions to the Environment 2008 and the Rules of Limitation, Suspension or Reduction of GHG Emissions to Atmosphere 2008. No special target has been fixed for the reduction of GHG emissions in general or for emissions from buildings. The Law on Energy Saving and Increasing of Energy Efficiency (1997, amended 17.11.2015) provides general principles of energy efficiency, including for construction of new buildings and reconstruction of existing buildings.

Project Requirements

The Project will be required to:

- evaluate and seek to reduce project emissions;
- observe established air emission limits;
- obtain the required environmental permits; and
- protect the environment and workers from harmful emissions.

Flora and Fauna Legislation

The Law on Specially Protected Natural Territories (July 2006, amended Sep 2014)

This normative legal act regulates issues related to Specially Protected Natural Territories (SPNT) - in particular the area of defining types and categories of specially protected natural territories, their legal status, competence of state authorities, and the procedure of arrangement, protection and use of

SPNTs. The Law also reaffirms the rights of citizens and public associations in the area of SPNTs and defines general requirements for the inventory and cadastres of such territories. It makes particular reference to territories representing special ecological, scientific, historical, cultural, or recreational value.

Law on 'About the Protection, Reproduction and Use of the Animal world' (2004)

This law regulates the protection, reproduction and use of fauna with the aim of ensuring the preservation of fauna and it biodiversity.

Forest Code of RoK 477-II of 8 July 2003 (amended 29.10.2015). This law regulates public attitudes (relations) in the field of protection, reproduction, and uses of flora and is aimed at maintaining the preservation of plant life and biological variety, sustainable use of floral species, with a view of satisfying ecological, economic, and aesthetic needs, in the interest of present and future generations.

Project Requirements

Any activities that will impact or potentially impact on fauna and its habitat will be required to meet the following requirements:

- preservation of biological diversity and health of fauna communities in their natural habitat;
- preservation of fauna habitat, important breeding grounds, migration paths and areas of high fauna concentration; and
- establishment of and compliance with the rules and standards for the protection of fauna.

Health and Safety

There are a number of legal acts directly or indirectly governing health and safety in mining in the RoK. The regulations stipulate that each mining company shall have a person specifically responsible for health and industrial safety. All workers who are directly involved in dangerous fields of work must regularly pass different certifications. The major legal acts approved by orders of the Minister of Industrial Safety are:

- General Requirements to Industrial Safety (Parts 1 and 2) approved by the Order dated Dec 2008, #219.
- Requirements to Industrial Safety at Development of Useful Mineral Fields by Open Pit approved by the Order dated Dec 2008, #219.
- Requirements to Industrial Safety at Development of Useful Mineral Fields by Underground Means approved by the Order dated July 2008, #132.

- Requirements to Industrial Safety at Explosion Works approved by the Order dated Sep 2007, #141.
- Industry-Wide Requirements to Industrial Safety (Part 3) approved by the Order dated Oct 2012, #484.
- Requirements to Industrial Safety at Crushing, Sorting, and Beneficiation of Minerals and Agglomeration of Ores and Concentrates approved by the Order dated Oct 2008, #189.

In addition, Article 115 of the Subsoil Law ("Ensuring Subsoil Use Conditions Safe for Population and Staff") sets out major requirements for owners, employers, managers, and employees in relation to health and safety. For example, such requirements include the prohibition or immediate termination of works if they are or become dangerous to the life and health of people; admitting to work only those people that have special qualification; procuring special clothes; having available means of individual and collective protection; using equipment and materials that meet safety and sanitary requirements; and constantly monitoring the atmosphere for availability of oxygen and harmful gas and dust[2].

Health and Safety practices in Kazakhstan are regulated by the RoK Labour Code No. 251-III dated 15.05.2007 (amendments Oct 2015). Under the Labour Code, labour relations are regulated by employment agreements and, if applicable, collective labour agreements. Employment contracts must be in writing and must conform to the minimum standards prescribed by the Labour Code.

The RoK Law 188-V "About civil protection" (Apr 2014, amended Jan 2015) regulates the process of carrying out emergency civil procedures as a result of natural and anthropogenic emergency situations, including the delivery of medical and psychological aid, industrial and fire protection provision.

Project Requirements

The Company must comply with a number of obligations toward its employees, including the provision of a work place which complies with the regulatory requirement. In addition, the employer must insure its civil liability in the case of causing harm to employee's health during the performance of their labour duties.

The RoK Tax Code (Dec 2008, amended Feb 2013 and 2015)[3]

The RoK Tax Code establishes, introduces, and provides a framework for the procedure of the payment of taxes and other obligatory payments to the budget as well as relations between the state and the taxpayer ("the tax agent") which are associated with the performance of tax obligations. The fundamental principles of this code are that:

[2] Article 10.1 in http://www.iclg.co.uk/practice-areas/mining-law/mining-law-2015/kazakhstan
[3] http://www.salyk.gov.kz/eng/nk/documents/taxcode022013.pdf

- Its legislation shall be based upon the RoK constitution, as enshrined within the Code document itself as well as regulatory legal acts adopted as specified within the Code.
- No agent should be burdened with the duty to pay taxes and other obligatory payments which are not specified within the Code.
- Taxes and other obligatory payments to the budget shall be established, introduced, altered, or abolished in accordance with the procedure and on the terms established by the Code.
- Where a contradiction exists between the Code and other legislative acts of the RoK, for taxation purposes the provisions of the Code shall apply.
- Where an international treaty ratified by the RoK establishes other rules than those which are contained in the Code, the rules of said treaty shall apply.

Law on Architectural, Urban Planning and Construction Activities (July 2001)

The RoK Law on Architectural, Urban Planning and Construction Activities stipulated that only facilities requiring approval from state acceptance committees needed obligatory design and technical supervision in order to come into operation. However, presently design and technical supervision is also required for objects to be accepted by the acceptance committee (non-State). Currently, according to this Law, to perform construction and installation works the developer is now required only to notify the authorities of architectural-construction supervision upon the commencement of works (at least 10 business days prior to the start date) instead of obtaining the respective permit. The State Architectural and Construction Inspectorate representatives are entitled to visit the site within five business days of receiving the notice in order to check the validity and the information specified in the notice.

Amendments to this Law were made in Aug 2012, which included abolishing licensing and reducing permits for a number of industrial and architectural activities [4].

RoK Customs Code

The Code 'On Customs Affairs in the RoK' (2010, #196-IV) and the Customs Code of the Customs Union (Annex to the Agreement on the Customs Code of the Customs Union (Nov 2009, #17) define the legal, economic, and organisational principles of customs activity in the RoK and is aimed at the protection of the sovereignty and economic security of the RoK, enhancing the relationships between Kazakhstan's economy within the world economic systems and the liberalisation of international economic activity.

[4] http://www.hg.org/article.asp?id=28429

Other Relevant Decrees

In May 2013, two RoK Government Decrees (#133 and 134) were published in official national newspapers. These are:

- Rules for Procurement of Goods, Works and Services in Subsoil Use Operations through the State Information System called the, "Register of Goods, Works and Services Used in Subsoil Use Operations and their Suppliers" (133).
- Rules for Procurement of Goods, Works and Services (GWS) in Subsoil Use Operations (134). According to these rules, a subsoil user must procure GWS via a system synchronised with the Register of Goods, Works and Services Used in Subsoil Use Operations and their Suppliers [new.reestr.nadloc.kz]. Given that systems may not be currently synchronised with the Register in the RoK, Subsoil Users are still obliged to use the Register but through Rule 133 instead[5].

Social Engagement

According to RoK legal regulations, information disclosure and dissemination, as well as public consultation, are a part of the development process, especially if the project is likely to impact on the environment.

The following legislative acts relate to public participation in decision making within Kazakhstan:

1. Environmental Code of RK No. 212-III of 09.01.2007 (as amended on 17.07.2009);
2. Instruction of Environmental Impact Assessment Conduction of Proposed Economical. Other Activities during Development of Pre-planning, Planning, Pre-design and Design Documentation, approved by Order of Minister of Environmental Protection of RK No.204-p of 28.06.2007;
3. Rules on Public Hearing Conduction, approved by Order of Minister of Environmental Protection of RK No.135-p of 07.05.2007;
4. Rules on Access to Environmental Information Relevant to Environmental Impact Assessment (EIA) Procedure and Decision-Making Process on Proposed Economical and Other Activities, approved by Order of Minister of Environmental Protection of RK No.233-p of 25.07.2007; and
5. Rules on Conduction of Public Hearing while Considering Application for Approval or Change of Tariffs (Prices, Rates) of Entities which are Natural Monopolies. Approved by Decree of RK Government No. 376 of 21.04.2003.

As such the current legislative system provides guidelines for public consultation and participation in decision-making, although the scale of such activities is dependent on the type and scale of the proposed project and degree of public interest.

[5] http://www.gratanet.com/up_files/article%20on%20new%20procurement%20rules_eng%20%282%29_2.pdf

Project Requirements

The Company must comply with the RoK legal regulations outlined above, ensuring that stakeholder engagement and consultation activities are in accordance with these legislative acts.

Closure

The procedures required by law for the decommissioning and closure of an industrial enterprise are dictated by the Law on Subsoil Use (Article 111: "Liquidation and Conservation of Subsoil Use Objects") and the Environmental Code. The Company will be required to establish and submit a Mine Closure Plan to the State authorities no later than 2 years after signing the mining contract. Existing closure regulations in Kazakhstan generally refer only to the replacement of top soil and grass at the end of mine life and there is no requirement for the provision of further specification or post-closure environmental monitoring.

The Code requires the Company to rehabilitate disturbed land upon completion of the Project, defined as the termination of subsoil use or depletion of mineral resources. If an urgent decision on the termination of production is required, the subsoil user must carry out a set of measures for the conservation of production units before their liquidation or conservation. The operation is financed by the liquidation (abandonment) fund of the subsoil user and, if it is not sufficient, at the expense of the subsoil user itself[6].

When undertaking land rehabilitation, the company shall take the following into account:

- nature of disturbance within the land area;
- natural and physical properties of the surrounding area;
- final intended land-use, whether it be for agriculture, residential or natural condition; and
- Re-establishment of vegetation.

The financial provision for the maintenance of a liquidation (closure) programme is required to be provided by the establishment of a trust fund in which up to 5% of book value assets are paid by a company each year. However, this concentrates on the aforementioned actions only.

The liquidation or conservation of subsoil use objects is considered complete only after the signing of the act of acceptance by the commission established by the Competent Authority, which consists of officials in the fields of environmental protection, study, and use of subsoil, industrial safety, sanitary-epidemiological service and land resources management and by the regional local executive body.

[6] Article 8.2: http://www.iclg.co.uk/practice-areas/mining-law/mining-law-2015/kazakhstan

Project Requirements

- commission a Mine Closure Feasibility Study;
- segregate and manage soils and geological wastes in accordance with the Law on Subsoil Use and with foresight for progressive restoration;
- develop a Mine Closure Plan; and
- accrue a Closure fund.

Public Health

Public relations in the field of healthcare with the aim of upholding constitutional civil rights of health protection are listed in the Code of RoK 'On people's health and the healthcare system' (Sep 2009, amended Oct 2015). Article 62 of this code states that sanitary epidemiological conclusions must be granted alongside the project ESIA, including on formalising land properties under construction.

Energy

The most recent Law "About energy saving and energy efficiency raise" was adopted in Jan 2012 and amended in July 2012 and covers the field of energy saving and efficiency. It relates to the former RoK Law "On Energy Saving" (Dec 1997) and the current "On Supporting the Use of Renewable Sources of Energy (July 2009). The Law introduced several specific measures to enhance energy efficiency, including: establishment of registration requirements, mandatory energy audits, energy management systems, energy consumption rates, mandatory use of energy efficient materials in new buildings, energy resources meters and automated systems of regulation of heat consumption. Adoption of the Law was followed by the issuance of several implementing regulations, including those prescribing energy efficiency requirements for newly constructed buildings and energy efficiency management systems[7].

It is worth noting that in his annual message, the President of the RoK set the goal to reduce the energy intensity per GDP by 25% by 2020.

Additionally, one of the main targets of the National Programme for Accelerated Industrial and Innovation Development of the RoK (2010-2014) was to reduce energy intensity of industry in order to achieve competitiveness within the nation's economy[8].

[7] EBRD policy document: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&ved=0CFEQFjAJ&url=http%3A%2F%2Fwww.ebrd.com%2Fdocuments%2Flegal-reform%2Fkazakhstan-country-law-assessment.pdf&ei=ym5xVbX2LMOO7Abmi4Jo&usg=AFQjCNFIsX8OxALBlriezBST3wznkxQRBQ&bvm=bv.95039771,d.ZGU&cad=rja

[8] http://www.energypartner.kz/index.php?option=com_content&view=article&id=23&Itemid=32&lang=en

Historical and Cultural Heritage

The Law of RoK 1488-X11 (July 1992, amended Jan 2014) on the Protection and Use of Objects of Historical and Cultural Heritage defines the goals, objectives and legal basis for the protection and use of historical and cultural heritage. In particular, Article 2 covers the definition of cultural and historical monuments, including those of architectural and archaeological value, as well as their protection and use. At Bakyrchik, objects of cultural heritage were not found during the social and environmental baseline studies.

Local or Provincial Legislation

A number of regulations and legal requirements of the East Kazakhstan region may be applied to the project, including the following legislative acts and regulations. However, Kazakh legislation is centralised and consists mostly of codes, laws, and Governmental Decrees. Local authorities do not have the right to adopt laws.

Nevertheless, a specific case exists within Article 495.9 (Fee Rates) of the Tax Code, which stipulates that the local representation body (the "maslikhat") is entitled to increase the rates set out by this Article for environmental emissions no more than two times and for pollutions from gas flaring no more than 20 times.

Regional Legislation

There are no regional rules, protocols, policies, or laws relating to several countries in the particular region that need to be take into account.

Native Title and Land Rights

There is no concept of native title in Kazakh law. Surface rights (land use rights) are separate from mining rights. Article 68.5 of Subsoil Law (Execution and Registration of Contract), execution of a subsoil contract is the ground for the provision of a relevant land plot by the relevant regional akimat, except in the cases of the expropriation of a land plot (land use right) for State needs under the Land Code.

According to Article 71.1 of the Land Code (Use of Land Plots for Survey Works), individuals and entities carrying out geological, geophysical, and search works can perform such works without taking away such land plots from their owners or leaseholders. Such provision is normally used for exploration purposes.

In such cases, or if land plots where mining is supposed to be undertaken is owned or leased by a third party (an individual or entity), the subsoil user shall conclude a relevant agreement with such owners/leaseholders. Normally, the subsoil user shall reimburse losses of agricultural activity (due to

withdrawal of land plots used for agricultural activities). In certain cases, subsoil users are obliged to conclude servitude contracts.

The only constant and free right which individuals and entities have with regard to subsoil use at the land plots owned or leased by them is the mining of commonly occurring minerals for their own needs.

2.4 Law on Subsoil and Subsoil Use, 2010 (amended Dec 2014)

Kazakhstan has adopted comprehensive new legislation governing its large mineral resources. While not a fundamental shift from the prior regulatory regime, in June 2010 a new Sub-soil Law was adopted, with the expectations that it would achieve the important government goals of greater control, sustainability and social responsibility. It consolidated a number of previously complementary, but sometimes inconsistent, laws and regulations. It incorporated broad change of control provisions requiring consent to any transfer involving subsoil use rights, with a corresponding state priority right to purchase. It incorporated comprehensive requirements on protection of the environment, employment and training of local personnel, and hiring of local businesses, as well as obligatory funding requirements for the development of local projects. It also provides strong backstop safeguards allowing amendments to subsurface use contracts to protect the State's economic and national security interests.

One major change commencing in 2010 was the reorganisation of the ministries to support and elevate the mining industry. The mining industry is now under the supervisory control of the Ministry of Industry and New Technologies. Previously, the mining industry and the Oil and Gas industries were under the supervisory control of a single ministry.

Kazakhstan has recently renewed its focus upon continuously improving the regulatory environment, raising industry practices to internationally recognised standards.

According to the Resolution of the Government of the RoK 'On approval of rules granting rights' (dated Dec 2010, amended Dec 2013), subsoil use rights are provided for conducting the following operations:

- state geological subsurface studies;
- exploration;
- development; and
- construction and/or exploitation of underground constructions not related to exploration and mining operation.

Project Requirements

In accordance with the Law on Subsoil Use, the Project will be required to:

- prevent wind erosion of soils and waste rock landforms;
- create impervious barriers between operational areas and surface and groundwater features to prevent pollution;
- prevent the discharge of pollutants into the atmosphere;
- rehabilitate areas of land disturbed by mining activities;
- prevent subsoil pollution from either the storage or burial of oil and other harmful substances underground or the discharge of sewage water; and
- comply with ecological requirements when storing and placing industrial waste to prevent their accumulation in areas of surface and ground water collection.

Environmental Policy of RoK

The Environmental Policy of Kazakhstan provides a number of guiding principles that indicate and require a strong adherence to sustainable development, and a high commitment to ensure that environmental activities:

- consider impacts on human and natural environments;
- provide for an early consideration of environmental impacts in projects and programs design;
- recognize public consultation;
- include mitigation plans and contingency plans;
- provide for auditing and monitoring;
- are a legally binding requirement; and
- are institutionalised.

The Environmental Code of the RoK dates back to Jan 2007, with amendments carried out in Dec 2011. Ecological expertise can be carried out in two forms, as delineated in Article 45 of the Ecological Code, entitled "Types of Ecological Expert Examinations". According to this Article, State, authorised by a government body, and public, conducted by expert commissions, ecological expert examinations shall be carried out in the RoK.

The policy underpins the regulatory requirements for Environmental Impact Assessment (EIA, or OVOS) and pollution control, requiring developers to aspire to the highest international standards of environmental and social management for project development.

The procedure for obtaining a construction permit is governed by the resolution entitled, "On the rules for conducting the expertise of the pre-project (feasibility studies) and project (design and estimate)

documentation for the construction independently from funding sources, as well as the approval of projects that are built at the expense of State investments" (as of April 2014)

2.5 The OVOS/ESIA Process

All pre-planned, planned, pre-designed and designed documentation is subject to Kazakh (or RoK) state ecological expertise (review). This includes the submission of an OVOS or ESIA report. The OVOS/ESIA process is regulated at the national level by Section 35 of the Environmental Code of the Republic of Kazakhstan (Jan 2007, amended Dec 2014) and by instructions on the assessment of proposed economic and other activities on the environment when developing pre-planning, planning, design, and project documentation, as approved by the Order of the Minister of Environment of the RoK (June 2007).

Economic activity cannot be implemented until the positive conclusion of the expertise has been received and permission for the special nature management is issued.

The Kazakh permitting procedure encompasses two phases: project initiation (covering project development and construction) and project operation. Within this, the OVOS, or ESIA, process comprises a number of stages characterised as within either pre-OVOS, or full OVOS portions, of the study. The pre-OVOS (preliminary assessment of the environmental impact) is developed prior to planning and investment phase, documenting planned economic and other activities, and also comprises the Feasibility Study, which is the main pre-project document. The OVOS (ESIA) provides a detailed analysis of the full impact of all aspects of objects and the structure of planned economic activities on the environment.

OVOS regulations contain general requirements as to how developers must conduct the assessment of environmental impacts and approval of an OVOS submission, which requires a public hearing for stakeholders and approval by the state authorities, before mining operations can commence. Discussions at public hearings are recorded.

Public hearings are regulated by the Order of the Minister of Environment of RoK: 'About the approval of rules for public hearings' (May 2007, amended March 2013). Public involvement issues are regulated by:

- Clauses 2-4 of Article 57 of the Ecological Code of RoK (2007), stating that: "all interested individuals and associations shall be granted a possibility to express their views during the period of the performance of state ecological expert examination"; "public consultations shall be held under projects where implementation may directly affect the environment and health of individuals"; "the authorized body in the area of environment protection shall establish the procedure for holding public consultations, and it shall determine identification of interested persons, places where information and consultations may be obtained, method of informing the population, determining

the method by which consulting of the population is carried out, and deadlines for holding public consultations".

- Article 163 of the Ecological Code of RoK (2007), pertaining to access of ecological information. It states that ecological information shall be recognised as generally accessible, except for cases provided for by the laws of RoK.
  'Instructions on conduction of environmental impact assessment stated by business and other activity to the environment, whilst operating of pre-planned, planned, pre-project, and project documentation.'

Each stage of the OVOS is subject to evaluation by state ecological experts. A positive conclusion from such an evaluation is a necessary prerequisite for the implementation of the project. In addition, the conclusion of the evaluation must be approved by local environmental regulatory departments.

The pre OVOS assessment will assess how much atmospheric, solid and liquid emissions/discharges will be released at Bakyrchik, in accordance with Kazakh norms for emission levels.

Whilst an OVOS and ESIA may be broadly comparable, they are produced to meet different requirements. The OVOS is produced to fulfil the requirements of State permitting, an international ESIA is developed for project financing. The ESIA expands on the requirements of the OVOS to meet specific IFC PS criteria, including carrying out a more extensive consideration of the socio-economic impacts a project has. Much of the same environmental baseline data can be used between an OVOS and ESIA, ensuring there is compatibility in collection and preparation methods of baseline data in accordance with international best practice methods with the differences being the extent of baseline data collection and impact assessment process for the topics listed below:

- social/community aspects;
- biodiversity;
- water resources; and
- integrated ecosystem services.

Figure 2.1 outlines the ESIA process and how this is developed alongside Feasibility Studies. This figure also identifies the requirement to engage with stakeholders throughout this process.

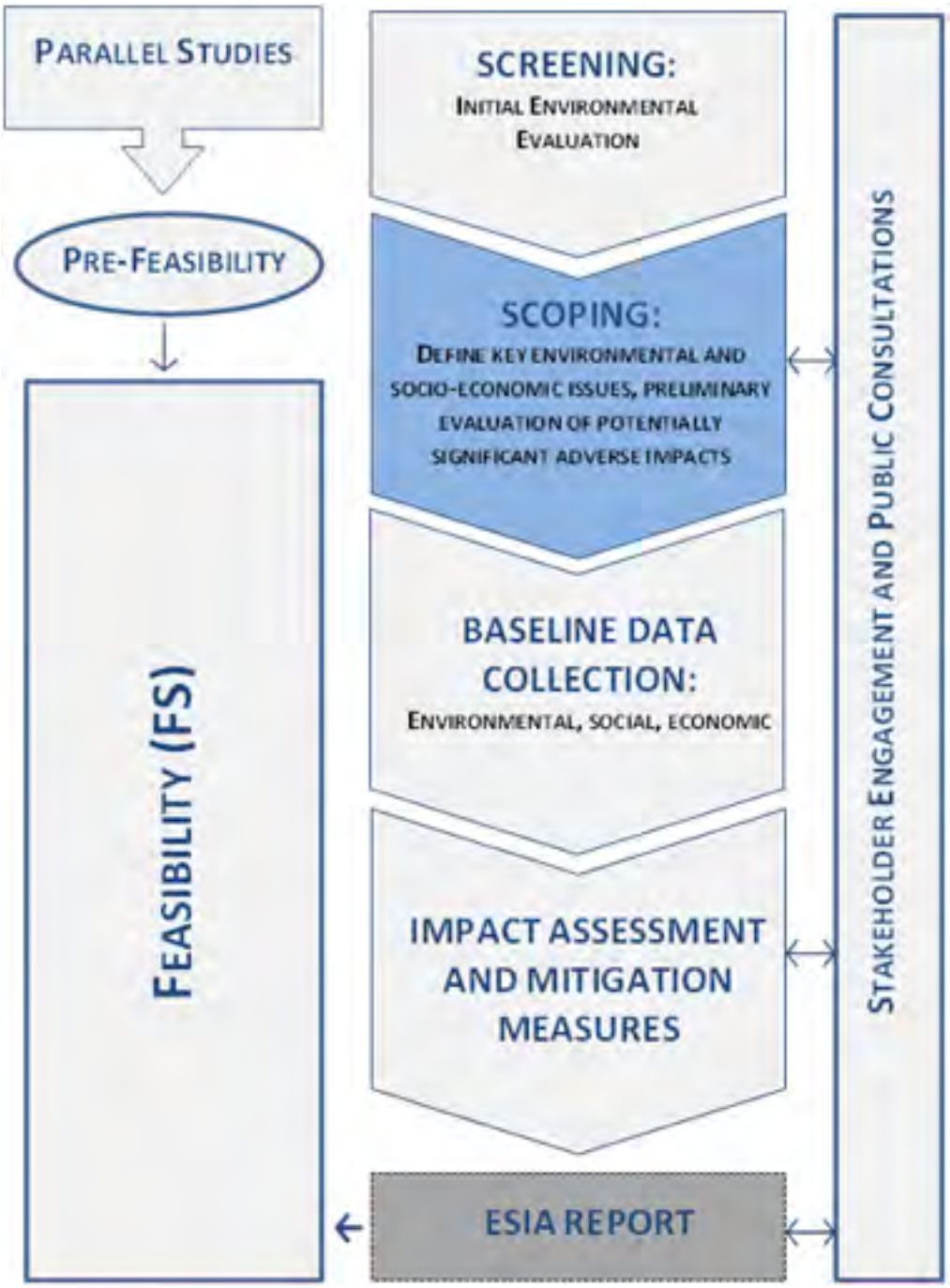


Figure 2.1: The ESIA Process

The OVOS for Bakyrchik was finalised in 2012 and public hearings for the OVOS/ESIA scoping were undertaken in March 2012. Expertise review and approval has subsequently been received for the project. The OVOS provides further details of the Kazakh maximum permissible emissions of polluting agents into the environment, including: atmospheric pollutants, waste water and waste disposal.

State

State ecological expertise is carried out by the agency authorised in the environment protection sphere and by the local executive board. State ecological expertise of category I objects is carried out by the central executive board in the environment protection sphere; category II and III objects are examined by the territorial form of the agency authorised in the environment protection sphere; the objects of category IV are examined by the local executive board. The conclusion of state ecological expertise is an official document and must be executed.

Social

Participation of the public (civil society) is developing, and public opinion is generally seen as advisory in nature. Public participation in compliance and enforcement is one way that the public may be involved in and exert an influence on environment protection and the rational use of natural resources and prevention/mitigation of negative impacts on the environment.

Social ecological expertise is an activity carried out on a voluntary basis by expert commissions created at the initiative of the population separate groups, associations and scientific organizations in order to assess any environmental impact.

The existing environmental legislation requires OVOS implementation on all stages of economic activity from the initial plans through design, construction, and exploitation until facility closure. Foresight and ecological risk assessment is the main object of OVOS with State ecological expertise aimed at checking this.

Project Requirements & Status

In accordance with the Environmental Code, an OVOS comprises several stages including:

- a baseline assessment;
- a preliminary assessment for the purposes of a feasibility study;
- a detailed assessment and development of a programme of environmental protection;
- mandatory public hearings where representatives of interested parties can discuss potential environmental impacts of the project (considered the only form of public consultation required to meet Kazakh requirements); and
- a post-completion assessment made one year after the start of the operation.

Permitting and Licensing

The Ministry of Environmental Protection has authority to issue annual natural use permits in relation to the exploitation of natural resources. The Company is also required to obtain a number of other

certificates, permits and licences in relation to the use of natural resources, and potentially toxic chemicals, the transportation and import of hazardous materials, and explosive materials for blasting, as well as water usage. Many of these are administered through regional/local level executive authorities (Akimats).

There are two types of environmental permits covering all types of emissions:

- Permits for environmental emissions - This type of permit is more common. Environmental users are divided into four categories, depending on their specific activities and scope of yearly discharges. Permits for environmental emissions are issued for a specific term from three to five years. The exact duration depends on the category of the environmental user.
- Complex environmental permits - Complex environmental permits can be issued for an indefinite term to those environmental users that comply with the best available environmental technologies and only for certain projects pre-approved by the government.

Prior to mining operations, several permits and licences are likely to be required, including:

- Mining Licence;
- Water abstraction licence (originally obtained by BMV in 2009);
- Permit for emissions to the environment including air, water discharge and waste landfilling (obtained in 2011);
- Subsoil Use Contract (contract signed in 1995);
- Explosives Production Permit*;
- Explosives Transportation Permit*;
- Explosives Handling Permit*;
- Explosives Storage Permit*; and
- Hazardous Waste Permit.

(* Note: all explosive permits are required prior to blasting operations so Polymetal intend on starting the permitting process for these in 2014).

Non-compliance with permitting requirements can result in administrative liability (mostly fines) and in certain cases, criminal liability. Administrative fines can be very substantial, reaching up to 1,000% of the cost of emissions discharged in excess of the limits set out in the permit.

2.6 International Conventions

Kazakhstan participates in the following international environmental and social conventions, which in most cases supersede domestic legislation.

- Convention on environmental impact assessment in trans-boundary context (ESPOO) – joined 31st January 1994.
- Basel Convention on control over trans-boundary shipment of dangerous waste and their disposal – signatory since 3rd June 2003; regulates trans-boundary movements of hazardous wastes and provides obligations to Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner. The Bakyrchik project will generate hazardous wastes.
- Vienna Convention on ozone layer safety (dated 22nd March 1985) – Accession on 26th August 1998; aims to ensure global co-operation for the protection of the ozone layer. The Bakyrchik project should aim to reduce or eliminate emissions of anthropogenic ozone depleting substances.
- UN/ECE Convention on long-range transboundary air pollution (December 1979).
- UN/ECE Convention on the transboundary effects of industrial accidents (Helsinki 1992).
- Montreal Protocol on ozone destructing substances – Accession on 26th August 1998.
- UNO Frame Convention on climate change – KR joined by KR Law of January 14, 2000, # 11.
- Kyoto Protocol to UNO Frame Convention on climate change – ratified on 19th June 2009; Introduces emissions targets. The Bakyrchik project's emissions will count towards Kazakhstan's total emissions output.
- Rio Convention on Biological Diversity – Accession on 8th September 2008; promotes conservation of biological diversity and sustainable use of its components.
- Cartagena Protocol in biological safety to the Convention on biodiversity – Accession on 8th September 2008.
- The Agreement on Cooperation among CIS countries in the field of ecology and environmental protection (1999).
- CIS countries cooperation in the field of environmental monitoring (1999).
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), or the Washington Convention (accession 2000; Aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival).
- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (deposited 2007; aims for the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.
- The government of Kazakhstan has ratified the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in

Environmental Matters, also known as the Aarhus Convention – signatory in January 2002. The Aarhus Convention requires the government to grant the public rights regarding access to information on the environment, including information on the environmental impacts of corporate activities, access to which is available only to the relevant environmental authority. This ecological information should be provided in advance to any affected party.

- Stockholm Convention on Persistent Organic Pollutants – signatory 2001, accession 2007; Ensure the limitation of pollution by persistent organic pollutants (POPs), the Convention defines the substances in question whilst also leaving open the possibility of adding new ones, and it also defines the rules governing reduction, importing and exporting those substances. Substances covered by this convention may potentially be used in this Project and guidance or restrictions governing these substances will be adhered to.
- Convention of European and Mediterranean organization on plant protection.
- International Labour Organisation (ILO): The project will need to employ workers and recognise these principles.
    - Convention on Forced Labour (#29, ratified 2001; adopts proposals to eliminate forced or compulsory labour);
    - Convention on Freedom of Association and Protection of the Right to Organize (#87, ratified 2000; protects the right to freedom of association and protection of the right to organise);
    - Convention on the Right to Organise and Collective Bargaining (#96, ratified 2001; determines that workers shall have protection from discrimination and interference);
    - Convention on Equal Renumeration (#100, ratified 2001; adopts proposals on the principle of equal remuneration for men and women for work of equal value);
    - *Convention on the Abolition of Forced Labour* (#105, ratified 2001; stipulates that all parties shall eliminate and will not make use of any form of compulsory forced labour;
    - Convention on Discrimination [Employment and Occupation] (#111, ratified 1999; promotes equality of opportunity and treatment in employment and occupation);
    - Convention on Minimum Age (#138, ratified 2001; pursues the abolition of child labour and increases the minimum age for admission to employment);
    - Convention on the Forms of Child Labour (#182, ratified 2003; obliges parties to take effective measures to prohibit and eliminate the worst forms of child labour).
- Other UN conventions: The project will need to employ workers and recognise these principles.
    - Convention on the Elimination of All Forms of Discrimination against Women (ratified 1998, sets out an agenda to end discrimination against women). The

project will employ workers and Polymetal will need to recognise the requirements for gender equality in the Project's HR policy and recruitment process.

- Convention on the Political Rights of Women (ratified 1999, gives women the right to vote or hold office, as established by national law, on equal terms with men and without discrimination on the basis of sex);
- Convention on the Rights of Persons with Disabilities (ratified 2006, promotes non-discrimination and equality of opportunity);
- Convention to Suppress the Slave Trade and Slavery (ratified 2008, undertakes to prevent and suppress the slave trade and to progressively bring about the complete elimination of slavery in all its forms);
- Convention for the Suppression of the Traffic in Persons and of the Exploitation of the Prostitution of Others (ratified 2005, requires state signatories to punish any person who "procures, entices, or leads away, for the purposes of prostitution, another person, even with the consent of that person" and/or "exploits the prostitution of another person, even with the consent of that person");
- International Covenant on Economic, Social, and Cultural Rights (ratified 2006, promotes equal rights of men and women to enjoy all economic, social, and cultural rights);
- Convention against Torture and Other Cruel, Inhuman, or Degrading Treatment or Punishment (ratified 2008, requires states to take effective measures to prevent torture within their borders, and forbids states to transport people to any country where there is reason to believe they will be tortured;
- UNICEF Convention on the Rights of the Child (ratified 1994, a human rights treaty setting out the civil, political, economic, social, health, and cultural rights of children);
- International Convention on the Elimination of All Forms of Racial Discrimination (ratified 1998, undertakes to eliminate racial discrimination in all its forms and promotes understanding);
- UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (ratified 1972, acceptance 1994; confirms the protection and preservation of the world's cultural and natural heritage);
- UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (ratified 2011; Purposes are to safeguard intangible cultural heritage, ensure respect for the tangible cultural heritage of the communities, groups, and individuals concerned; to raise awareness at the local, national, international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof.

2.7 International Standards and Guidelines for Environmental and Social Performance

Leading industry practice for international projects in emerging markets is generally driven by the international lending community. A most important facet is compliance with the Equator Principles (EP), a risk framework for identifying, assessing, and managing environmental and social risks in Project Finance transactions based on the International Finance Corporation (IFC) Sustainability Framework including the Performance Standards (PS).

Equator Principles

The Equator Principles were initially developed in June 2003 by a group of leading financial institutions to provide an approach to determine, assess and manage environmental and social risk in project financing. By August 2012, over 77 financial institutions were signatories to the Equator Principles (thus referred to as Equator Principle Financial Institutions, EPFIs) to ensure that the projects that were financed were developed in a manner that is socially responsible and reflect sound environmental management practices.

The Principles apply to all new project financings globally with total project capital costs of US$10 million or more. The ten Equator Principles as adopted in July 2006 are:

- **Principle 1 – Review and Categorization**: Obliges the categorization of projects based on the magnitude of potential impacts and risks in accordance with the social and environmental screening criteria of the IFC.
- **Principle 2 – Social and Environmental Assessment**: Requires the evaluation of social and environmental impacts and risks and the identification of mitigation and management measures that are needed to reduce impacts to acceptable levels.
- **Principle 3 – Applicable Social and Environmental Standards**: Establishes the IFC Performance Standards and Environmental, Health and Safety (EHS) Guidelines to complement the host country legislation as the basis for social and environmental performance.
- **Principle 4 – Action Plan and Management System**: Requires the development of a plan for implementing the mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified by the Assessment.
- **Principle 5 – Consultation and Disclosure**: Obliges free, prior and informed consultation and the facilitation of informed participation for projects that may have significant adverse impacts to local communities and the public disclosure of the Assessment and Action Plan in a culturally appropriate manner.
- **Principle 6 – Grievance Mechanism**: Requires that an appropriate grievance process be included as part of the management system and that affected communities are informed of the process.

- **Principle 7 – Independent Review**: Calls for an independent social or environmental expert to review the Assessment, Action Plan, and consultation process to assess compliance with the Principles.
- **Principle 8 – Covenants**: Incorporates into the lending covenants compliance with host country requirements, Action Plan implementation commitments, periodic reporting of social and environmental performance, and facility decommissioning and closure where appropriate.
- **Principle 9 – Independent Monitoring and Reporting**: Calls for an independent social and/or environmental expert to verify monitoring and reporting information.
- **Principle 10 – EPFI Reporting**: Commits the EPFI to publicly report its Equator Principles implementation process and experience on an annual basis.

Principle 3 expressly cross references and incorporates the IFC's Performance Standards and the World Bank Group (WBG) Environmental, Health, and Safety (EHS) Guidelines, thus obliging projects seeking financing from EPFIs to apply IFC Performance Standards, WBG/ EHS Guidelines, including applicable WBG/IFC Industry-Specific EHS Guidelines.

The IFC has developed its own policies which apply specifically to IFC investments. These include i) the Policy on Disclosure of Information which defines IFC's obligations to disclose information about itself and its activities; and ii) the Policy on Social and Environmental Sustainability which defines IFC's role and responsibility in supporting project performance in partnership with project sponsors.

At the project level, which applies to both IFC and EPFI investments, the Performance Standards, Guidance Notes, EHS Guidelines, and best practice materials are applicable.

On 13 August 2012, the Equator Principles (EP) Association released the draft of the updated Equator Principles (EP III) for stakeholder consultation and public comment. Key themes and areas of development proposed in the EP III draft include:

- an extension in the scope of the EP to Project-Related Corporate Loans and Bridge Loans;
- changes reflecting the recent update of the International Finance Corporation (IFC) Performance Standards;
- new requirements related to managing impacts on climate;
- greater emphasis on human rights considerations in due diligence and an acknowledgment of the UN "Protect, Respect and Remedy" Framework for Business and Human Rights and Guiding Principles on Business and Human Rights; and
- a strengthening of reporting and transparency requirements.

Categorisation of projects is based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the IFC. According to the IFC classifications, projects fall into one of three categories, depending on the type, location, sensitivity, and scale of the

project and the nature and magnitude of its potential environmental impacts. The Category definitions are as follows:

- Category A – projects with the potential for significant adverse impacts, which are diverse, irreversible or unprecedented.
- Category B – projects with limited potential adverse impacts which are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.
- Category C – projects which have minimal or no potential impacts.

The majority of environmental and social impacts at Bakyrchik mine have already occurred as a result of previous activity at the sites; however additional, generally site specific, impacts are applicable as a result of extended activities and new operations coming online. There will also be cumulative impacts to consider.

Based on industry experience and professional judgement WAI considers that the proposed project will fall into Category A, primarily due to the location of the proposed TSF with the associated potential surface water diversions.

As a result of this categorisation, a full ESIA is required.

IFC Performance Standards and Guidelines

The IFC Performance Standards on Social and Environmental Sustainability, previously published in April 2006 and updated in January 2012, are considered to be the most comprehensive standards available to international finance institutions working with the private sector. The Performance Standards define a project's role and responsibilities for managing health, safety, environmental, and community issues to receive and retain IFC and/or Equator-participating lender support (see Figure 2.2).

Figure 2.2: Framework for IFC, PS Standard and Guidelines

The IFC Performance Standards are supported by Guidance Notes giving further information on the requirements of the Performance Standards, and on good practice to enable improved project performance. IFC Performance Standards 1 to 6 and 8 are all relevant to the Project. Where 'the client' is used, this refers to the owner/operator of the Project.

The Performance Standards are summarised below, followed by more detailed content definitions:

- **Performance Standard 1 – Assessment and Management of Environmental and Socials Risks and Impacts**: This standard seeks to identify and assess the social and environmental impacts of the Project, including cumulative and/or sectoral impacts and technically and financially feasible alternatives, and to avoid, minimize, and manage any unavoidable adverse impacts to people, their communities, and their environment. It requires the development of a formal environmental and social policy reflecting the principles of the PS. It clarifies levels of stakeholder engagement under different circumstances and required engagement beyond affected communities. It promotes improved environmental and social performance through effective management systems and periodical performance review by senior management. Finally it refers to private sector responsibility to respect human rights.
- **Performance Standard 2 – Labour and Working Conditions**: This standard seeks to establish, maintain, and improve the working relationship between workers and management. It mandates equal opportunity and fair treatment of workers and protects against child and/or forced labour practices. It demands that the workplace offer safe and healthy working conditions that promote the health and welfare of the employees. It establishes requirements for comparable terms and conditions for migrant workers, compared to non-migrant workers, and introduces the quality requirements for workers' accommodation. Additionally it requires on-going

monitoring of primary supply chain and introduces "safety" trigger for same. Updates to the PS require the inclusion of monitoring construction contractors.

- **Performance Standard 3 – Resource Efficiency and Pollution**: This standard is intended to minimize adverse impacts on human health and the environment by minimizing pollution and reducing emissions that contribute to climate change. It introduces a resource efficiency concept for energy; water (including unacceptable water stress), and core materials inputs. Requirements on energy efficiency and greenhouse gas measurement are important, similarly on the concept of "duty of care" for hazardous waste disposal. The 2007 EHS Guidelines give guidance for evaluating and selecting pollution prevention and control techniques for projects. These Guidelines contain the performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from the levels and measures presented in the EHS Guidelines, project proponents will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the proponent will provide full and detailed justification for any proposed alternatives. This justification will demonstrate that the choice for any alternate performance levels is consistent with the overall requirements of this PS. Updates to the PS have reduced the annual threshold for reporting GHG emissions down to 25,000 tonnes.
- **Performance Standard 4 – Community Health, Safety, and Security**: This standard limits risks and impacts to the local communities associated with all phases of the Project, including unusual conditions. It requires that the health and safety risks be evaluated during all phases of the Project and that preventative measures be implemented to a level that is commensurate with the risk. It considers risks to communities associated with use, and/or alteration of natural resources and climate change through an ecosystem approach. It also gives consideration for the risks posed by security arrangements. Security arrangements must be guided by the principles of proportionality, good international practices in terms of hiring, rules of conduct, training, equipping and monitoring of such personnel, and applicable law. The use of force is typically not sanctioned and a grievance process must be established to allow affected communities to express concerns about the security arrangements and acts of security personnel. Updates to PS 4 have introduced requirements to consider construction workers accommodation.
- **Performance Standard 5 – Land Acquisition and Involuntary Resettlement**: This standard seeks to avoid and minimize involuntary resettlement and to mitigate unavoidable adverse impacts through compensation for loss of economic assets and economic and standard of living restoration measures. Land use issues are key to sustainability and requirements regarding consultation are essential. Resettlement measures are intended to aim at improving economic and livelihood conditions. PS updates have changed the scope of application of PS 5 to include resource users e.g. fisheries, land users etc.

- **Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources**: This standard calls for the balancing of conservation of biodiversity and the promotion of sustainable management of natural resources. It explains in details definition of and requirements for various types of habitat. It introduces clear requirements for biodiversity offsets, with updates in 2012 requiring projects to develop a net positive gain for critical habitats. The Project site is host to certain sensitive ecosystems or habitats that are important to fauna and flora species of international concern and the ESIA will fully consider ecosystems services.
- **Performance Standard 7 – Indigenous Peoples**: This standard ensures that Project development respects the dignity, human rights, and cultures of indigenous peoples and avoids adverse impacts to their traditions and values. It seeks to establish and maintain on-going relationships and to foster good faith and informed participation of indigenous peoples when projects are located on traditional or customary lands and to respect and preserve those cultures and practices. It introduces the concept of Free, Prior, and informed Consent (FPIC) under certain circumstances. Based on the IFC definition of Indigenous Peoples, this Performance Standard is not applicable to the current Project.
- **Performance Standard 8 – Cultural Heritage**: This standard protects cultural heritage sites from Project-related impacts and promotes the equitable sharing of benefits from the use of cultural heritage in business activities. It requires clients to allow access to cultural sites. Items of local cultural importance that will be affected by the Project include old tombs and artefacts in the lowlands. Changes to this PS in 2012 relate to access to information policy.

These Performance Standards, and all IFC reference documents, are included at http://www.ifc.org and are supported by Guidance Notes for each Performance Standard.

The table below provides a brief summary of how each Performance standard applies to the Kyzyl Project.

IFC Performance Standard	Brief summary of how each Performance Standard applies to the Kyzyl Project
1 - Assessment and Management of Environmental and Socials Risks and Impacts:	• Social and environmental impact assessments have been undertaken and mitigation measures outlined to avoid, minimise, compensate/offset and manage adverse impacts. • On-going stakeholder engagement has been provided, including use of the SEP. Involvement and communication with stakeholders throughout the project, including beyond the scope of directly affected communities. • Provision of guidance and recommendations towards ensuring on-going public and stakeholder participation in the Project. This includes recommendations referring to participatory monitoring programmes with relevant NGOs and community members. • Development of effective and integrated management systems. This requires on-going commitment by Polymetal as outlined in the ESIA. • Responsibility to respect human rights has been embedded throughout the ESIA.
2 - Labour and Working Conditions:	• Establish and maintain high standards of relationships between workers and managers. Polymetal need to formalise their employee grievance mechanism as outlined in the ESIA. • Fair treatment of employees, no child and/or forced labour. • Safe working conditions for all employees, including contractors. • Consideration and on-going monitoring of supply chain.
3 - Resource Efficiency and Pollution:	• Minimise adverse impacts on human health and the environment by reducing pollution. This will be achieved through the incorporation of mitigation measures in Chapter 5 (Impact Assessment and management plans). The ESIA refers to on-going monitoring requirements. • GHG emissions have been calculated within the ESIA and require on-going monitoring.
4 - Community Health, Safety, and Security:	• The ESIA has considered risks to communities and employees throughout all impact assessment sections. Monitoring is required through all phases of the Project to ensure preventative measures are in place to reduce risks. • The ESIA outlines the necessity for on-going training to employees and the steps Polymetal need to take moving forward relating to community health, safety and security. • Project impacts on ecosystems services have been addressed within the ESIA and require on-going monitoring and review throughout all Project phases. • The ESIA addresses actions Polymetal need to take, such as implementing a formal employee grievance mechanism.
5 - Land Acquisition and Involuntary Resettlement:	• The Project development requires resettlements and has a direct effect on livelihoods relating to the development of the licence area. Farming forms one of the main sources of paid employment for residents of Auezov and Shalabay, the closest settlements to the Project. • The Project has involved rental of state land for the proposed TSF facility and processing plant; this requires Polymetal to

IFC Performance Standard	Brief summary of how each Performance Standard applies to the Kyzyl Project
	communicate promptly and clearly with local farmers and herders to ensure that Project activities, specifically the fencing-off of some land, do not alter livelihoods of residents in Auezov.
6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources:	• The ESIA provides a biodiversity baseline, in addition to biodiversity and ecosystems services impact assessments. The Project has not identified critical habitats. • The ESIA makes clear recommendations relating to on-going considerations and actions recommended for minimising the Project's impact on sensitive animal and plant species. On-going monitoring and review is highly recommended.
7 - Indigenous Peoples:	• There are no indigenous communities, so this does not apply to the Project.
8 - Cultural Heritage:	• The ESIA includes an archaeology and cultural heritage baseline and a cultural heritage impact assessment. Based on anticipated significant adverse impacts, the ESIA has a 'cultural heritage management plan'; • The Cultural Heritage Management Plan outlines a 'Chance Finds Procedure', which Polymetal are implementing on site. The Chance Finds Procedure should be communicated to all contractors and employees involved in site development and operation, with appropriate training given.

Chapter 7 summarises environmental and social impacts from the Project and provides further details on the applicability of project impacts to IFC PSs.

Documents relevant to various aspects of Project implementation include, but are not limited to, IFC and WBG publications, itemised in Table 2.1.

Table 2.1: IFC and WBG Guidance Publications Relevant to the Project	
Title	**Date**
Pollution Prevention and Abatement Handbook	1999
Assessing Private Sector Contributions to Job Creation: IFC Open Source Study	April 2012
IFC Investing in People: Sustaining Communities through Improved Business Practice	2001
Good Practice Note: HIV/AIDS in the Workplace	2002
Good Practice Note: Addressing Social Dimensions of Private Sector Projects	2003
Good Practice Note Number 4, Managing Retrenchment	2005
Good Practice Note: Non-Discrimination and Equal Opportunity	2006
A Guide to Biodiversity for the Private Sector, IFC	March 2006
Stakeholder Engagement: IFC guide on Good Practice Handbook for Companies Doing Business in Emerging Markets	May 2007
IFC Introduction to Health Impact Assessment	April 2009
Developing a Transparent System for Local Contracting, IFC	November 2008
Developing SMEs Through Business Linkages, IFC	November 2008
Projects and People: A Handbook for Addressing Project-Induced In-Migration, IFC	December 2009
Guide to Human Rights Impact Assessment and Management; IFC, Global Compact, International Business Leaders Forum	June 2010
Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	January 2012
Guidance Note 8: Cultural Heritage	January 2012
Stakeholder Engagement: A Good Practice Handbook for Companies doing Business in Emerging Markets	2007

The EHS Guidelines are technical reference documents designed to assist a wide range of users including project proponents, financiers, facility managers, and other decision makers by providing relevant industry background and technical information. This information supports actions aimedat avoiding, minimizing, and controlling environmental, health, and safety impacts during the construction, operation, and decommissioning phases of a project or facility.

The General EHS Guidelines are organized to capture common themes which are applicable to any industry sector and project. The General EHS Guidelines and the Industry Sector EHS Guidelinesare designed to be used jointly. On complex projects like Bakyrchik, multiple industry-sector guidelines are applicable (see Table 2.2).

Table 2.2: EHS Guidance Publications relevant to the Project	
Title	**Date**
Environmental, Health, and Safety Guidelines for Waste Management Facilities	December 2007
Environmental, Health, and Safety Guidelines for Water and Sanitation	December 2007
Environmental, Health, and Safety Guidelines General Guidelines	May 2007
Environmental, Health, and Safety Guidelines, Base Metal Smelting and Refining	September 2007
Environmental, Health, and Safety Guidelines, Mining	December 2007
Environmental, Health, and Safety Guidelines for Thermal Power Plants	December 2008

The Mining EHS guidelines present mining EHS best practices approaches and requirements that are already adopted and in place in many countries. The Mining EHS guidelines cover water balances based on probable climatic events, secondary containment for hazardous materials, compliance with

the International Cyanide Management Code (ICMC) for cyanide use, together with a range of activities that require consideration for mining operations.

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities at reasonable costs by existing technology. The applicability of the EHS Guidelines may need to be established for each project based on the results of an environmental, health, safety and social assessment where site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

Stakeholder engagement is an important part of complying with Equator Principles (Principle 5), IFC Performance Standards (PS 1) and EBRD Performance Requirements (PR1). The purpose of stakeholder engagement is to build and maintain a constructive relationship with affected communities. The nature and frequency of engagements should be in-line with the risks to and adverse impacts on the communities. Engagement must be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information.

Disclosure of relevant project information helps affected communities understand the risks, impacts and opportunities of the project. If communities may be affected by risks or adverse impacts from the project, the project proponent must provide such communities with access to information on the purpose, nature and scale of the project, the duration of proposed project activities, and any risks to and potential impacts on such communities.

If affected communities may be subject to risks or adverse impacts from a project, consultation must be undertaken in a manner that affords affected communities the opportunity to express their views on project risks, impacts, and mitigation measures and have due consideration given to that input in project decision-making. This consultation should begin early in the ESIA process, focus on the risks and adverse impacts and the measures and actions envisaged for their mitigation, and be carried out in a manner that is inclusive and culturally appropriate.

For projects with potentially significant adverse impacts on affected Communities, an Informed Consultation and Participation (ICP) process should be conducted, which will result in the affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the affected Communities on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The Stakeholder Engagement Plan (SEP) outlines how Polymetal will engage with stakeholders, in accordance with international good practice such as the IFC Stakeholder Engagement guide and EBRD PR 10 which covers stakeholder engagement.

Polymetal's HR management system will include policies and provisions to ensure the required quality standards for workers' accommodation and basic services, as per IFC PS 2. This includes ensuring that accommodation follows principles of non-discrimination and equal opportunity, and that accommodation arrangements will not restrict workers' freedom of movement or of association.

2.8 Company Policy and Framework

Polymetal has developed a draft framework Social and Environmental and Social Management and Monitoring Plan (fSEMMP). This provides basic information relating to a global overview of the Project, legislative framework, SEMMP objectives and relevant management plans, Environmental and Social Policy, current roles and responsibilities, training, stakeholder engagement, grievance mechanism(s) and proposed environmental monitoring.

Polymetal have a 'Policy of safety, labour and environment protection'. This document clearly defines commercial and social preferences that are related to the safe operational environment and also well-trained and abiding employees.

In addition, Polymetal have a 'Safety and Labour Protection Management System' (SLPMS) 2012. The aim of the SLPMS is to facilitate the protection of Polymetal employees against the impacts of dangerous and hazardous production factors, elimination of the accidents and professional diseases.

SLPMS is designed to:

- Act as the guidelines for provision of SLPMS policies in Polymetal (hereinafter referred to as the Company) as the component part of general policy and management system.
- Facilitate activation of all Company Employees and their representatives to use current principles and methods of labour protection management, oriented to continuous improvement of labour protection activity.

2.9 Project Compliance Targets and Assessment Criteria

The Project will potentially require funding from financial institutions which are signatories to the Equator Principles. Therefore, Polymetal made the decision to undertake environmental and social assessment and apply standards and guidelines for environmental and social performance as exemplified by the Principles, taking into account the January 2012 version of the IFC Performance Standards. This ESIA will be in line with IFC PS, with PS applied in accordance to the project size and requirements.

As the Project has committed to complying with the relevant international and/or national standards for environmental releases; to be achieved through appropriate design, combined with mitigation measures targeted at control and abatement of emissions, this section presents the specific regulatory

compliance criteria for the various potential environmental release categories that could result from Project implementation from Construction through Operations and into Closure.

The Project is required to be undertaken and managed in full recognition of all relevant national and international environmental standards. Those standards considered relevant to the Project are presented in the following sections and comprise the following:

- Natural background concentrations relevant to Kazakhstan – soil fertile layer.
- Kazakhstan National Maximum Allowable Concentrations (MAC) of Toxic and Potentially Toxic Chemical Elements, Compounds and Substances – for ambient air, soil and, drinking water.
- Commonwealth of Independent States (CIS) Environmental Standards – for ambient air, soil for residential soils and drinking water (in some cases standards for fisheries are used in the absence of Pollution drinking water standards).
- World Bank Pollution Prevention and Abatement Handbook Environment and Health and Safety Guidelines; these are the World Bank policies and guidelines, supplemented with information from IFC sources and the proposed revisions to the World Bank guidelines.

For each identified discharge or emission, appropriate standards will be identified, related to the ability of the receiving environment to absorb and disperse any contaminants.

Water Quality

Foul water from the mine camp will be treated to RoK standards and reused. The mine camp will generate waste water, sewerage and domestic waste. The mine plan identifies that a sewage wastewater treatment will be required at the camp. It is proposed to use a Bio-Acos-40 packaged biological treatment station with 40 m^3/day average capacity: this unit performs biological treatment of domestic and other similar wastewater up to established standards for disposal of wastewater into bodies of water used for commercial fishing activity. Discharge from this treatment facility will be directed to the tailings pond. The TMF will be a closed system, and no discharge will occur from this area.

Liquid waste streams (effluents and residual liquids) will not be released to the environment unless they conform to Kazakh regulatory requirements and internationally recognised concentrations.

Applicable compliance criteria for each of these expected discharge sources and for receiving waters are detailed in the following sections:

Water quality guideline values have been based on Kazakh MPCs and have been provided in detail in Chapter 4, Water Resources section.

Surface Water and Groundwater (Non-Drinking Water)

For chemicals detected in surface watercourses and groundwater resources that are not utilised for drinking water, then typically the most appropriate water quality guideline values are those listed in the Kazakh Guidelines for MPCs (as outlined in the Water Resources section, Chapter 4).

Air Quality

Atmospheric Air Protection

Air pollution is regulated by the Environmental Code. Permits for air pollution are issued within the integrated permitting regime. Limits for discharge of pollutants into the air are defined in the permits for environmental emissions, issued by the Ministry and Akimats.

Discharge of pollutants into the air without a permit is prohibited and may result in administrative penalties.

The basic principles of the government's policy on climate change matters are set out in the Environmental Code and underlying regulations such as the Rules of Trade of Quotas and Undertakings for the Reduction of Emissions to the Environment 2008 and the Rules of Limitation, Suspension or Reduction of GHG Emissions to Atmosphere 2008.

Law on Energy Saving and Increasing of Energy Efficiency (amended 17.11.2015) provides general principles of energy efficiency, including for construction of new buildings and reconstruction of existing buildings.

No special target has been fixed for the reduction of GHG emissions in general or for emissions from buildings.

Ambient Air Standards

International standards for the amount of contaminants of concern in air that people may breathe have been established by the World Health Organisation (WHO). Kazakhstan has also established standards for acceptable levels of each contaminant in the air (New Sanitary Norms and Rules of the Republic of Kazakhstan #168, 25 January, 2012). Table 2.3 below lists the international and Kazakh standards for acceptable levels of contaminants in the air, and the sampling durations for monitoring air to detect these contaminants.

Table 2.3: Ambient Air Quality Standards[1,2]		
Parameter	**WHO Guideline Value µg/m³**	**Kazakh limit[3] µg/m³**
Particulate Matter - PM_{10}	*Annual averages:* 70 (interim target 1) 50 (interim target 2) 30 (interim target 3) **20 (guideline)**	*1-hour average:* **300**
	24-hour averages: 150 (interim target 1) 100 (interim target 2) 75 (interim target 3) **50 (guideline)**	
Particulate Matter – $PM_{2.5}$	*Annual averages:* 35 (interim target 1) 25 (interim target 2) 15 (interim target 3) **10 (guideline)**	N/A
	24-hour averages: 75 (interim target 1) 50 (interim target 2) 37.5 (interim target 3) **25 (guideline)**	
Nitrogen dioxide (NO_2)	*Annual average* **40 (guideline)**	*24-hour average* **40**
	1-hour average **200 (guideline)**	
Sulfur dioxide (SO_2)	*24-hour averages:* 125 (interim target 1) 50 (interim target 2) **20 (guideline)**	*24-hour average* **125**
	1 hour average: **350 (guideline)**	

[1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.
[2] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.
[3] Based on new Kazakh Sanitary Norms and Rules #168, 25, January, 2012
[4] Based on Canadian Air Quality Standards, 2005

Soils and Land Use

The RoK has defined MACs for potentially harmful substances in soil values which are used for the assessment of concentrations of harmful substances in soil.

Table 2.4 identifies MACs, which are applicable to the assessment of soil chemistry. For comparative purposes, mean soil concentrations were also compared against the following industrial/commercial soil screening values, in addition to Kazakh soil MAC values:

- United Kingdom General Assessment Criteria (GAC) guidelines.

- United States Environmental Protection Agency (USEPA) Regional Screening Levels guidelines (risk-based concentrations that are considered by the USEPA to be protective for humans over a lifetime). However, the USEPA values are "regional" and reflect variance in soils/climatic conditions across US. To adjust for this variance, the Region 9 USEPA preliminary remediation goals (PRGs) have been harmonized with similar risk-based screening levels used by Regions 3 and 6 into a single table on the USEPA database and these USEPA Regional Screening Levels (RSLs) have been adopted.

During the Project construction phase, there will be a requirement to remove and store a reasonable volume of top soil. These soils will be re-handled and placed to achieve the designed closure specification during the reclamation of the mine site and associated infrastructure. Therefore, relevant Compliance Targets are required for soils, to ensure that contamination does not occur during operations and to establish a benchmark for soils to be used in reclamation; thus restoring a suitable soil profile to establish and maintain vegetation in the post closure phase. It should also be clarified that the UK GAC and USEPA RSL's identified in Table 2.4 relate to commercial/industrial land use given the lack of residential housing in the area and the nature of the development within the study area.

Table 2.4: RoK Soil MAC and International Values (mg/kg)

Parameter	Soil MAC	USEPA RSL's	UK GAC
Arsenic	2	1.6	640
Boron	25		
Chromium	100	1,500,000	8,840
Copper	23	41,000	71,700
Nickel	35	20,000	1,800
Lead	30	800	750
Zinc	100		
Benzo(a)pyrene	20		
Total PAH	1000		

As part of the baseline soil samples were submitted for leachate preparation to analyse for various metals and metalloids in soil water extract or leachate. Generally leachate preparation is considered to be more aggressive than natural processes in the unsaturated zone; the results give a broadly representative estimate of the leachability of substances in soil. Soil leachate samples were compared against Kazakh MAC (Maximum Allowable Concentration) for water quality and WHO Guideline Values for Drinking Water (Table 2.5).

Table 2.5: Soil Water Extract (Leachate) Concentration Summary (mg/l/100g)		
Parameter	**Water MAC[1]**	**WHO[2]**
Aluminum	-	0.2
Arsenic	0.05	0.1
Barium	-	0.7
Boron	0.5	2.4
Cadmium	0.001	0.003
Chromium	-	0.05
Cobalt	0.01	-
Copper	1	2
Cyanide	-	0.5
Iron	0.3	-
Lead	0.03	0.01
Ammonium	2	-
Antimony	-	0.02
Nickel	0.1	0.07
Nitrate	45	50
Vanadium	0.1	-
Zinc	5	-

[1]MAC source is SanR&S.

[2]WHO Guidelines for Drinking Water, Fourth Edition, 2011.

Noise, Air over Pressure and Vibration

Ambient Noise

Criteria given in the IFC Environmental, Health, and Safety (EHS) Guidelines (April 2007) states absolute noise level that should not exceed guideline limits identified in Table 2.6. In addition, the existing baseline (ambient) noise level should not be increased by more than 3dB at any off-site noise sensitive receptor (such as habited areas), as a consequence of site noise levels associated with the Project, see Table 2.6.

Table 2.6: Compliance Targets at Residential Properties within Communities		
Receptor Edge of community closest to mine	**A-weighted broadband sound pressure level, $L_{Aeq,1hr}$ (dB)**	
	Daytime (07:00-22:00)	**Night time (22:00-07:00)**
Absolute noise level (compliance criteria - not to be exceeded)	55	45
Predicted site noise level should not exceed the background (or ambient) by:	+3	+3

The daytime and night time absolute noise levels are suitable for residential, institutional and educational receptors and are broadly in line with internationally accepted standards (WHO Guidelines to Community Noise). Therefore, the absolute noise levels will be adopted as compliance criteria by the Project (see Table 2.6). The predicted site noise levels compared to existing ambient

conditions will be used to trigger investigation of noise levels where an exceedance of +3dBA occurs, in order to maintain compliance and take account of other external noise sources that may influence the ambient levels during the course of the Project.

Noise Workplace Exposure

Section 2.3 of the IFC EHS Guidelines (April 2007) provide guidelines for noise impacts on workers, given in Table 2.7 and these will be used by the Project as the relevant compliance criteria.

Table 2.7: Compliance Targets for Noise Working Environments

Location / Activity	Equivalent level LAeq,8h	Maximum LAmax, fast
Heavy industry (crushing plant, open pit and areas of the Project with mechanical operations, static and mobile)	85 dB(A)	110 dB(A)
Light industry (Areas within the Project with limited static plant and mobile equipment)	50-65 dB(A)	110 dB(A)
Details and zones to be based on detailed Work Place occupation noise assessment (see Health and Safety Management Plan)		

Blasting Air Overpressure and Vibration

As the site is remote from residential and other buildings Environmental and Community Criteria in relation to vibration has not been included.

Workplace Vibration

The Threshold limits as determined by ACGIH for hand arm vibration and the European Vibration Directive Exposure Limits (2002/44/EC) for whole body vibration in the workplace exposure are summarised in Table 2.8.

Table 2.8: Comparison of ACGIH Threshold Limit Values (TLVs) for Exposure of the Hand to Vibration in X, Y or Z Direction and Daily Exposure in EU Directive 2002/44/EC

Total Daily Exposure Duration (hours) (ACGIH)	Maximum value of frequency weighted acceleration (m/s^2) in and direction
4 to less than 8 hours	4
2 to less than 4 hours	6
1 to less than 2 hours	8
Less than 1 hour	12
Daily exposure (EC Directive - 2002/44/EC)	Maximum value of frequency weighted acceleration (m/s^2) in and direction
Daily Exposure Limit Value 8hr (DELV)	5
Daily Exposure Action Value (DEAV)	2.5

There is no direct comparison between the two sets of guidelines, as the ACGIH has values dependent on duration of exposure and is based on any single axis exceeding $4m/s^2$. The EU DELV identifies $5m/s^2$ as the vector sum of the three axes and is based on an 8hr exposure time. There is no major difference

in standard between the two; therefore the Project will use the EU Daily exposure limits as it is multi directional compliance criteria.

Whole body vibration identified as ACGIH limits are identified by Z and XY vector graphs; however ACGIH also refers to the EU Exposure Limit of 0.5m/s^2 action level. The EU Directive (2002/44/EC) uses limits on any of the three axes and the Project will use the EU exposure limits as compliance criteria (see Table 2.9).

Table 2.9: European Vibration Directive (2002/44/EC) Exposure Limits

Type	Daily Exposure Action Value (m/s^2)	Daily Exposure Limit (m/s^2)
Whole body vibration	0.5	1.15

Ionising Radiation

The Law of RoK 'About radiation safety of the population' (219-I, April 1998, amended Sep 2014) regulates civic society towards ensuring radiation safety of the population for the purpose of preserving human health from the harmful effects of ionising radiation.

Internationally accepted criteria have been used for dose comparisons undertaken during this ESIA study. These are the IFC Health and Safety Guidelines (2007) for Acceptable Effective Dose Limits for Workplace Radiological Hazards and the UK HPA NORM.

The criterion for annual effective worker dose-limit is 20mSv per year and for a trainee aged 16-18 years 6mSv per year. The exposure limit for members of the public from radiation-related activities is 1mSv per year (see Table 2.10). Within UK legislation a dose constraint for a member of the public of 300 µSv (0.3mSv) a year is applied for an exposure to ionising radiation from a single site/source (based on recommendations of the International Commission on Radiological Protection (ICRP)). All dose limits are for exposures in addition to natural background for the location.

The UK's Ionising Radiations Regulations 1999 (IRR99) reflects the current internationally accepted principles, dose limits and recommended practices in occupational radiation protection. The IRR99 enacts into UK law the relevant sections of the European directives (90/641/Euratom and 96/29/Euratom) relating to occupational radiation protection which are enforced across the EU. In turn the Euratom Directives incorporate the recommendations of the International Atomic Energy Agency (IAEA) detailed in the Basic Safety Standard (BSS) 1996 which was sponsored by the following organisations:

- Food and Agriculture Organisation of the United Nations;
- International Atomic Energy Agency;
- International Labour Organisation;

- Nuclear Energy Agency of the Organisation for Economic Co-operation and Development;
- Pan American Health Organisation; and
- World Health Organisation.

Recommendations relating to occupational radiation protection developed by the ICRP have been taken into account in the BSS.

Table 2.10 provides UK and IFC maximum exposure criteria for radiation. The Project will use the EU & IFC maximum effective exposure as compliance criteria.

Table 2.10: Radiation Exposure Limits for the Workplace (mSv y-1)

UK Regulations & IFC Guidelines max. effective exposure
20 (worker) 6 (trainee) 1 (member of the public)

Waste Management

International Best Practice / Lender Guidelines for Solid Waste Disposal

International best practice for solid waste disposal in accordance with International Finance Corporation's (IFC) Environmental, Health, and Safety (EHS) Guidelines and European Bank for Reconstruction and Development (EBRD) policies, and common solid waste management practices at mine sites.

The IFC EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The IFC EHS Guidelines which are applicable to hazardous materials management and waste management are found in sections 1.5 and 1.6 of IFC's General EHS Guidelines, respectively, with further guidance given within, IFC EHS Guidelines on Waste Management Facilities (Dec 2007) and Mining (Dec 2007).

IFC EHS Guidelines define GIIP for waste management as a sequential strategy of waste prevention, reduction, reuse, recovery, recycling. Non-hazardous wastes remaining after application of this strategy should be treated or disposed of at permitted facilities specially designed to receive the waste. Examples include compositing operations for organic, non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective waste type; or other methods known to be effective in the safe, final disposal of waste materials, such as bioremediation.

Similarly, EBRD social and environmental policy states that where waste cannot be recovered or reused, the client will treat, destroy, and dispose of it in an environmentally sound manner.

GIIP Solid Waste Management Practices

Waste management should be provided for waste from mining and processing operations as well as non-process waste. Other waste materials include industrial/construction waste, domestic/office waste, and hazardous waste. Waste materials should be classified based on their need for special handling, and specific handling and management strategies for wastes should be detailed in a project's Waste Management Plan and included in the Environmental and Social Action Plan (ESAP). The following presents a general summary of the waste management concepts for a project. Waste management should seek to:

- reduce waste generation at source;
- maximize re-use and recycling; and
- practice safe management of non-reusable and non-recyclable wastes.

These goals can be accomplished by:

- incorporating specific design criteria into the planning of the project and prior to commencement of construction activities;
- incorporating waste management requirements in equipment specifications;
- reusing/recycling excess and waste materials;
- storing and disposing of waste materials in an appropriate manner; and
- instituting management controls for these programs.

Identification of Waste Streams

A Waste Management Plan should cover waste streams that may be generated during the construction and operational phases of the mining operations. Example waste streams include:

- mine process wastes (mine tailings and process chemicals);
- hazardous wastes (waste oils, chemical containers, and medical wastes);
- industrial wastes (inert wastes such as plastic, glass, and construction materials); and
- domestic (organic) wastes (kitchen wastes, food and plant material, decomposable refuse).

Management of each waste stream is normally discussed in the project's Waste Management Plan.

The IFC EHS Guidelines for Mining require that, where there is need for disposal of non-hazardous waste (non-mining), it should not be disposed of together with waste rock "except in exceptional circumstances." GIIP and European standards also require that disposal of hazardous and non-hazardous waste, by landfill, be not conducted within the same engineered cell. Accordingly there will be provision made for a main Rock Dump to accommodate all rock generated by the mining activities,

with separate provision of engineered landfill cells, to accommodate the non-mining, non-hazardous and hazardous wastes, which require on site, landfill disposal.

3 PROJECT DESCRIPTION

3.1 Project Location and Overview

Located in East Kazakhstan Region (Oblast) of Kazakhstan, the Kyzyl Project is a gold deposit, 1,100km north of former capital Almaty, in the northwestern part of the Kalbinsky Range. The Project is located in Auezov municipality within Zharminsky District within the context of a historical mining area.

Mining began at the site in 1956, and has continued intermittently to the present day. A populated settlement, Auezov, exists on the mine boundary, and disused processing plant and mining infrastructure is already in place.

The preferred mine development option for the Project is a combined mining method that will be developed in two stages: Stage 1 – open pit mining; Stage 2 – underground mining. Stage one is scheduled from 2016 – 2026. Stage 2 is scheduled from 2026 to 2039.

Open pit mining will be carried out using conventional drill, blast, load, and haul methods. Underground mining will be carried out using the underhand cut and fill method, and will incorporate cement paste backfill. The backfill material will be sourced from the processing plant's tailings storage facility (TSF).

The design production rate for open pit mining is 1.8Mtpa of ore, with average feed gold grade of 6.90g/t. Underground mining will take place at 1.2Mtpa of ore, with an average feed grade of 8.5g/t Au. The processing plant will involve crushing, milling, and a complex flotation circuit that include a ball-mill regrind, carbon flotation, flash flotation, and more conventional sulphide flotation. The product from the processing plant will be a sulphide flotation concentration at a gold grade of about 99.2g/t. The concentrate will be dried and packed into 1.5t bags. The bags will be transported to Shalabay railway station via road, before loading on a freight railway car destined for further processing in Amursk.

Bakyrchik Ore Reserves as of January 1, 2015, in accordance with JORC Code (2012), are given in the table below (Table 3.1).

Table 3.1: Bakyrchik Ore Reserves as of January 1, 2015, as per JORC (2012)*

Ore Reserves	Tonnage, Kt	Au grade, g/t	Contained Au, koz
Probable			
OP	14 100	6.9	3 148
UG	15 050	8.5	4 106
Total Probable	29 150	7.7	7 254
* - Numbers may not add due to rounding.			

A by-product from the processing plant will be carbon concentrate that will have a gold grade similar to that of the feed grade (around 6.9g/t). Since this material cannot be further processed economically, it will be trucked to the carbon storage facility for future processing should gold prices or technology improve.

Waste product from the processing plant is tailings, which will be pumped into the TSF. Water will be recovered from the TSF for reuse in the process and mine.

The Kyzyl Gold Project general arrangement plan is shown in the Drawing 1.3.

3.2 Current Site Conditions

Due to historical mining activities there are several existing waste dumps and a number of existing open pits within the project area. A significant proportion of previously excavated waste material lies within the proposed footprint of the new open pit. Underground mining has also previously been undertaken at the site, with three shafts existing and previously used for either ventilation or access to underground workings. Historic activities also required development of a tailings storage facility, ore processing facilities (including a roaster), and an arsenic waste storage dump.

Auezov settlement is located south and adjacent to the existing mining infrastructure (ore processing facilities and administration buildings). A smaller hamlet, Solnyechni, is located about 1.5 kilometres south of Auezov, but is administratively part of Auezov. Presently Auezov receives potable water from the Kyzyltu borefield situated to the north of the project area. The water is pumped from Kyzyltu to a pump and filtration plant (PFP), where the water is purified for use in Auezov and mine buildings and infrastructure.

Auezov also has an operational sewage treatment facility located west of the settlement. Sewage travels to a sewage collection and pumping station via gravity flow, and is then pumped to the main treatment facilities for mechanical and biological treatment, prior to discharge to the Akbastaubulak stream.

The site layout, as it currently stands before mining activities, is show in Drawing 3.1.

3.3 Site Preparation, Construction, and Scheduling

The Kyzyl Project Schedule will be developed in two stages:

- Stage 1 – Open Pit method (2016 – 2024); and
- Stage 2 – Underground (developed under pit 2025 - 2039).

Each stage will have a construction and operational element to it. At the end of Stage 2, the mine will undergo decommissioning, reclamation, and closure.

The full project implementation schedule, to the level of detail required for the feasibility study is provided in Drawing 3.2. The level of detail in Drawing 3.2 is greater than that described in this ESIA project description. For the full technically detailed description of the project schedule, refer to the Kyzyl Project Bakyrchik Gold Deposit Feasibility Study, Volume 5.

Stage 1 Construction

Before Stage 1 mining production can begin, all buildings within the new pit blast zones and protection areas will be demolished. This includes old processing plant facilitates, but also includes the water tower that Auezov settlement uses for their water supply, and the coal-fired boiler house that produces the heating supply for Auezov's houses and residences. Polymetal will, as part of the Stage 1 construction activities, build a new water tower for Auezov to use, and construct a new boiler house (with ash and coal storage areas) for heating Auezov. The new boiler house will be located near the existing Auezov sewage treatment facilities.

The new processing plant will be constructed as part of Stage 1 construction activities, and will be located adjacent to and west of the existing tailings facility. The facilities to be constructed include a buffer ore stockpile, ore preparation facility (ore crushing and screening), process plant (including mills, flotation cells, and thickening tanks), and finished concentrate (the gold-containing final product) storage area. Supporting infrastructure at the ore processing facilities include a new boiler house for heating mine buildings, and a sewage treatment plant for treating mine generated household effluents.

Part of the Kyzyl Project design is to keep mining infrastructure and activities separate from public and community infrastructure and activities. This includes the heat supply network, water supply network, and access roads. Construction activities that start at the end of 2015, and continue until 2018 will include:

- The Bakyrchik – Bursak by-pass road
  - The new road will direct public traffic coming from the west (Shalabay) around Auezov, the new processing plant, haul road, and TSF, rejoining the main road east of the project.

- Auezov utilities, including:
  - Feeder power and lighting networks, and new transformer substation for Auezov's use
  - Replacement boiler house, with coal and ash storage
  - Replacement water tower
  - Heat supply networks
  - Drinking and household supply networks
  - Sewer networks
- Mine utilities, infrastructure, and plant, including:
  - Infrastructure at the Ore Processing Facility, namely;
    - Buffer ore stockpile;
    - Ore preparation facility
    - Process plant (milling and flotation);
    - tailings thickener
    - repair shops;
    - fuel and lubricants and materials and equipment;
    - boiler house with coal and ash storages;
    - sewage treatment plant
  - open pit water diversion/drainage system;
  - storage facilities for explosives, ammonium nitrate,
  - tailings storage, including water diversion/drainage system, waterproof lining of tailing storage bed;
  - waste dump site preparation;
  - open pit feeder power and lighting networks
  - sanitary and amenity building
  - drinking and household water supply structures, pumphouses, and networks;
  - heat supply networks;
  - sewer networks;
  - Household and drinking water supply pipeline from Kyzyltu borefield;
  - Heat supply networks
  - Power networks and new transformer station;
  - Mine access and support roads.

The items in the list above, under "Auezov utilities" represent those items of infrastructure that will only be used by the Auezov community. Although Polymetal will construct those items of infrastructure as part of the Kyzyl project, the Auezov Akim will have responsibility for managing those facilities. The items under "Mine utilities, infrastructure, and plant" will be under the control and responsibility of the mine.

Waste dump site preparation and tailings storage facility construction are two Stage 1 construction activities that will involve significant earthworks. The waste dump facilities footprint will be cleared of topsoil, and all topsoil will be stored in the topsoil stockpile to the east of the waste dump. The

base of the waste dump facility will be constructed of sandstone. Topsoil will also be stripped from the footprint of the tailings storage facility, and stored in the same location. The bottom of the TSF will be constructed with a protective soil layer (0.5m thick), overlain with an impermeable liner made of 1.0mm thick polyethylene film. Finally another soil layer (0.2m thick) is placed over the liner before the TSF will be put into use.

The TSF is designed with two containment dam walls, and an upstream dam. Containment Dam No.1 is the main dam wall that forms the tailings impoundment, downstream and to the south of the TSF. Containment Dam No.2 is an extension of the existing tailings dam wall, to the north-east of the new TSF. Its purpose is to keep the material in each TSF separate. Finally, Upstream Dam No.1 is constructed to redirect the unnamed stream around the TSF (redirected to the east of the TSF).

The waste dump footprint will also intersect the Akbastaubulak and Kyzyltu streams. The design approach to managing the intersection of these streams is to construct a waste dump protection dike for each stream. The dikes will cause two settling ponds to be formed along the dikes, north of the waste dump (settling pond No.1 and No.2). Water diversion trenches and drainage ditches will be constructed to manage water flows through and around the waste dump during the warmer seasons of the year. During winter, water diversions will not be necessary due to freezing temperatures.

Stage 2 Construction

Construction activities for the second stage of mining begins in the 10th year of the project (2024), and is scheduled to end in year 13 (2027).

As Stage 1 gets closer to completion, and the open pit nears its final extent and depth, Stage 2 construction activities will begin. Stage 2 construction activities are those that are necessary in order to support underground mining activities. The Western and Eastern Ventilation shafts will be repaired and refurbished to be used for underground heating and ventilation. The Capital Shaft, previously used for worker access to the old underground workings, will also be refurbished, but only used for underground ventilation. Each of the three ventilation shafts will have an associated ventilation fan and heat generating power unit. The heat generating power units are low duty, coal-fired modular units. In order to support underground mining activities, a backfill plant will be constructed in the old ore kiln charging building, and the mine water treatment station will be refurbished in order to treat mine water that is abstracted from underground.

Current underground mining infrastructure consists of five shafts. The Eastern and Western Ventilation Shafts, the Capital Shaft, Central Ventilation Shaft, and Skip Shaft. The shafts are distant from the proposed future underground mine workings, and so will not be re-equipped to hoist ore or waste. Presently the shafts are in need of reconstruction and repair work before they can be utilised. The Skip Shaft is partially flooded and not all of the necessary hoisting equipment is present. The Capital Shaft design is not considered suitable for the future proposed underground mining. The

Central Ventilation Shaft is currently filled with waste material. The Eastern and Western Ventilation Shafts are currently used as exhaust airways, but the Western Ventilation Shaft is partially flooded.

When Stage 2 mining commences, Western and Eastern Ventilation Shafts will be refurbished and used for underground ventilation. The Capital Shaft will be refitted for underground ventilation. The existing Skip Shaft and Central Shaft will not be used for underground mining, and personnel and rock hoisting will not take place via any of the existing shafts.
Construction activities during this phase will be solely for the use of the mine to facilitate underground mining activities. Mine utility construction for Stage 2 includes:

- Connecting networks to infrastructure constructed for Stage 1, namely;
  - Sanitary and amenity building;
  - Heat supply networks;
  - Household and drinking water storage tanks;
  - Sewage networks;
- Central area facilities, namely;
  - Underground mining facilities;
  - Lamp room;
  - Backfill plant;
  - Pithead facilities;
  - Feeder power and lighting networks
- Western area facilities, namely;
  - Underground mining facilities;
  - Pithead facilities;
  - Feeder power and lighting networks;
- Eastern area facilities, namely;
  - Underground mining facilities;
  - Pithead facilities;
  - Feeder power and lighting networks.

3.4 Mining Plan

Hydrogeological Context

The aquifer system consists mainly of the fractured bedrock aquifer, which is present across the entire area of the mine site. The bedrock aquifer has a significant thickness and water storage capacity, and represents a significant source of water. The Kysyltu wellfield north of the mine site exploits the bedrock aquifer to supply the mine with fresh water. Whilst the inflow from the aquifer to the open pit is low, pit dewatering will be required during mining. Dewatering is scheduled for both the open pit and underground stages of the project.

Stage 1: The open pit dewatering system during Stage 1 (open pit mining, 2016-2026) will be commissioned after the formation of a closed surface loop around the open pit. At this stage the groundwater is pumped out from the mine workings by the existing pump houses. Two pump houses, one to the west and one to the east, are located at the base of the corresponding pit, pumping inflow water via a pressure pipeline to the open pit water settling pond. The pump houses will be relocated to lower levels as the pit deepens. The anticipated annual volume of intercepted open pit water during Stage 1 is 413,000m^3.

Stage 2: During Stage 2 (underground mining) the open pit dewatering system will continue operating and will undergo upgrading to match an increase in open pit water inflow. Pumping upgrades will take into account the increased volumes of water from underground and open pit water ingress.

Open pit water will be pumped via a pressure pipeline to the same settling pond as for Stage 1. The open pit water treatment and drainage systems consist of the following facilities:

- Dam of open pit water settling pond;
- Pump house for the open pit water settling pond; and
- Pressure pipeline system.

The total estimated annual volume of open pit water intercepted during underground mining is 2,094,000m^3.

Open Pit Mining

Stage 1 of the mining operation commences with open pit mining. Open pit mining will proceed using conventional mining techniques. Drill-rigs will be used to drill blast holes in the waste rock and ore, and the explosives mix-truck will charge the blast holes. Following blasting, large rope shovels will load the overburden and waste rock on to 180t Belaz haul trucks, while ore will be loaded on to 90t Komatsu haul trucks. Overburden and waste rock will be stripped and hauled to the new waste dump, while some of the overburden material that conforms to construction specifications may be used to build the tailings storage facility, roads, and other auxiliary features. Ore material will be hauled, via newly constructed haul roads, to the new ore processing facilities. The design ore production rate is 1.8Mtpa. Open pit mining will take place 340 days per year, using two 12-hour shifts per day.

It is estimated that there is 14.1 million tonnes of probable ore in the open pit, at 6.9g/t Au.

The list of open pit mining equipment is given in Table 3.2 below.

Table 3.2: Major and Auxiliary Equipment	
Equipment	**Quantity, pieces**
Drill rig - Pit Viper 271 Atlas Copco	3
Drill rig - FlexiROC D65 Atlas Copco	3
Rope shovel - EKG-20	4
Hydraulic shovel - Komatsu PC-2000	2
Mix-pump truck - IVECO-AMT 693903	5
Dump truck - Komatsu HD 785-5	11
Dump truck - Belaz 7518	21
Bulldozer - Komatsu D 275A-5	7
Bulldozer - Komatsu D-375-A	5

Year by year development of the open pit and waste dump, from 2016 to 2026, is shown in Drawing 3.3.

The anticipated open pit mining rates, year by year, are summarised in Table 3.3.

Table 3.3: Open Pit Mining Schedule

Parameter	Unit	Total	second half of 2016	2017	first half of 2018	second half of 2018	2019	2020	2021	2022	2023	2024	2025	2026
Ore Reserves	thou m^3	5,401	-	77	38	192	690	651	690	688	689	728	689	268
	thou t	14,100	-	200	100	500	1,800	1,700	1,800	1,800	1,800	1,900	1,800	700
Au	g/t	6.9	-	5.8	5.9	5.9	6	7.1	7.6	7.7	6	6.5	7.7	8.1
	kg	97,902	-	1,162	591	2,953	10,839	12,125	13,712	13,775	10,863	12,317	13,904	5,660
Waste	thou m^3	160,088	6,855	20,527	11,956	12,190	23,101	22,238	21,932	17,037	14,366	6,399	2,651	836
	thou t	418,900	16,000	52,800	30,900	31,500	61,200	58,300	58,200	45,200	38,200	17,100	7,200	2,300
Total Rock	thou m^3	165,489	6,855	20,604	11,995	12,382	23,791	22,889	22,622	17,726	15,055	7,126	3,340	1,104
	thou t	433,000	16,000	53,000	31,000	32,000	63,000	60,000	60,000	47,000	40,000	19,000	9,000	3,000

3D view of Ore Reserves in the Bakyrchik open pit is given below as of 01.01.2015 (Figure 3.1).

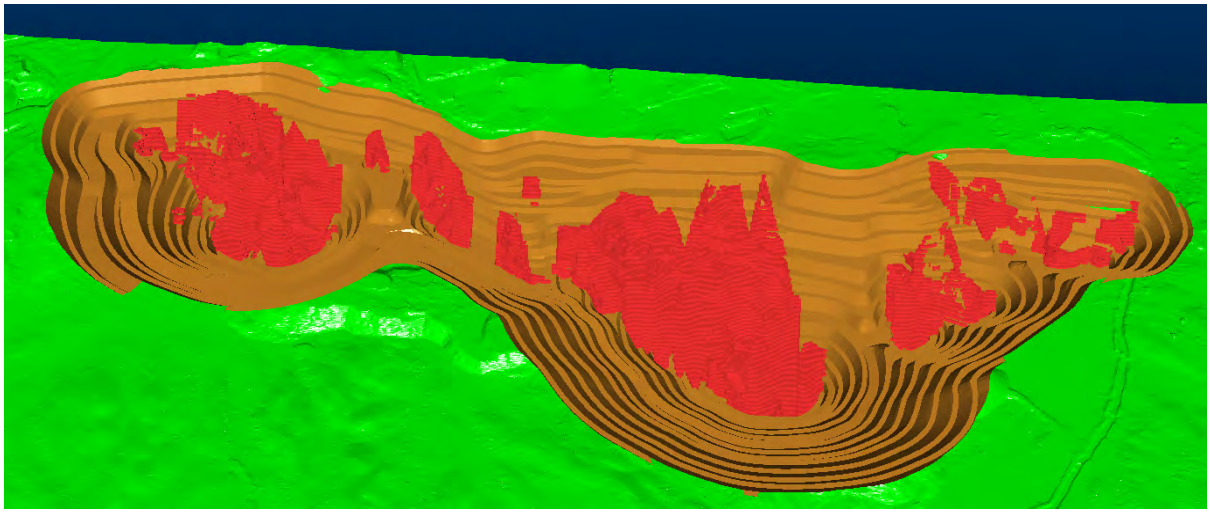


Figure 3.1: Bakyrchik Open Pit, Primary Access Scheme and Ore Reserves as of 01.01.2015

Waste Dump

The Belaz 180t haul trucks will deliver and dump the waste rock material on the dump, while Komatsu D-275A-5 dozers will be used for pushing overburden to the dump crest, cleaning and grading work sites, constructing guidance earth mounds, and snow shovelling (in winter). Up to 6 dozers will be in use at any one time, depending on the year of operation.

The waste dump will be constructed in two 50m high rises. The base layer will reach an elevation of 455m, while the second layer will peak at an elevation of 505m.

The design capacity for the waste dump is 163.42 million m^3 of waste rock, which is approximately 419 million tonnes of rock.

The final footprint of the waste dump will be approximately 374 hectares.

Formation of the overburden dump shall be commenced with construction of a starter wall raised at full dump length. The dump will be developed perpendicular to the completed starter wall to make the best use of natural terrain.

A special surveying team will be established to monitor the dump surface condition as the dumping front advances, in order to maintain safety. Water drainage and diversion ditches will be constructed along the dump perimeter to collect contaminated runoff from the waste dump area in settling sumps. The levelled waste dump surface will be sloped along the outside perimeter towards the open pit to prevent ponding of surface rain and melt waters.

The waste dump layout and cross-sections across the waste dump are shown below in Figure 3.2, Figure 3.3, Figure 3.4 and Figure 3.5 to illustrate the design.

Figure 3.2: Waste Dump Plan View with Estimated Section Lines

Figure 3.3: Waste Dump, Cross Section 1-1

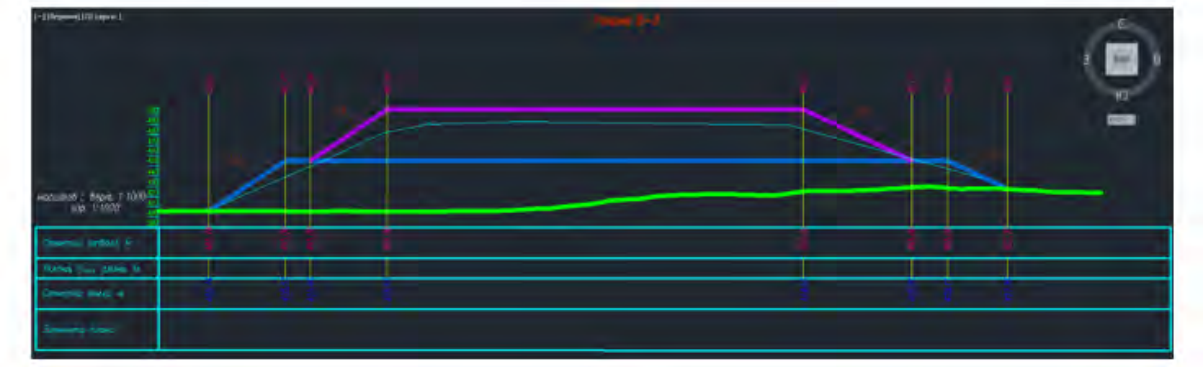


Figure 3.4: Waste Dump, Cross Section 2-2

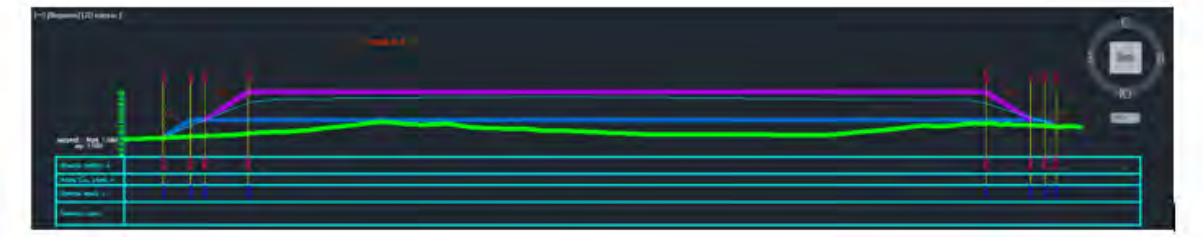


Figure 3.5: Waste Dump, Cross Section 3-3

Underground Mining

Underground mining design production rate is 1.2Mtpa. It is estimated that there is 15.05 million tonnes of probable ore underground, at a grade of 8.5g/t Au. The underhand cut and fill mining method will be used for underground mining at the Project. Underground mining will take place 365 days per year, with three 7-hour shifts per day.

Underhand cut and fill is a mining method where the ore deposit is mined from the top downwards. In this way mining during the earlier years of Stage 2 will be shallower, while mining at the end of Stage 2 will be at deeper elevations in the deposit.

For an illustration of the underground deposit development and ventilation network, refer to Drawing 3.4. Drawing 3.4 shows a 3D view of the open pit (coloured reddish-brown), and the extent of the western, central, and eastern deposits underground (coloured grey). The green lines show the routes (haulage declines) that underground haul vehicles will take to bring ore to the surface, at the bottom of the pit. It also shows the routes the ventilation network will take through the mine. Fresh air will be pumped into the mine via the routes shown in blue, while stale air will be pumped back out to surface along the routes shown in red. Historic underground mining infrastructure is also shown (grey lines).

Access to and from underground workings will be via adits in the bottom of the open pit. There will be four adits in total. Two in the central area, and two in the eastern area. One adit in the central area will be used for hauling ore to the surface, while the other will be used for personnel and other access.

Similarly for the eastern adits. The areas underground where ore is extracted are known as stopes. The stoping chamber is designed to be 5m high by 5 m wide. The length of the stopes run horizontally, and are extended using drilling and blasting. Ore breaking and blast hole drilling will be carried out using twin-boom jumbos equipped with telescopic slides. The blast holes will be charged using a special charging machine. After blasting, the broken ore will be collected from the ore drift using load-haul-dump trucks, delivering the broken ore to an underground storage area with capacity for at least 1000t of ore. Underground haulage trucks with 30t capacity will take the ore from the underground storage area to the surface, exit the pit via the adit, and place the ore in a ROM ore pad located in the pit bottom. The ore on the ROM pad will then be loaded on to 90t haul trucks, using a front-end loader, for delivery to the ore processing facility.

Figure 3.6 shows how stoping and backfilling underground will proceed.

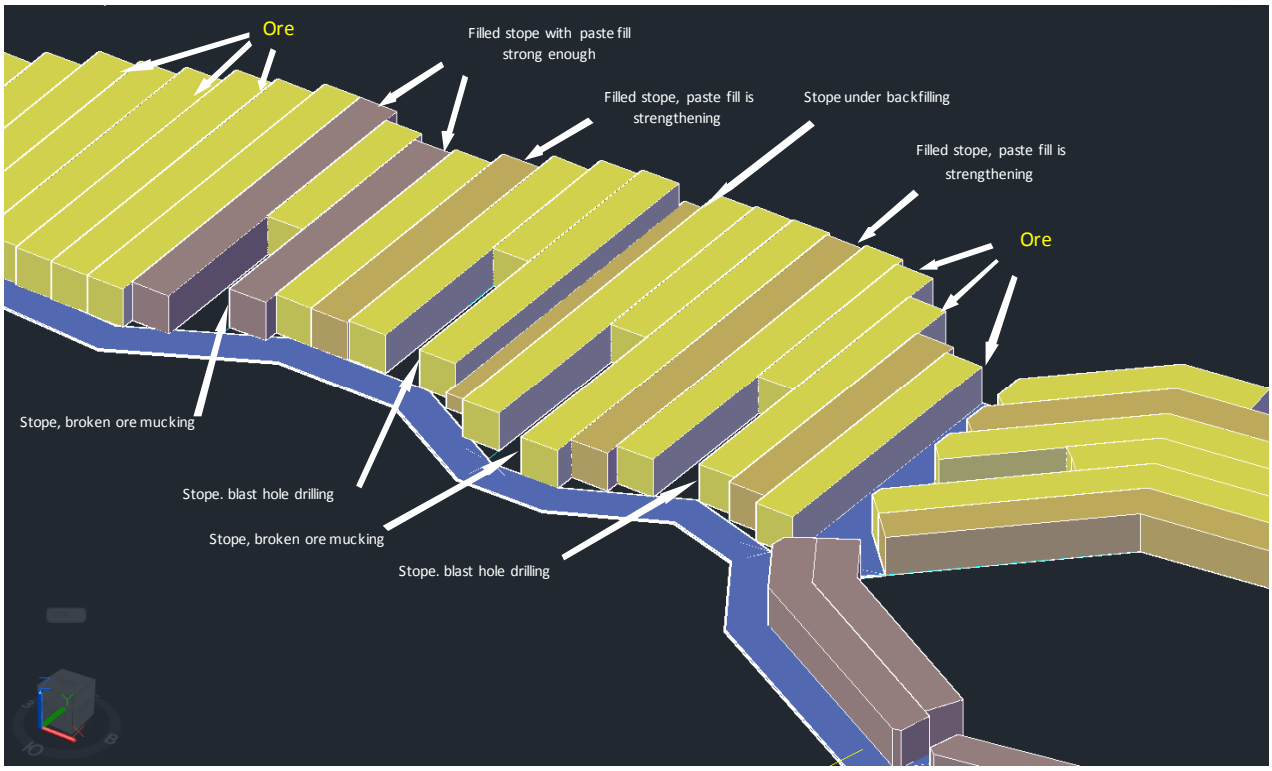


Figure 3.6: Isometric View of a Lift. Transverse Mining Sequence

When all the ore in a particular stope is mined out, the ore drift will be backfilled, with cemented tailings paste backfill. During Stage 2, tailings from TSF will be pumped to the backfill plant through pipelines. The backfill plant is designed to provide 508,000m^3 of backfill to underground workings per year. Backfill material will be prepared at the backfill plant by mixing in cement and achieving a composition of 60% process plant tailings (solids), 10% cement, and 30% water by mass. The paste backfill will then be pumped into the mined out stopes, via an underground backfill reticulation system. Once the filled stope has hardened, it is then possible to mine the neighbouring stope in the lift. A lift is a series of stopes adjacent to one another on the same level.

Mine Ventilation

The overall ventilation concept is based on a push-pull air system approach, whereby main surface intake and exhaust air fans located at the ventilation raises are sized and operated to draw fresh air into the mine. The various development headings in the mine (ore and waste) will be ventilated using forced ventilation supplied by auxiliary, axial mine fans. A series of new fresh and return air raises will be excavated for each lens to ensure proper delivery and removal of uncontaminated/contaminated air to/from the working faces at reasonable velocities.

The design air flow rate, based on the values required in the process of the planned mine operation, is 1 150m^3/s, including 540m^3/s for the Central area, 350m^3/s for the Western area and 260m^3/s for the Eastern area. This flow rate covers the maximum design demand of the areas.

Also refer to Drawing 3.4 for an illustration of the ventilation network.

Backfill Plant

A paste backfill plant will be constructed on surface in the existing fine ore building. The surge tank and cement silos are located outdoors close to that building.

In order to successfully extract the many parallel ore drifts, a cemented tailings paste backfill system has been selected for completion of backfilling activities. The high fill quality that is typically realized with these systems is viewed to be a critical element for the safe and efficient extraction of ore in the ground conditions likely to be encountered in the Bakyrchik deposit. Tight backfilling of all ore drifts will be a necessity to limit unravelling of the rock mass. Filling operations will need to be strictly controlled in order to realize productivity assumptions and permit safe extraction below previously mined-out areas.

The backfill plant operating specification are shown in Table 3.4.

Table 3.4: Main Backfill Plant Parameters

Parameters	units	Value	
		rated	range
Backfill plant productivity in terms of ready fill	m^3/hour	120	100-130
	t/hour	220	200-230
Final backfill density	t/m^3	1.85	1.8-1.9
Tailings flow rate for fill preparation	t/hour	133.2	120-140
	m^3/hour	181.1	160-185
Tailings water flow rate	m^3/hour	133.2	120-140
Binding material (cement) content	%	10	7-10
Cement consumption	t/hour	22.2	20-23
Backfill water content	%	30	25-35
Water consumption	m^3/hour	66.6	60-70
Water recycle to process plant	m^3/hour	66.6	60-70

3.5 Ore Processing

During both Stage 1 and Stage 2 of the Project will be fed directly into the primary crusher that forms part of the ore preparation facility (also referred to as Communition plant) or temporarily stored on the ore buffer stockpile. The ore processing facility is designed with a feed capacity of 1.8Mta, and will treat this amount of ore during Stage 1, and will treat 1.2Mtpa during Stage 2 of the Project. The average feed grade during open pit mining is 6.90g/t Au, and 8.5g/t Au during underground mining. Gold recovery into the sulphide concentrate will be about 93.44% yielding a concentrate product at 99.2g/t Au grade. The saleable product is a gold-bearing sulphide concentrate.

The main parts of the ore processing facility are:

- buffer ore stockpile;
- ore preparation facility (crusher, conveyor, and crushed ore stockpile); and
- processing plant (mills and flotation circuit, concentrate and tailings thickeners)

The Bakyrchik ores can be classified as low-grade and low-sulphide by their composition and as disseminated by their textural features. The main detrimental ore components are organic carbon and arsenic. The content of organic carbon, which causes major problems during hydrometallurgical processing, ranges from 1.2% to 1.6% on average (at a total carbon content of 2.0–3.5%). The arsenic content varies from 0.3% to 1.5%.

The Bakyrchik ores are referred to as "double refractory" metallurgical raw material, characterized by ultrafine gold dissemination in sulphide minerals in the presence of a significant amount of carbonaceous inclusions with extremely high preg-robbing capacity.

Buffer Ore Stockpile and Ore Preparation Facility

The Buffer ore stockpile is adjacent to the process plant and located on a common site with the primary crushing plant feed bin within the ore preparation facility, 700m southeast of the open pit. The maximum stockpile capacity is 115,000m³.

The construction of the stockpile will include a 0.5m waterproof liner and 1.75m aggregate layer.

ROM ore, fed to the primary crusher either via the buffer stockpile, or directly from haul vehicles, will be crushed by the primary crusher to a target size of 100% -250mm. The crushed ore will be conveyed to a crushed ore stockpile with a reclaim tunnel. Crushed ore will then be fed into the SAG mill in the main processing plant building.

The main items of equipment at the ore preparation plant are shown in Table 3.5.

Table 3.5: List of Main Ore Preparation Equipment			
Equipment	**Quantity, units**	**Power, kW**	**Unit weight, kg**
ST1673 (FSx 1666) Grizzly Screen Feeder with a frequency inverter (Sandvik)	1	4x10.8	6 580
C150 Jaw Crusher (Metso Minerals)	1	200	51 200
RB 700 Boom with MB 1000 Hydraulic Breaker and hydraulic power pack (Atlas Copco)	1	55	11 000
Electric top-running bridge crane Duty class:A3; loading capacity :20 t; span:10.5 m; lifting height: 12 m.	1	24	16 700
Belt Conveyor #1 Belt width:1 200 mm; horizontal length: 92 m; lifting height: 17.8 m; drive power : 90 kW; belt speed: 1.25 m/sec. Smooth start. Rubber-fabric cold-resistant belt.	1	90	54 300
1-15-90B Apron Feeder with a variable frequency four-speed electric motor	1	75	-
Belt Conveyor #2 Belt width:1 200 mm; horizontal length: 82.5 m; lifting height: 9.5 m; drive power: 37 kW; belt speed: 1.25 m/sec. Frequency inverter. Rubber-fabric cold-resistant belt.	1	37	-
VHRS 8 Conveyor Scales for a belt type B=1 200 mm (Hasler, Germany)	1	0.5 A	45
MK-1-11 Metal Detector for a belt type B=1 200 mm (Vitebsk Prototype Manufacturing Plant)	1	30 VA	119

Processing Plant

The SAG mill will operate within a wet circuit. Process water will be fed to the SAG mill and the ground material leaving the mill will be collected in a sump and then screened. Oversize material will be returned to the SAG mill for more grinding, while material that meets the size specification will be pumped to the Carbon Flotation circuit. In flotation, the floats are the materials that float to the top of the cells while the sinks are the heavier materials that sink to the bottom of the flotation cells. There will be several flotation stages in the processing plant according to the design. Flotation stages include Carbon Flotation, Flash Flotation, and Sulphide Flotation. Sulphide Flotation will be carried out using conventional flotation methods, but the Carbon Flotation and Flash Flotation stages use specialised flotation equipment. Various different flotation reagents are added to each flotation stage in order to encourage the selected material to either float or sink, allowing for several separation stages. The list of reagents and consumptions rates used in flotation is shown in Table 3.6.

Table 3.6: Flotation Reagent Conditions						
Reagent	**Operation**	**Consumption**				
		g/t	**kg/h**	**L/h**	**kg/day**	**t/year**
OP F-597	Carbon flotation	110.0	27.9	29.7	669.7	198.0
	Rougher flotation	40.0	10.15	10.8	243.5	72.0
	Total	**150.0**	**38.05**	**40.5**	**913.2**	**270.0**
Soda ash, Na_2CO_3	Flash flotation	900.0	228.3	3261.6	5479.5	1620.0
	Primary cleaner flotation	150.0	38.1	543.6	913.2	270.0
	Total	**1050.0**	**266.4**	**3805.2**	**6392.7**	**1890.0**
Copper sulphate, $CuSO_4$	Flash flotation	200.0	50.74	507.36	1217.7	360.0
	Rougher flotation	200.0	50.74	507.36	1217.7	360.0
	Total	**400.0**	**101.5**	**1014.71**	**2435.4**	**720.0**
AERO 633	Flash flotation	100.0	25.4	1268.4	608.8	180.0
	Rougher flotation	100.0	25.4	1268.4	608.8	180.0
	Primary cleaner flotation	100.0	25.4	1268.4	608.8	180.0
	Total	**300.0**	**76.2**	**3805.2**	**1826.5**	**540.0**
PBX	Flash flotation	50.0	12.7	422.8	304.4	90.0
	Rougher flotation	40.0	10.2	338.5	243.5	72.0
	Scavenger flotation	45.0	11.4	380.5	274.0	81.0
	Total	**135.0**	**34.3**	**1141.8**	**821.9**	**243.0**
AERO 8045	Flash flotation	50.0	12.7	11.4	304.4	90.0
	Rougher flotation	40.0	10.2	9.2	243.5	72.0
	Scavenger flotation	45.0	11.4	10.3	274.0	81.0
	Total	**135.0**	**34.3**	**30.9**	**821.9**	**243.0**

In the Carbon Flotation stage, the floats are directed to the carbon concentrate thickener, and the sinks are directed to a mixing tank and then fed to the flash flotation circuit. The floats from the flash flotation circuit will join the sulphide concentrate and be fed to the concentrate thickener. The sinks from flash flotation are fed to the sump of the regrind circuit. From the sump the material is pumped to a bank of cyclones. Small, light particles spin upward, leave via the top of the cyclones and are pumped to the Sulphide Flotation circuit. Larger, heavier particles leave the bottom of the cyclones and are fed into a ball mill that that grinds the particles to a smaller size before discharging into the sump.

The Sulphide Flotation Circuit, after passing pulp through rougher, scavenger, and three cleaner banks of flotation cells, produces a sulphide concentrate with increased gold concentration, which is pumped to the concentrate thickener. The waste material, that now contains practically no gold, will be pumped to the tailings thickener.

The main milling and flotation equipment list is presented in Table 3.7 below.

Table 3.7: List of Main Milling and Flotation Equipment	
Equipment	**Quantity**
Primary grinding stage - SAG grinding	
8 000×4 000 SAG Mill	1
Banana Screen	1
Primary flotation stage	
SkimAir-1200 Flotation Cell– flash carbon flotation	5
SkimAir-500 Flotation Cell – flash intermediate flotation	3
Secondary grinding stage	
5 500×8 000 Central Discharge Ball Mill	1
CAVEX500CVX10 Cyclone	3 operating; 2 stand-by
Sulphide flotation	
TankCell -50 Flotation cell – rougher flotation	4
TankCell -50 Flotation Cell –scavenger flotation	8
TankCell -40 Flotation Cell – primary cleaner flotation	6
TankCell -40 Flotation Cell – secondary cleaner flotation	4
TankCell -40 Flotation Cell – tertiary cleaner flotation	3

Dewatering and Thickening

The tailings thickener is a circular tank of 32m diameter that will collect the tailings material, allowing solids to sink to the bottom and clarified water to leave via launders at the top. The water will be reused in the process (pumped to the reclaim water tank) while the thickened tailings at the bottom of the thickener will be pumped to the tailings storage facility.

The carbon concentrate thickener will be 8m in diameter, and works on the same principle as for the tailings thickener. In the case of carbon concentrate, the thickened underflow from the thickener will pass through a press filter to recover additional water, prior to discharging the carbon concentrate on to conveyors. The conveyors will load the carbon concentrate on to vehicles that will transport it to the carbon concentrate storage area. The carbon concentrate is a waste product, but has gold grades at the same concentration as the ore fed to the processing plant. Unfortunately, additional processing is too expensive at present to recover the contained gold economically. For this reason the carbon is stored in the carbon concentrate storage facility. Recovered water will be returned to the process water tank.

The concentrate thickener will be 11m in diameter. Water is reclaimed from the overflow launders, while the thickened concentrate is first filtered, and then dried in a drying kiln.

The flotation tailings and concentrate thickening and dewatering equipment is listed in Table 3.8.

Table 3.8: Flotation Tailings and Concentrate Thickening Equipment	
Item	**Quantity**
Tailings thickening equipment	
32 m dia. High Rate Supaflo thickener	1
Carbon product thickening equipment	
8 m dia. High Rate Supaflo thickener	1
Larox FP 1200 Filter Press	1 operating; 1 stand-by
Sulphide (combined / high carbon) concentrate thickening equipment	
11 m dia. High Rate Supaflo thickener	1
Larox FP 1200 Filter Press	2 operating; 1 stand-by
BN 2.2-12 drier	2 operating; 1 stand-by
Low-carbon concentrate thickening equipment	
Larox Filter Press	1
Drier	1

The dried concentrate leaves the drier, and will be kept in an intermediate bin, before it will be loaded into large, flexible, 1.5t capacity bags. The bags containing the concentrate will be transferred to the concentrate storage area using overhead cranes.

Periodically, as the concentrate storage area fills with bags, the bags will be transported via road to Shalabay railway station. There they will be loaded onto rail cars and transported to Far Eastern Russia for further concentrate processing at a facility in Amursk.

3.6 Tailings Storage Facility

The TSF will be designed with a number of water discharge and reclaim pipelines. Tailings will be discharged into the tailings facility from the tailings thickener underflow. Two mobile water reclaim pumps will float on the TSF and pump water back from the dam to the process water tanks at the ore processing facility. During Stage 2 of the Project, a tailings pulp pipeline will abstract pulp from the southern edge of the TSF (at Containment Dam No.1) and pump it to the Backfill plant. Another pulp abstraction point is at Containment Dam No.2, at the boundary between the old and new TSF.

See Drawing 1.3 showing location of dam walls.

Containment Dam No 1

Containment dam No 1 will be a key structure, which will form the tailings impoundment. It is designed to have a 1.5 mm thick polyethylene film liner. The dam will be constructed in four stages. The starter dam will be 20 m high. The second, third, and fourth-stage expansions will be 5 meter high each and will be filled from the side of downstream slope of the dam. The design of the containment dam is predetermined by the availability of local construction materials, as well as by environmental and economic circumstances.

The starter dam is constructed mainly of local debris and rubble soil from tailings pond beds and pit overburden. Lack of local soil for dam embankment and protective layers is compensated for by imported pit soil.

The maximum total height of the tailings dam after all expansions will be 35m.

Tailings Impoundment Liner

The tailings impoundment will be protected with an impermeable liner of one millimetre thick polyethylene film, placed onto the base course, free of large inclusions. Sections of polyethylene film will be joined by welding, with quality control checks on welding workmanship.

A protective soil layer without large inclusions will be filled on the top. This design ensures that the liner will be waterproof. The liner of the tailings impoundment will be constructed in four stages, like containment dam No 1, and to the same elevations. As soon as the second, third and fourth-stage expansions of the TSF are constructed, the polyethylene film of the tailings facility liner and polyethylene film of containment dam No 1 will be tightly joined on a step-by-step basis. These measures ensure that the adjacent area is protected from water seepage from the tailings impoundment.

Containment Dam No 2

Containment dam No 2 will be constructed as an expansion of the existing tailings dam. The expansion will be carried out from the side of the downstream slope of the dam (from the side of the design TSF). The slope ratio will be 1:3. After expansion, the height of containment dam No 2 will reach 12m. Containment dam No 2 will be equipped with a 1.5mm thick polyethylene film impermeable liner. The impermeable liner of containment dam No 2 will be joined to the liner on the bottom of the tailings facility.

Upstream Dam No 1

Upstream dam No 1 will be constructed as an expansion and slope reduction of the existing check dam in the unnamed creek, which flows north-south within the area of the TSF. After the dam wall expansion, Upstream Dam No 1 will reach a height of 5m. Upstream dam No 1 will be equipped with a 1.5mm thick polyethylene film liner. In the same way as the liners in the other dam walls will be connect to the liner on the facility floor, the liner of upstream dam No 1 will be tightly joined to the layer of the tailings impoundment.

3.7 Carbon Concentrate Storage Facility

The carbon concentrate storage facility will be lined with an impermeable liner, designed to collect and remove surface run-off. The base is designed as follows: a base soil course free of large inclusions

(consisting of particles with a 20mm top size) will be filled onto the graded compacted rock bedding. A 1.5mm thick polyethylene membrane will be placed onto the base course, which will be free of large inclusions. Sections of polyethylene liner will be joined by welding, with checks carried out to ensure weld quality. The base will be covered with a protective soil layer without large inclusions and filled to the top. This design ensures that the impermeable liner will be waterproof. The carbon product is placed on top.

The carbon concentrate storage design will be a 15m high single-tier stack, formed on the prepared waterproof liner. Trucks from the processing plant will dump the carbon product on the heap, with bulldozers used to level the surface.

The settling pond, which will be established in an existing excavation, is designed for rough clarification of the run-off from the carbon product storage. Maximum water levels in the settling pond will be 2m lower than the minimum elevation of the carbon storage facility liner, which will enable the carbon product run-off to move by gravity into the settling pond. The settling pond will be divided by the filtering dam, which will capture the fine particles that have not been settled in the pond.

3.8 Water Supply

Site Wide Water Balance

The site wide water balance for Stage 1 and Stage 2 of the project is shown in Drawing 3.5 and Drawing 3.6, and should be referred to while reading Section 3.8 and 3.9 on water supply and management.

Existing Water Supply Conditions

Supply

Household/potable water is supplied to current mine infrastructure and Auezov settlement from the surface water intake at the Kyzylsu river water reservoir and from the underground water well intake, located in the Kyzyltu river valley. Water from both intakes is delivered to the pump and filtration plant (PFP) that has a 5,000m^3/day capacity. Here the water is treated and decontaminated according to national potable water standards, and then supplied to the mine site areas and residential areas in Auezov. The existing water supply facilities contain two clean water reservoirs of 1,000m^3 each, a water tower with 300m^3 reservoir, and a distributing pipeline network of 50-200mm diameter.

The existing 300m^3 water tower is a stand-alone building, designed to facilitate headwater control and water storage of household and potable water to the mine site and Auezov village. It is located within the sanitary protection/buffer zone and the hazardous blast zone of the design open pit.

Effluents

The mine site and settlement household effluents are currently transported by gravity flow sewers to a sewage pumping station and then pumped to biological treatment facilities at a volume of 3,500m^3/day.

The household effluents treatment plant is located close to the western outskirts of Auezov village and is used for mechanical and biological treatment, as well as anti-bacterial decontamination of the mine site and settlement household effluents. After treatment, the effluents are discharged into the Akbastaubulak stream. When the project commences it is proposed that the Auezov Akim take financial responsibility for the sewage treatment facilities, as the mine will construct sewage treatment facilities for the mine facilities.

New Water Supply

Supply

Polymetal are constructing a new pipeline from the Kyzylsu reservoir, located approximately 7km south of Auezov. Once Stage 1 commences, this pipeline will be the main source of water supply to Auezov settlement. This pipeline will supply water to the PFP. The existing PFP will be linked up with the newly constructed water tower. Auezov will still have the possibility to abstract water from the Kyzyltu borefield if necessary, but this would only happen under exceptional circumstances where water supply from Kyzylsu is cut off.

Water for processing needs will be sourced as a combination of water from pit dewatering and water reclaimed from the new tailings storage facility. There is some groundwater inflow into the current mine workings originating from the fractured aquifer system. The water inflow rate is low, but dewatering will be undertaken in order to allow open pit mining to take place. Water flowing into the open pit will be pumped to the open pit water settling pond – one of the disused pits located east of the new proposed open pit workings. The shape of the disused pit is long and narrow, and a dam wall will be constructed to prevent water draining from the pond back into the mine workings. Water will be pumped from the water settling pond to the process water tank at the ore processing facilities. The other main source for process water will be reclaim water from the new tailings storage facility which will be constructed as part of Stage 1 construction activities. Water will be pumped out of the tailings facility and returned to the process water tank at the ore processing facility.

Evaporative water losses are expected from the water supply storage areas. When necessary, water from the Kyzyltu borefield will be used to make up for water losses in the process water system, or in an emergency for fire-fighting. The primary use for water abstracted from the Kyzyltu borefield will be as the source of potable and household water for mine facilities. To distribute this water around mine facilities, a new pump house will be built west of the new ore processing facilities.

Effluent

These values relate to effluents generated specifically from household and domestic waste. The new treatment plant for mine facilities will be built between the ore processing facilities block and the old tailings facility to accommodate effluents from other mine areas. The new treatment plant is designed to treat a volume of 51.13m^3/day at the open pit mining period and 66.09 m^3/day during the underground mining period.

Water Consumption

The water source for the process and fire water supply system is provided by the open pit and mine drainage water, delivered to the water tanks from the open pit settling sump. The Kyzyltu groundwater intake is regarded as a backup process and fire water supply source.

Process water consumption is given in Table 3.9. Household and potable water consumption for the mining amenities is given in Table 3.10

Table 3.9: Process Water Consumption					
Area	1st stage (OP)		2nd stage (UG)		Comments
	m^3/day m^3/hour	,000 m^3/year	m^3/day m^3/hour	,000 m^3/year	
1. Process plant	794.4 33.1	236.52	794.4 33.1	157.68	operation with concentrate selection
	156.0 6.5	46.10	156.0 6.5	30.75	operation without concentrate selection
2. Make up of vehicle wash recycle water system	7.0 1.0	2.56	7.0 1.0	2.56	-
3. Underground mine, including:	-	-	1718.4 71.6	627.216	-
- Western area	-	-	441.6 18.4	161.184	-
- Central area	-	-	991.2 41.3	361.788	-
- Eastern area	-	-	285.6 11.9	104.244	-
4. Service road sprinkling	85.0 -	12.05	77.0 -	11.60	From open pit settling sump
Total at the process plant operation with concentrate selection:	886.4m^3/day	251.13	2 596.8m^3/day	799.056	-
Total at the process plant operation without concentrate selection:	248m^3/day	60.71	1 958.8m^3/day	672.126	

Table 3.10: Household and Potable Water Consumption					
Area	1st stage (OP)		2nd stage (UG)		Comments
	m^3/day	'000 m^3/year	m^3/day	'000 m^3/year	
1. Mine site	30.25	9.94	80.30	26.38	-
2. Process plant	7.94	2.61	7.78	2.56	-
3. Laboratory	4.90	1.61	4.90	1.61	-
4. Canteen	12.00	3.94	20.00	6.57	-
5. Repair shops	6.63	2.18	8.39	2.76	-
6. Boiler house, including:	44.82	13.98	85.57	27.37	-
- hot water supply	39.82	13.08	80.57	26.47	-
- heat supply pipeline make up	5.00	0.90	5.00	0.90	Non-recoverable losses
Total:	106.54	34.26	206.94	67.25	-

3.9 Water Management

The major surface infrastructure development at Bakyrchik Mine, such as the TSF and waste dump, will have an effect on the landscape and a number of water courses that run through the project area. The open pit and underground mine workings will affect groundwater, and require mine dewatering.

Due to this, extensive water management engineering and activities will be required for the project.

Refer to Drawing 3.7 for an illustration of water management infrastructure, water diversions and trenches, and pipelines.

Open Pit Water

During open pit mining, rain, snowmelt and groundwater ("open pit water") will flow into the mined out area of the open pit. The open pit water will be pumped via a pressure pipeline to the pit water-settling pond. The settling pond will be located within the existing abandoned open pit.

A floating pumphouse will be installed on the pit water settling pond. This pump will pump the open pit water to the process water tanks and firewater supply, and during Stage 2 will also pump the water to the process and firefighting supply for the Western, Central, and Eastern areas of the mine. The excess water after settling will be discharged to the Akbastaubulak creek.

Anticipated water flow rates, by pit area and mining stage (open pit or underground) are show in Table 3.11. Water pumping will operate 365 days per year, for 3, 8 hour shifts per day.

Table 3.11: Water Pumping Rates for Pit Dewatering

	Heavy Rain	Snowmelt	Summer	Winter	
Eastern pit area: Open pit mining	1608	1152	504	not specificed	m^3/day
Western pit area: Open pit mining	4032	2904	1248	not specificed	m^3/day
Eastern pit area: Underground mining	4104	2832	1584	1080	m^3/day
Western pit area: Underground mining	11736	7776	4680	3432	m^3/day

Waste Dump Water

The Akbastaubulak creek and its tributary, the Kyzyltu creek, flow south through the footprint of the proposed waste rock dump. In order to protect the stability of the waste rock dump, a protection dike for each creek will be constructed. Protection dike No. 1 (containment dam No 1) will block the Kyzyltu creek valley and protection dike No. 2 will block the Akbastaubulak creek valley, preventing the waste dump from flooding.

Settling ponds No.1 and No.2 will be formed where the Kyzyltu and Akbastuabulak creeks are blocked. The water that collects in the settling ponds will be piped away to the west to the Kjholodny Klyuch creek via a stream diversion channel. The channel will be designed to handle an estimated flow of $Q_{P=3\ \%} = 2.96 m^3/s$.

Although the Kyzyltu and Akbastuabulak creeks will be diverted around the waste dump, rainfall and snowmelt water will still fall within the footprint of the dump. This water will percolate through the waste rock and collect at the bottom, and then leave from the southern part of the dump via ditch No.1. Water flowing through drainage ditch No.1 eventually reaches settling sump No.1, located south of the western ventilation shaft, and north of Auezov. The purpose of the settling sump is to

allow time for suspended solids and debris to settle out of the water so that cleaner water will be discharged. Water will then discharge into the unnamed brook that runs near that location.

The other route that waste dump water will leave the dump is via the eastern side of the dump. This water will be captured in drainage ditch No.2, which will be directed north around the eastern side of the waste dump to settling sump no.2. From settling sump No.2, water will discharge into Settling Pond No.1.

The water flowrate from the waste dump are tabulated in Table 3.12.

Table 3.12: Water Flow Rates from Waste Dump to Settling Ponds

Flow route	Maximum (m^3/day)	Normal (m^3/day)
Waste dump to Ditch No.1	2430	343
Waste dump to Ditch No.2	4050	570
Kyzyltu to Settling pond No.1		260
Akbastaubulak to Settling pond No.2		610

Open Pit and Waste Dump Water Treatment

The settlement sumps are designed to capture suspended solids and oil products, and remove them from the water flow prior to discharge to brooks and creeks. The settlement sumps will be constructed with filtration dikes to help settle solids and capture oil products. Most of the oil products will adhere to the settled solids, but a portion of the oil products will float to the surface. Oil products that float on the water surface will be trapped by oil sorbent booms fitted on top of the sumps.

Tailing Storage Facility Drainage Facilities

Dam wall construction and placement is discussed in Section 3.6 (Tailings Storage Facility). As previously discussed, an unnamed creek runs through the footprint of the TSF. A stream diversion channel will be constructed to redirect the creek around the eastern side of the TSF footprint.

A cut-off drain will be constructed along the northern edge of the TSF, running south from the carbon storage facility. It will be constructed with a polyethylene liner and will prevent rain water run-off from entering the TSF. Instead run-off water will be directed around the TSF towards the diversion trench to the east. Upstream Dam No.2 will be constructed along the route of the cut-off drain to block another tributary of the unnamed creek, allowing water flowing along the cut-off drain from the west to reach the diversion ditch and existing impoundment at Upstream Dam No.1.

The diversion ditch will then direct water flow south, discharging it into the Alaayzyr creek.

Process Plant Run-Off Water Management

Surface water runoff will be dealt with under a separate system to process water. There will be three distinct areas as shown in the Table 3.13. Within this system, surface water runoff from the process plant and heat and power generation areas will be collected and sent to a settling pond. This water will be used for dust suppression on haul roads. Runoff from the other two areas will be sent to the TSF after treatment.

Two further treatment plants are included in the feasibility design for the project; namely, a treatment plant for vehicle washing and recycling waters and a second mine water treatment plant unit for use during the period of underground mining, which doubles plant capacity.

Table 3.13: Water Volumes to be Managed in Process Areas

Mine site area	Area (ha)	Snowmelt		Rainfall water	
		m^3/day	'000 m^3/year	m^3/day	'000 m^3/year
Processing plant and heat and power generation unit area	9.0	500	4.6	680	4.2
Reagent storage and repair and storage area	8.5	450	4.3	680	3.9
Fuel and lubricant storage area	1.4	90	0.7	56	1.3

3.10 Utilities and Supporting Infrastructure

Electricity Supply

Power will be supplied from the national power grid via a new 220kV transmission line, supported by steel pylons with overhead cables, delivering power to a newly designed 110/35/6kV main transformer substation with 2 x 25,000kVA transformers via a 6kV package outdoor switchgear, located close to the process plant.

See Drawing 3.8 for an illustration of the electrical supply network.

Average annual power consumption expected during open pit mining (years 2016 – 2024) is approximately 109.7GW.hrs.

The average annual power consumption during underground mining (2025 – 2039) will be approximately 76.9GW.hrs due to a reduction in the utilisation of the installed electrical capacity.

For a detailed breakdown of the electrical consumption sources during the full life of mine, refer to the Feasibility Study Volume 5. Infrastructure and Power Supply System.

Heat Supply System and Ventilation

Surface Heating and Ventilation

During Stage 1, the existing boiler house in Auezov settlement will be dismantled due to its location within the blast zone, and a new boiler-house with a 7.5MW capacity will be constructed. Heat networks from the new Auezov boiler house will join the existing network at a tie-in point, and the pipelines will run above ground on low stand-alone supports. A two-pipe system is used for the heat supply networks.

The heat supply source for the mine infrastructure heating and building ventilation will come from the new coal-fired boiler house constructed at the ore processing facility. This boiler will have a 13.1MW capacity. Table 3.14 shows the expected fuel consumption from the Auezov and mine boiler houses. Note the increased heat supply during the underground mining phase.

Table 3.14: Main Heat Source Technical and Economic Parameters

Heat source	Location	Installed capacity, kW	Annual heat supply, Gcal/year	Annual fuel consumption, t
Boiler house, during open pit mining	Boiler house area	13 100	15 430	5 190
Boiler house, during underground mining	Boiler house area	13 100	18 810	6 320
Auezov boiler house	Auezov settlement	7 500	1 100	-

The heat networks of the Kyzyl Project infrastructure are above-ground delivered on low stand-alone supports. A four-pipe system is used for the heat supply networks from the mine boiler house.

Heat supply pipelines are laid on high supports and along racks by the side of the road and fire access route crossings. Hot water of 95-70°C is used in the boiler-houses as a heat carrier.

Underground Heating and Ventilation

Each ventilation shaft and fan will be equipped with an MTEU-VNU heat-generating power unit. In total there will be three heat-generating power units installed during Stage 2. The MTEU-VNU is a low duty heating unit that is modular in construction. The MTEU-VNU is coal-fired, and each of the three MTEU-VNU units will have a coal and ash storage area.

Hot air from their combustion-chambers will pass through a heat exchanger and mix with outside air, cooling the heated air to around 2°C. The air will then be delivered to the shafts using the ventilation fans.

Typical specifications for the heat-generating units are as shown in Table 3.15:

Table 3.15: Heat-Generating Power Unit Specification for Underground Ventilation		
Indicator	**Facility Type**	
	VNU-01R	**VNU-02R**
Heat output, Gcal/h (MW)	0.9 (1.0)	1.7(2.0)
Heating combustion gases temperature, ^{o}C	500	500
Hot air temperature, ^{o}C	300	300
Amount of ventilating air provided by heat at outside air temperature - 50°C, m^{3}/min	1150	2300
Approximate consumption of equivalent fuel, tonnes of fuel equivalent per hour	0.12	

Rail Transport

East Kazakhstan Region (Oblast) has an extensive existing rail infrastructure, with the nearest junction of the new Ust-Kamenogorsk - Almaty-Shar railroad line at Shalabay village and at Charsk station, located 50km from Auezov.

All transportation of goods off-site will be by railway and motor vehicles. Deliveries of coal, oil, lubricants, and other goods will be transported by railway in mainline locomotives to Charsk or Shalabay station, and then by road vehicle to the Project site using access roads.

Road Transport

The Project can be accessed via the existing Almaty-Semey national highway, and also by road to the Charsk railroad station to the west, as well as from the Almaty – Ust-Kamenorgorsk road to the east.

Mine road specifications for the Project are shown in Table 3.16 below.

Table 3.16: Access Roads Parameters

Parameter	Eastern exit - waste rock dump	Eastern exit - ore preparation facility	Ore preparation facility - repair shops	Secondary roads
Access road category	I-K	III-K	IV-K One-lane with two-way traffic	IV-B One-lane with two-way traffic
Road earthwork width, m	38.00	30.60	24.50	9.00
Carriageway width, m	27.50	21.00	9.5	4.5
Roadside width (with a guard wall), m	2.50 (8.00)	2.50 (7.10)	4.75 (10.25)	2.25
Turn radius, m	30	30	30	30
Design speed, km/h	30	30	30	30

General Maintenance will be required to maintain haul roads; this is particularly important in winter, when the road should be cleared from snow and ice before being covered with sand or gravel. In the summer, roads are sprayed with water to control dust.

Most vehicle deliveries will come from the new, upgraded railway station at Shalabay, or from Charsk.

Reagent, Fuel, and Lubricant Storage

Reagent storage is designed to receive, store and distribute reagents for ore processing. The list and volumes of reagents are given in the Table below (Table 3.17). A one-month supply of reagents will be stored at the storage. Reagents are delivered to the site in original packaging in 20-foot containers packed by the manufacturer in compliance with specifications for each reagent.

Table 3.17: Volume of Stored Reagents, Type of Packaging and Method of Storage			
Reagent	**Packaging**	**Storage method**	**Actual stored volume, t**
OPF-597	Plastic tank, 920kg capacity, 1,200 x 1,000 x 1,160	Heated room	24.84
Sodium carbonate (Na2CO3)	Soft disposable container MKR, 1 t capacity, 10 MKR containers placed in each 20-foot container	Outdoor container site	160
A-633 (aeroflot)	25kg plastic bags, 900kg placed on a pallet	Heated room	40.5
Potassium xanthate	50 kg metal drums	Unheated rooms, below 23ºC in the warm time of the year	22.4
AERO-8045	Plastic tank, 1,150kg capacity, 1,200 x 1,000 x 1,160	Heated room	20.7
Copper sulfate (CuSO4)	Soft disposable container MKR, 1t capacity, 10 MKR containers placed in each 20-foot container	Outdoor container site	60
Magnofloc 10 flocculant	25kg plastic bags, 900kg placed on a pallet	Heated room	8.1
Magnofloc 5250 flocculant	25kg plastic bags, 900kg placed on a pallet	Heated room	0.9

Table 3.18: Operation Program of the Fuel and Lubricants Storage		
Parameter	**Unit**	**Value**
Diesel fuel turnover	tpy	30,910
	m^3/year	37,700
Oil turnover	tpy	1,720
	m^3/year	2,100
Stored diesel fuel	m^3	3,000 with possible increase to 4,000
Stored oils	m^3	68
Storage method for diesel fuel		Vertical reservoirs, 1,000 m3
Storage method for oils		200 l drums

The fuel and lubricants storage operates according to a distribution-type layout varying by demand and, for vehicle storage, according to transportation needs. The storage area carries a range of flammable and combustible oil products. Loading and unloading at the storage is performed with 1t forklifts with a special drum-gripping device. Drainage and collection manholes are provided for removal of storm water runoff from the site.

Table 3.19: Reagent Characteristics and Properties	
Reagent	**Characteristics**
OPF-597	Viscous liquid with a peculiar odour
Sodium carbonate (Na_2CO_3)	Water-soluble finely crystalline powder
A-633 (aeroflot)	Mixture of hydrocarbon polymer and dye, hazardous ingredient is cresyl acid
Potassium xanthate	Crystalline substance with a peculiar odour
AERO-8045	Liquid with a peculiar odour
Copper sulfate ($CuSO_4$)	Crystalline substance, readily soluble in water
Magnofloc 10 flocculant	High molecular non-ionic polyelectrolyte based on polyacrylamide
Magnofloc 5250 flocculant	High molecular non-ionic polyelectrolyte based on polyacrylamide

Plant and Heavy Vehicle Workshops and Warehouses

There are both outdoor storage areas and indoor repair workshops on the site. There are two outdoor storage areas: an outdoor storage site and a container storage site for equipment and materials covering an area of 30x80m.

Repair shops serve for routine and scheduled repairs and all types of maintenance for mining and hauling equipment, processing equipment, and processing or general use vehicles.

All mining and hauling equipment and vehicles come to the washing area prior to repair works, in accordance with the maintenance and repairs schedule. Vehicles are washed with recycled water. The washing station is equipped with fixed washing equipment for washing of all types of vehicles. A high pressure washer is provided for flushing contaminants with hot water. Recycled wash water effluent is treated at a 10m^3/h modular treatment plant, which operates in a closed-loop system. The storage and repair shops are operating 365 days a year according to two 12 hour shifts.

Site Administration and Security

All administrative services will be headquartered in the existing office building (after repair), located at the mine site. There will be also a first-aid room to render medical assistance to the personnel. The administrative and managerial staff of the ore processing facilities will be accommodated directly in production areas, in outbuildings and extensions of the main production buildings.

Site perimeter security will be ensured by the existing fences around the facilities and new galvanized steel-wire fences, erected along the perimeter of the design facilities using 2.6m-high metal posts. Main security and CCTV equipment will be installed in guard rooms as well as additionally designated places. Security equipment can be partially installed in the office building server room.

Site Emergency Services

Fire engine access is provided to all buildings and facilities within the Project site, including the existing, upgraded and design facilities.

More significant injuries will be treated at Auezov and Shalabay healthcare centres, with the most serious cases sent to Charsk by ambulance.

Staff Amenities, Facilities, and Accommodation

A full set of amenities and sanitary facilities will be provided to the personnel, in accordance with the regulatory requirements. Layout and areas of sanitary and amenity premises are based on groups of production processes, set by the Project's process design. Amenities will be provided in near proximity to workplaces and distributed by the areas. Sanitary and amenity premises for employees involved in open pit mining operations will be in the sanitary and amenity building (former mine rescue team building), located at the mine site. There will also be a laundry facility for washing and handling work clothes. An additional sanitary and amenity building for underground mine workers will be constructed when the underground mining is started (Stage 2). Amenities for personnel of ore processing facilities and repair and storage facilities will be in the allocated areas of the corresponding production buildings (main process plant building, laboratory, repair shops).

A 100-seat staff canteen will be constructed at the ore processing site. The mine site shift workers will eat in the dining facilities. Meals will be delivered from the canteen.

The personnel will be accommodated in the leased or mine-owned residential premises (apartments, hotel rooms) in Auezov, located in close vicinity to the production sites. The personnel will be recruited from Auezov's population. Shift personnel will be transported to the site by mine vehicles.

Waste Management

No specialised production and household waste landfills are proposed for the Kyzyl Project at Bakyrchik mine. Production and consumption waste, generated in the main and auxiliary facilities will be disposed by specialised third party companies with a relevant waste management licence. This will be carried out on contract basis in accordance with the legislation of the Republic of Kazakhstan.

Explosives and Ammonium Nitrate Area

Ammonium nitrate-based explosives will be used for blasting during mining activities. In order to be explosive, ammonium nitrate requires an explosive detonator

The explosives storage facilities will be located at several separate sites situated to the east of the waste dump. Facilities will include the explosives container storage site, initiating devices storage, explosives preparation and distribution building, office building, and guardhouse. Ammonium nitrate will be stored about 400m from the waste dump. It will be adjacent to the road heading to the explosives storage to minimize transportation costs. The explosives container storage sites will be earth-mounded. Ammonium nitrate will be trucked to site in one tonne soft disposable containers. Containers will be stacked in two tiers in the ammonium nitrate storage area.

There will be a mixing and charging machine loading station within the fenced area for ammonium nitrate storage. The loading station will charge ammonium nitrate into the hopper of the mixing and charging machine, but explosive preparation will not be carried out at this location. The mixing and charging machine will transport the ammonium nitrate to the blasting point in the pit, and the explosives will be prepared directly at the blasting point.

An explosives test and destruction range will also be constructed to test explosives and to destroy unused explosive materials and packaging. Explosives and ammonium nitrate building locations are shown in Drawing 1.3.

The annual consumption rate and stored amounts of explosives are shown in Table 3.20.

Table 3.20: List of Explosives, Annual Consumption Rates and Stored Volume

Material	Annual Consumption	Stored Volume	Storage Method
Ammonite 6ZhV (ANFO)	110 t	12 t	On an outdoor bunded site in special containers
TNT block TG-500	97.5 t	12 t	On an outdoor bunded site in special containers
Initiating devices (waveguides)	4,950,000 m	448,000 m	In unheated rooms on shelves
Detonating cord	137,000 m	11,500 m	In unheated rooms on shelves
Ammonium nitrate		1,435 t	

3.11 Labour

The FS has been prepared on the basis that the mine will be primarily owner-operated and that the mine labour force will be drawn predominantly from labour resources within Kazakhstan. Mine management will be conducted by experienced top managers of higher qualification.

The Feasibility Study reports that the Kyzyl project will employ an estimated 1,025 people (417 shift and 608 daily) in its first Operational Phase (Open Pit Mining) and subsequently 1,617 people (533 shift and 1,084 daily) during the Project's second Operational Phase (Underground Mining of Under-Pit Reserves). All labour will be hired in accordance with Kazakh legislation, adhering to all applicable Kazakh regulations on health and safety.

Stage 1 – Open Pit Mining

The detailed breakdown of staff employed at the mine during Stage 1 is shown in Table 3.21 below.

Table 3.21: Manpower of Repair and Storage Facilities for the Period of Open-Pit Mining

Position	People per 1st shift	People per 2nd shift	Total per day
Ammonium nitrate storage, mode of operation 365x1x12			
Head of storage	1	-	1
Warehouseman	2	-	2
Storage guards	1	1	2
Total without guards	3		3
Reagent storage, mode of operation 365x1x12			
Head of storage	1	-	1
Warehouseman	3	-	3
Fork lift driver	1	-	1
Total	4	-	4
Repair shops with an outdoor area, mode of operation 365x2x12			
Head of shops	1	-	1
Foreman	2	2	4
General mechanic	6	6	12
Repairman	4	4	8
Electrical fitter	2	2	4
Fuel system fitter	2	2	4
Machine tool operator	2	2	4
Welder	2	2	4
Store keeper/tool maker	2	1	3
Total	23	21	44
Materials and equipment storage, mode of operation 365x1x12			
Head of storage	1	-	1
Store keeper	1	-	1
Loader	2	-	2
Total	4	-	4
Fuel and lubricants storage, mode of operation 365x2x12			
Head of storage	1	-	1
Operator	1	1	2
Warehouseman	2	1	3
Total	4	2	6
Concentrate storage, mode of operation 365x2x12			
Warehouseman	2	2	4
Total	2	2	4
Explosives storage, mode of operation 365x1x12			
Head of storage	1	-	1
Warehouseman	2	-	2
Technician	1	-	1
Watchman	3	3	6
Total without guards	4	-	4

Table 3.22: Total Manpower Requirement for the First Operational Phase - Bakyrchik Project (Open Pit Mining)

Manpower	Shift		Daily	
	male	female	male	female
Open pit				
Engineers and technicians	22	-	24	-
Workers	61	-	92	-
Total	83	-	116	-
Process plant				
Engineers and technicians	10	2	11	3
Workers	26	8	45	16
Total	36	10	56	19
Assay laboratory				
Engineers and technicians	1	1	1	1
Workers	1	5	2	10
Total	2	6	3	11
QA/QC				
Engineers and technicians	1	2	1	4
Workers	-	6	-	12
Total	1	8	1	16
Metallurgical laboratory				
Engineers and technicians	1	4	1	4
Workers	1	5	1	5
Total	2	9	2	9
MSR department				
Engineers and technicians	3	-	3	-
Workers	10	-	10	-
Total	13	-	13	-
Sample preparation area				
Engineers and technicians	1	-	1	-
Workers	1	1	2	2
Total	2	1	3	2
Ore preparation facility				
Engineers and technicians	1	-	1	-
Workers	4	-	6	-
Total	5	-	7	-
Concentrate containerization area				
Workers	4	-	8	-
Total	4	-	8	-
Repair and storage facilities				
Engineers and technicians	8	-	10	-
Workers	41	-	68	-
Total	49	-	78	-
Utility network services + coal-fired boiler house				
Engineers and technicians	2	-	2	-
Workers	5	-	11	-
Total	7	-	13	-
Power network services				
Engineers and technicians	7	-	9	-
Workers	12	-	18	-

Table 3.22: Total Manpower Requirement for the First Operational Phase - Bakyrchik Project (Open Pit Mining)

Manpower	Shift		Daily	
	male	female	male	female
Total	19	-	27	-
Tailings storage facility				
Engineers and technicians	2	-	3	-
Workers	3	-	7	-
Total	5	-	10	-
Transport station				
	Main vehicle fleet			
Drivers	36	-	72	-
	Administrative vehicle fleet			
Drivers	27	-	32	-
	Auxiliary vehicle fleet			
Drivers	10	-	20	-
Total	73	-	124	-
Housekeeping personnel				
Total	9	17	15	19
Office and management personnel				
Total	42	14	42	14
Total	352	65	518	90
	417		608	

Stage 2 – Underground Mining

A detailed breakdown of staff during Stage 2 of the project is shown in Table 3.23.

Table 3.23: Manpower of Repair and Storage Facilities for the Period of Underground Mining

Position	People per 1st shift	People per 2nd shift	Total per day
Ammonium nitrate storage, mode of operation 365x1x12			
Head of storage	1	-	1
Warehouseman	2	-	2
Storage guards	1	1	2
Total without guards	3		3
Reagent storage, mode of operation 365x1x12			
Head of storage	1	-	1
Warehouseman	3	-	3
Fork lift driver	1	-	1
Total	4	-	4
Repair shops with an outdoor area, mode of operation 365x2x12			
Head of shops	1	-	1
Foreman	1	1	2
General mechanic	3	3	6
Repairman	2	2	4
Electrical fitter	1	1	2
Fuel system fitter	1	1	2
Machine tool operator	2	2	4
Welder	1	1	2
Store keeper/tool maker	2	1	3
Total	14	12	26
Materials and equipment storage, mode of operation 365x1x12			
Head of storage	1	-	1
Store keeper	1	-	1
Loader	2	-	2
Total	4	-	4
Fuel and lubricants storage, mode of operation 365x2x12			
Head of storage	1	-	1
Operator	1	1	2
Warehouseman	2	1	3
Total	4	2	6
Concentrate storage, mode of operation 365x2x12			
Warehouseman	2	2	4
Total	2	2	4
Explosives storage, mode of operation 365x1x12 - accounted in underground minemanpower			
Lamp house, mode of operations 365x3x7.2 - accounted in underground mine manpower			

Table 3.24: Manpower of Repair and Storage Facilities for the Period of Underground Mining

Position	People per 1st shift	People per 2nd shift	Total per day	Process group
Ammonium nitrate storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	2	-	2	2g
Storage guards	1	1	2	2g
Total without guards	3		3	
Reagent storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	3	-	3	2g
Fork lift driver	1	-	1	2g
Total	4	-	4	
Repair shops with an outdoor area, mode of operation 365x2x12				
Head of shops	1	-	1	1a
Foreman	1	1	2	1a
General mechanic	3	3	6	1b
Repairman	2	2	4	1b
Electrical fitter	1	1	2	1b
Fuel system fitter	1	1	2	1b
Machine tool operator	2	2	4	1b
Welder	1	1	2	2b
Store keeper/tool maker	2	1	3	1b
Total	14	12	26	
Materials and equipment storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Store keeper	1	-	1	1a
Loader	2	-	2	2g
Total	4	-	4	
Fuel and lubricants storage, mode of operation 365x2x12				
Head of storage	1	-	1	1a
Operator	1	1	2	1a
Warehouseman	2	1	3	2g
Total	4	2	6	
Concentrate storage, mode of operation 365x2x12				
Warehouseman	2	2	4	2g
Total	2	2	4	
Explosives storage, mode of operation 365x1x12 - accounted in underground minemanpower				
Lamp house, mode of operations 365x3x7.2 - accounted in underground mine manpower				

3.12 Project Land Requirements

The existing land allotment and land plots, requested for the open pit facilities, are shown in Drawing 3.9

The data on lands, required for construction and operation of the Bakyrchik mine and process plant, are given in the table below (Table 3.25).

Table 3.25: Land Requirement				
Area	Unit	Value		
		Total	including	
			within existing land allotment	within design land allotment
Land allocation	ha	2 328.8	1 856.1	472.7
Including areas allocated for the following sites:				
Mine site	ha	1 369.5	904.4	465.1
Facilities, including	ha	838.7	831.1	7.6
- ore processing facilities	ha	659.7	652.1	7.6
- office and amenity block	ha	0.5	0.5	-
- repair and maintenance facilities	ha	4.0	4.0	-
- utility facilities	ha	16.5	16.5	-
- heat and power supply facilities	ha	31.7	31.7	-
- storage facilities	ha	126.3	126.3	-
Offsite facilities, including	ha	86.5	86.5	-
- existing facilities	ha	80.7	80.7	-
- reconstructed facilities	ha	2.7	2.7	-
- utility facilities of Auezov settlement	ha	3.1	3.1	-
Land allocated for construction of a 110 kV o/h power line (future construction)	ha	3.1	3.1	-
Land allocated for construction of a 110/35 kV o/h power line (future construction)	ha	5.2	5.2	-
Land allocated for construction of a by-pass road (future construction)	ha	25.8	25.8	-

3.13 Decommissioning, Reclamation and Closure

After the planned life of the mine has expired, complete mine closure will be carried out, which will include rehabilitation and restoration of disturbed land.

Closure and reclamation goals for the project include:

- Ensuring future public health and safety are not compromised;
- Any residual environmental impacts are minimised and that environmental resources will not be subjected to Project-related physical and chemical deterioration over the long term;
- After-use of the site is beneficial and sustainable in the long term and acceptable to the mine owners, the local communities and the regulatory authorities;
- Any adverse impacts on local communities are minimized;
- All socio-economic benefits are maximised; and
- Closure and rehabilitation will be fully funded without recourse to public funds.

The MCRP (Mine Closure and Rehabilitation Plan) will identify further activities and cost lines that may be required for delivering an adequate closure process, such as environmental awareness among the local communities, retrenchment costs and workers' re-training, as well as links to closure focused

community development activities, such as building capacity within local institutions for managing usable infrastructure post-closure, and any potential opportunities for partnerships with other organisations with the aim of post-mining economic diversification.

The land rehabilitation plan shall consider the following aspects:

- local natural conditions (climate, geology, hydrology);
- location of the disturbed plot of land;
- development prospects of the mine region;
- actual or expected conditions of disturbed land at the moment of rehabilitation (i.e. area, technological landforms, natural revegetation degree, actual and future land uses, presence of a topsoil layer and potentially fertile rocks, predicted groundwater depth, inundation, drying, erosion, and soil contamination);
- chemistry, grain size distribution, agrochemical and agrophysical properties, and geotechnical properties of overburden and host rocks and combined dumps;
- local economy, social and economic and sanitary and hygienic conditions;
- period of use of the rehabilitated lands, taking into account potential repeated disturbance; and
- flora and fauna conservation.

Generally, engineering activities for land rehabilitation involves the following primary steps:

- topsoil removal, loading and delivery to temporary stockpiles;
- rough and final surface grading, backfilling cut-off drains, water supply and diversion drains, and minimising slope angles;
- removal and disposal of process installations and construction debris from the rehabilitated area;
- maintain all hydraulic engineering facilities until the rehabilitated land is transferred to another land user;
- soil erosion prevention planning; and
- apply topsoil to surfaces of dumps and sites, and revegetate.

General Site Rehabilitation

The sites where mine engineering rehabilitation of disturbed lands will be carried out, are listed in Table 3.26 below.

Table 3.26: Bakyrchik Mine Disturbed Lands		
Parameters	**Unit**	**Area**
Area of disturbed lands within Bakyrchik mine site including:	ha	816.0
open pit	ha	139.0
waste rock dump	ha	390.0
dump water settlers	ha	1.00
settling ponds	ha	23.0
pit water settler	ha	18.8
ore buffer/surge stockpile	ha	11.0
tailings storage facility	ha	162.0
underground mine site	ha	5.0
mine and process plant site	ha	19.8
carbon product storage site*	ha	9.9
boiler house site	ha	2.8
fuel and lubricants storage site	ha	2.0
household and drinking water supply pump station site	ha	0.4
explosives storage site	ha	1.3
ammonium nitrate storage site	ha	1.0
Akbastaubulak and Kyzyltu stream diversion channel	ha	9.8
water diversion and collection drains	ha	7.6
Roads	ha	11.6
* - taking into account the area of the carbon product run-off settling pond, storage base, slopes and water diversion drains		

Mine engineering rehabilitation of disturbed land will be carried out after demolition/dismantling on-site buildings and structures, and dismantling and removal of on-site equipment, is completed.

Building and structure demolition will be carried out according to a specialised demolition/closure project for the entire mine, or for each individual production circuit or a facility, providing for special demolition work safety measures.

After the buildings and structures are demolished, the surface where the structures previously stood will undergo rough and final grading to create slopes that are as close to natural terrain as possible. Final grading will include reapplying the stockpiled topsoil, which will have been removed during the initial site preparation stage of the project.

Reinforced concrete water diversion chutes will also be demolished (according to the building and structure demolition project) and covered with earth. Some open earth ditches will be left in place to prevent surface water stagnation and the formation of bogs.

Existing mine roads will be used for access to rehabilitated sites, and will not be removed or rehabilitated.

Mine rehabilitation will make use of the equipment that was used during the open pit operation.

Open Pit Rehabilitation

It is expected that, at closure, a pit lake will be formed in the deep portion of the pit due to inflow of groundwater and precipitation into the mined void. This final rehabilitation stage will take place once the underground mining of under-pit ore reserves is complete and dewatering pumping, needed for underground mining, ceases.

The key Bakyrchik pit lake parameters will be as follows: water surface elevation - 380m; water surface area – 1 150 000m^2; maximum lake depth - 320m; volume - 118 million m^3.

115ha of the pit area will form a pond, and 24ha is expected to self-revegetate. According to preliminary predictions, pit ponding by streams, groundwater and precipitation, will take more than 35 years after completion of the underground mining. Ponding time will be adjusted based on the results of hydrodynamic simulation.

Waste Dump Rehabilitation

At the end of the life of mine, the waste rock dump will have the following characteristics:

- maximum height - 105m (first tier - 55m, second tier - 50m);
- minimum width of safety berms - 20m;
- slope angle of each tier – 340;
- length at longest point – 3500m;
- width at widest point – 1500m; and
- total footprint area - 390ha.

It is assumed that the waste dump will be rehabilitated through natural self-revegetation. In order to assist revegetation, the following engineering activities will be carried out:

- prior to dumping waste rock, topsoil will be removed, and delivered to temporary stockpiles;
- final surface grading and roughing, and minimising slope angles to support vegetation establishment;
- removal of process installations and construction debris from the rehabilitated area;
- maintenance of all hydraulic engineering facilities until the rehabilitated land is transferred to another land user;
- topsoil application to surfaces of dump sites.

Carbon Product Storage Rehabilitation

The rehabilitation scope of work for the carbon product storage includes the following measures:

- rough grading of the carbon product stockpile surface by a bulldozer;
- final grading of the carbon product stockpile surface by a bulldozer;
- application of 10-20 cm thick clay layer onto the graded stockpile surface and compaction;
- equipping stockpile slopes with a geonet to prevent slope slides and to enhance the protective clay layer; and
- filling the geonet cells with clayey material; and
- compaction.

Surface grading shall provide formation of inclines, which ensure favourable conditions for further use of disturbed land. In this case, they shall prevent harmful impacts of the carbon product storage on the environment during wind and water erosion.

At the end of mining and rehabilitation, the carbon product stockpile will have the following characteristics:

- number of tiers - 1;
- maximum tier height - 15m;
- tier slope angle – 270;
- maximum length – 490m;
- maximum width – 140m; and
- final footprint area - 5.6ha.

Tailings Storage Facility Rehabilitation

After ceasing operations, the TSF is subject to reclamation. Reclamation activities are aimed to eliminate environmental pollution after the TSF has been closed.

At the first stage of TSF closure, the settling pond will be removed from the TSF area. Pond water will be discharged via preliminarily constructed ditch into a receiving water body during flood period. The water discharged from the tailings pond is mixed with clean creek water and diluted.

At the same time as the water is discharged from the tailings pond, slurry pipelines, water lines and pump equipment are dismantled.

After water has been completely discharged from the tailings pond and groundwater level has become lower in tailings mass, the actions are taken to eliminate surface erosion, prevent dust emissions from tailings, and ensure their integrity.

To this end, the surface of compacted and dried tailings is filled with debris and rubble soil with a thickness of 0.6m across the whole TSF area.

A water diversion ditch is established in the TSF area to provide for discharge of precipitation fallen within the TSF area into the tributary of the Alaigyr creek. The TSF area is graded so as to be sloped to the water diversion ditch. The graded surface is covered with a 0.2m thick fertile and potentially fertile soil layer.

The graded area will be self-revegetated with trees and shrubs.

The stream diversion channel, water diversion ditch and cut-off drains will continue functioning.

4 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Introduction

The Republic of Kazakhstan is a landlocked country with a continental climate with cold winters and dry hot summers. Temperatures at the site, which is located in East Kazakhstan Oblast, vary between over 40°C in the summer, to -49°C during winter. The project is located in steppe terrain, generally undulating with shallow ravines. The closest mountains are approximately 100km to the southeast in the Kabinskiy Range, which is also the location of the nearest forests. The Kabinskiy Range is a spur of the Altai Mountains and reaches an elevation of 1,700m. The streams in the project area drain into the Kyzyl-Su River, a tributary of the Irtysh River. The mine site is at an elevation of approximately 400m above the Baltic Mean Sea Level (bmsl) and there is approximately 50m range in elevation across the site. The district is semi-desert, with very low density of the population. The Project is shown in an international and domestic context in Drawing 1.1. Drawing 1.2 shows the Kyzyl Project area in relation to urban centres within East Kazakhstan Oblast.

4.1.1 Format of the ESIA Baseline

The baseline stage provides an analysis of the appropriate environmental data and social conditions to enable the detailed characterisation of existing conditions that are likely to be influenced through the development of the Project that comprises the following phases: construction, operation, closure and aftercare. Baseline analysis has been designed to provide a basis for assessment of potential impact, design of mitigation measures and monitoring of residual effects. Baseline information and data on the present status and condition of the environment and socio-economic setting have been obtained from a range of sources, including:

- primary field data collected by in-country consultants (to inform the OVOS);
- primary field data for the social baseline collected by WAI working alongside Kyzyl;
- primary hydrology field data collected by SRK;
- secondary archive data obtained from published sources, local statistical records and other available governmental data;
- mapping to provide spatial land-based data; and
- qualitative and quantitative analysis prepared by in-country consultants and informed with additional analysis undertaken by WAI.

4.1.2 Environmental Baseline

For the purpose of the ESIA and the collection and consideration of baseline data, the environmental baseline has been defined through a Project study area, identified in Table 4.1.1. Where individual baseline studies have been extended, the boundary has been defined within the individual sections of this chapter.

Baseline study areas for the Project can be much more extensive and can cover a wider area than the zones that have been defined to assess potential impacts, as a consequence of Project implementation; and these variations have been identified in the relevant sections of Chapter 5. It should be noted, therefore, that the baseline study areas identified within Chapter4 do not necessarily represent zones where the influence of a potential impact may have a measurable effect; they have been defined to analyse the extent within which environmental, socio-economic, and human interest baseline data is appropriate, in the context of the Project, taken as a whole. Table 4.1.1 summarises roles and responsibilities for collecting baseline data, which Polymetal have been overseeing. In general and unless otherwise stated, the baseline data was supplied to WAI by Polymetal for the purpose of writing this baseline section. Data from the OVOS has also been used within this baseline.

Table 4.1.1: ESIA Baseline Collection	
Topic	**Specialist/Company involved in collecting the data**
Project managing Environmental and Social baseline collection	David Brignall – Project director, Biodiversity and soil lead Julia Boiko – Coordinator of contractual arrangements and client liaison Alison Allen – Project Manager, Environmental Specialist. Narina Shorland – Project description Ruslan Sevostyanov – Contract administration
Environment	Neil Robinson – Environmental Specialist, contribution to air quality, noise, and vibrations
Mapping	Scott Sleight – Drawings, climate change specialist Craig Dunlevy – Drawings and mapping specialist
Climate data	Simon Allen – Energy and climate specialist
Geology	Aaron Wilkins - Geologist
Seismicity	Aaron Wilkins - Geologist
Air	Malcolm Walton – Air quality, noise and vibration lead
Noise and vibrations	Neil Robinson – Environmental Specialist
Soils and land capacity	Jakub Olewski – Soils and land capacity
Water resources	Alex Gallagher – Water resources lead Bertrand Burnet – Water resources specialist
Biodiversity	Helen Simpson – Ecosystem services lead, biodiversity management plan
Archaeology and cultural heritage	Richard Newman – Archaeology lead and review of Chance Finds Procedure
Traffic	Amer Wahid – Transport Engineer
Social and community baseline, including: governance, demography and culture; social infrastructure, health and education; economy, livelihoods and vulnerable groups.	Elizabeth Adey – Social and community lead Edvard Glücksman - Social and community specialist, public consultation, cultural heritage assessment and management
Waste management	Adrian Lea – Waste management plan

4.1.3 Social Baseline

The socio-economic Project incorporates a larger study area than that for the environmental baseline, reflecting the location of neighbouring communities and potential effects of the mining project on the local and regional economy. Whilst environmental impacts from a Project can be defined in terms of spatial (and temporal) potential impacts on the affected area, potential social impacts require consideration over a geographical area sufficient to consider even the influx of people to an area or considering where employees come from.

The social baseline for the Kyzyl Project has been developed to consider the three tiers of government in Kazakhstan:

- East Kazakhstan Oblast (regional) tier, which includes the local executive and representative state administrations across each oblast.

- Zharma rayon (district) tier, which includes the local executive and representative state administrations across each.
- Auezov rural administrative area (local) tier. The local Akim is based in Auezov village and covers the settlements of Auezov and Solnyechni. The territory of the municipality of Shalabay surrounds Auezov; its administrative centre is the Akimat of Shalabay village, located 6 km to the west of Auezov, which also covers the hamlet of Zhanaaul located roughly 10km away housing 55 residents.

The Project is located in the north-eastern region of the Republic of Kazakhstan, 1,100km north of the former capital Almaty, 750km east of the present capital Astana, 160km southeast of Semey and 100km south-west of Ust-Kamenogorsk (or Oskemen), which is considered the industrial centre of East Kazakhstan Oblast. The Project is located adjacent to the town of Auezov, which was formed in the 1950s to support mining activities in the area. The social structure of Auezov is strongly influenced by the operational state of the mine; for example, since the deposit entered a Care & Maintenance regime in 1997 the town's population has steadily decreased and remaining residents, including former miners, have had to take on new professions.

The hamlet of Solnyechni, located 2km from the main village, also belongs to Auezov municipality. Auezov is surrounded by the municipality of Shalabay, which includes both the village of Shalabay (6km west of the deposit) and the off-shoot hamlet of Zhanaaul (Photo 4.1.1).

Drawing 4.1.1 shows the closest settlements to the Project located within Auezov and Shalabay municipalities, which together are the focus of the social baseline.

Photo 4.1.1: The Hamlet of Zhanaaul

Polymetal have a comprehensive Human Resources policy in place favouring local recruitment; however, as some mining project specialist staff will be recruited based on capability and experience, this may require Polymetal to source some employees from a wider area, including outside the district or even the oblast. Nevertheless, given the distance from the Project to other settlements, the focus of local data collection for the social baseline has been on Auezov, Solnyechni and Shalabay.

The social baseline was gathered using a range of methodological tools, including primary and secondary data collection. Formal and informal interviews were also carried out to develop the social baseline, including a range of key stakeholders based in Auezov, Solnyechni, Shalabay, Zhanaaul, and Ust-Kamenogorsk. The work was completed during a 20-day period in June and July 2015.

Household surveys have been carried out by Polymetal and WAI specifically in the closest settlements – Auezov, Solnyechni and Shalabay – to collect the necessary local data required for the social baseline. WAI provided support to Polymetal to oversee the collection of social baseline data. The household survey was completed using randomised sample collection and a sample size 126 households (52 from Auezov, 9 from Solnyechni, and 65 from Shalabay) to achieve a confidence level of 90% with a corresponding 10% margin of error calculated based on household sizes. This margin of error is in line with standard requirements household surveys for a social baseline, ensuring statistical reliability in the data collected. As with any household survey, respondents do not always answer all questions and the responses provided are at their own discretion.

WAI interviewees included:

- East Kazakhstan regional (oblast)-level in Ust-Kamenogorsk:
  - Representatives of the oblast Akimat's Entrepreneurship Office;
  - Representatives of the Department of Ecology of East Kazakhstan Oblast;
  - Representatives of the regional Cultural Heritage Department;
- Zharminsky District (rayon)-level in Kalbatau:
  - Head of Kalbatau Hospital;
  - Chief Economist for the district;
  - Coordinator for the district-level Akimat;
  - Archaeological expedition to view pre-Bronze Age stone carvings;
- Auezov village (local)-level stakeholders:
  - Town Akim;
  - Representatives of Auezov Mosque, including the imam;
  - Shopkeepers from a range of shops and supermarkets;
  - Chefs and representatives of local restaurants and cafes;
  - Village elders;
  - Fishermen fishing in local rivers and lakes;
  - Herders responsible for local livestock;
  - Head Librarian;
  - Representatives of the Women's Union;
  - Head Teacher at the local school;
  - Police officer;
  - Residents displaced as a result of the Project;
  - Residents of Auezov and the satellite hamlet of Solnyechni, including through a structured household survey;
  - Range of private and industrial water users;
- Shalabay village (local)-level stakeholders:
  - Town Associate Akim;
  - Shopkeepers from a supermarket;
  - Leadership of Shalabay LLP, large-scale farm and major local-level employer;
  - Head Teacher at the local school;
  - Workers at Shalabay train station, set to serve the Project;
  - Range of private and industrial water users;
  - Residents of Shalabay, including through a structured household survey;
- Zhanaauil village (local)-level stakeholders:
  - Villagers on a hunting and fishing expedition;
  - Local farmers;
  - Private and agricultural water users;
- Polymetal and BMV employees:
  - Head of Project;
  - Chief of Security;

- Health and Safety Officer;
- Legal Office representatives;
- HR Department representatives;
- Environmental Department representatives;
- Head of Production and Technical Department;
- Community Liaison Officer;
- Land Use and Subsoil Team representatives.

Polymetal undertook interviews with:

- Residents of Auezov, as part of the Household Survey (results discussed in sections 4.12-15);

The visit involved interviews and discussions with a range of Polymetal employees and State agencies to identify accurate sources of statistics which have been utilised throughout the social baseline chapter. Secondary data sources, including settlement passports, were also used for the purpose of developing the social baseline.

The site visit also included several site reconnaissance sessions, looking at key aspects of the Project from a social perspective, including to schools, hospitals, the previous and current site of relocated graves, and across agricultural land currently used by herders to keep livestock belonging to residents of local settlements. Finally, the site visit included visits to the homes of citizens displaced by the Project in order to determine the extent to which national legislation and international standards of best practice were followed during the relocation process.

4.2 Climate

4.2.1 National Climatic Conditions

Kazakhstan is a landlocked country, located centrally within the Eurasian continent (Figure 4.2.1). It is the ninth largest country in the world, with a total area of 2.72 million square kilometres, and shares borders with five countries: the Russian Federation, the Republic of Uzbekistan, the People's Republic of China, the Kyrgyz Republic, and Turkmenistan.[1]

Figure 4.2.1: Republic of Kazakhstan

The majority of Kazakhstan lies in the arid zone and is represented by four natural climate zones: forest-steppe, steppe, semi-desert and desert. Forest-steppe is composed of grassland interspersed with areas of woodland or forest. The steppe, including the area around the Project, is a vast territory in the northern regions of the country characterised by grassland plains without trees. The semi-desert areas of central Kazakhstan comprise arid steppes and desert landscapes occupy most of the country's plain.

The national climate of Kazakhstan is described as continental with warm summers and cold winters. Water resources are limited. In central regions the climate is arid steppe and the temperature is cold and dry. To the south west the climate is arid desert with cold temperatures. To the south east the climate is predominantly warm temperate with dry hot summers. In the north the climate is snowy and fully humid with warm to hot summers.[2]

[1] "Kazakhstan - Overview of Climate Change Activities" World Bank, October 2013

[2] R:\Environment Overseas (52)\52-0133 Altynalmas - ESIA Pustennoye Kazakhstan\Report\ESIA\ESIA final version\ESIA draft version 1 for Altynalmas\Chapters\Chapter 4 Environmental and Social Baseline.docx

Kazakhstan's remoteness from the world's oceans creates an extreme continental climate with generally low levels of rainfall and broad temperature fluctuations between seasons. Annual precipitation in the foothill areas ranges from 500 to 1,600mm, while on the steppe it is 200 to 500mm and in the desert 100 to 200mm.[3]

In the winter average temperatures for January range from -18°C in the north of the country to -3°C in the south. In July summer temperatures range from 19°C in the north to 29°C in the south. Winter in the north is long and cold. Historical records show that in some years the winter temperature falls as low as -52°C in the northern regions of the country, although there are also thaws at up to 5°C as well. The highest recorded temperature of the ground air in July in the north does not exceed 41°C, and in the south, within Kyzyl Kum desert the temperature has reached 47°C. The variation in temperatures between night and daytime can reach 20–30°C.

4.2.2 Local Climatic Conditions

Auezov settlement supports the mine at Kyzyl deposit, which is located approximately 80km west-southwest of Ust-Kamenogorsk and 125km southeast of Semey, in the East Kazakhstan Region.

The Köppen-Geiger climate classification[4] for most of Eastern Kazakhstan is Dfb, designating a snowy climate with fully humid precipitation characteristics and warm summer temperatures. Climate is sharply continental with wide daily, seasonal and annual temperature ranges. Winters are cold with little snow, and summers are relatively long and dry.

In terms of the climate definitions from a Kazakh and Russian perspective, the agro-climatic zoning of the territory of the region belongs to two agro-climatic regions[5]:

1. Very arid warm temperate;
2. The dry heat.

These zones are defined based on heat and moisture in the atmosphere, and these are both limiting factors for vegetation growth. Soil moisture conditions are very harsh, with crop growth limited by drought conditions during most years.

[3] Second National Communication of the Republic of Kazakhstan to the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), 2009

[4] Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger climate classification updated.*Meteorol. Z.*, **15**, 259-263. DOI: 10.1127/0941-2948/2006/0130

[5] "ПРЕДВАРИТЕЛЬНАЯ ОЦЕНКА СОСТОЯНИЯ ОКРУЖАЮЩЕЙ СРЕДЫ (ПРЕДОВОС) НА УЧАСТКЕ ДЛЯ СТРОИТЕЛЬСТВА И ЭКСПЛУАТАЦИИ МЕТАЛЛУРГИЧЕСКОГО КОМПЛЕКСА С РАСЧЕТОМ ПРЕДВАРИТЕЛЬНОЙ СЗЗ И РАСЧЕТОМ РАССЕИВАНИЯ ЗАГРЯЗНЯЮЩИХ ВЕЩЕСТВ В ПРИЗЕМНОМ СЛОЕ", filename: Process Plant PreEIA 2012 Final Version_Russian.doc, Almaty, 2012

The seasons in the project area are defined as follows:

Season	Duration
Spring	mid-April to late May
Summer	early June to mid-September
Autumn	mid-September to late October
Winter	early November to mid-April

In the summer extreme weather events include prolonged period of drought, combined with dry winds and dust storms.

In winter extreme weather conditions include air temperatures <-20°C, blizzards, ice, and resulting in a prolonged period of snow cover.

4.2.3 Weather Station Data

The classifications described in the preceding section are verified by the observations of the Shalabay weather station[6], located approximately 5km south-west of the Bakyrchik Deposit. The mean monthly and annual precipitation and temperature results for the long-term observations (1938-2013) at Shalabay weather station are presented in Table 4.2.1 and Table 4.2.2, and illustrated in Figure 4.2.2.

Table 4.2.1: Mean Monthly and Annual Precipitation, mm (1938 – 2013)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Shalabay	16	16	19	26	36	37	43	32	26	33	30	21	335

Table 4.2.2: Mean Annual and Monthly Air Temperature, ˚C (1938 – 2013)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Shalabay	-15.7	-14.9	-7.7	4.5	12.6	18.2	20.5	17.8	12.0	4.1	-6.7	-13.4	2.6

[6] Bakyrchik Mining Venture LLC , The Bakyrchik Gold Deposit, MINE AND PROCESS PLANT CONSTRUCTION, 34.01.06.00100 PZ3, St. Petersburg, 2015

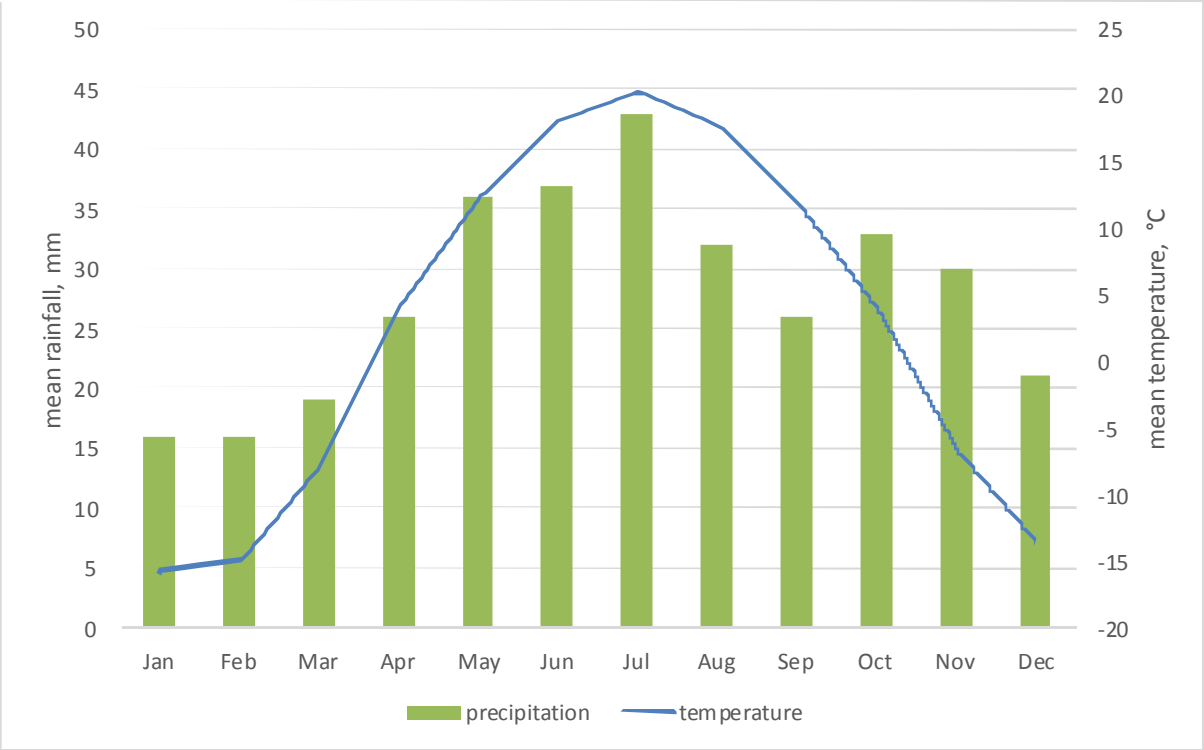


Figure 4.2.2: Graph of Mean Monthly Precipitation and Temperatures, Shalabay Weather Station 1938 - 2013

The cold period is considered to last for 150 days, while the warm period (days with a mean daily temperature above 0°C) lasts between 205 and 215 days.

Mean annual precipitation in the warm period (April to October) is 233 mm. Mean annual precipitation in the cold period is 102mm. The mean annual precipitation of the cold and warm period at 63% exceedance probability is 91mm (winter) and 207mm (summer). Maximum daily precipitation at 20% exceedance probability is 27mm, at 1% – 46mm. Annual evaporation from open water bodies in the Project area is approximately 500mm.

Temperatures recorded during the year have been observed to range from -40 °C to +40°C. Summers are generally dry and hot, with occasional dust storms. Winters are cold and snowy, with a greater frequency of high winds (greater than 15m/s).

There is considerable variation between maximum and minimum temperatures during any particular month. Maximum and minimum air temperatures at Shalabay weather station recorded between 1994 and 2013 and plotted by month show that variation can be up to as much as 35 °C, throughout the year (see Figure 4.2.3).

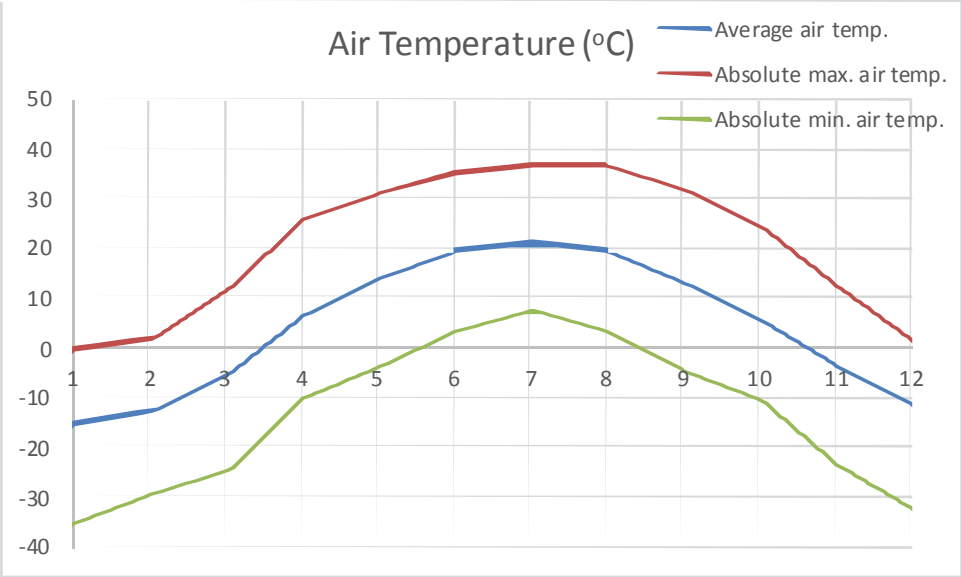


Figure 4.2.3: Variation in air temperature at Shalabay 1994-2013[7]

Summaries of wind data collected from the anemometer situated at Shalabay weather station situated at 10m above ground level (AGL) between 1986 and 2009 are presented in Table 4.2.3, Table 4.2.4 and Table 4.2.5.

Table 4.2.3: Average Annual Frequency of Occurrence (%) Wind Direction and Calms

N	NE	E	SE	S	SW	W	NW	Calm
12	8	9	21	18	9	11	12	24

Table 4.2.4: Frequency of Wind Speeds by Gradations (%)

Speed range (m/s)	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-20	21-24
Frequency (%)	50	24	14	7	3.0	1.0	0.7	0.2	0.1	0	0

Table 4.2.5: Average Wind Speed by Wind Direction (m/s)

N	NE	E	SE	S	SW	W	NW
3.1	2.2	2.2	3.6	4.0	3.6	3.3	3.3

Wind speeds at Shalabay weather station are relatively low with average wind speeds by direction varying between a low of 2.2m/s and high of 3.6m/s. The prevailing wind direction is from the south to southeast quadrant (see Figure 4.2.4).

[7] "*Hydrometeorological Survey at the Construction Site of the Mining and Processing Infrastructure at Bakyrchik Mine*" The Ministry of Investments and Development Republic of Kazakhstan LLP "EK Geological Survey Center", Ust-Kamenogorsk, 2014

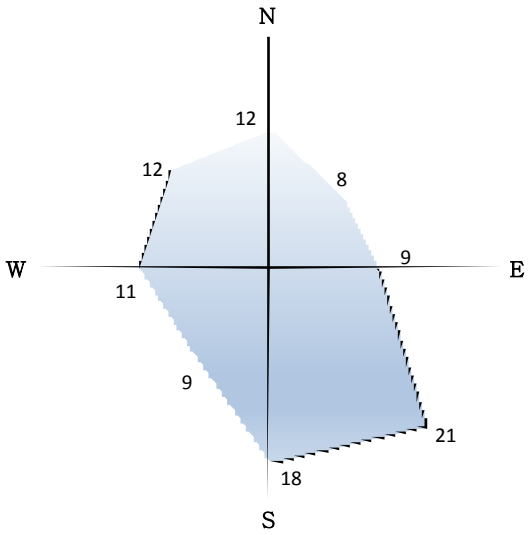


Figure 4.2.4: Wind Rose for Shalabay Weather Station (m/s)

Maximum gust wind speeds are considerably higher than the average wind speeds. Figure 4.2.5, illustrates the maximum wind speeds recorded 10m AGL at Shalabay weather station averaged over the period 1994-2013. These are generally more than 12m/s higher than the average wind speeds recorded during the same period.

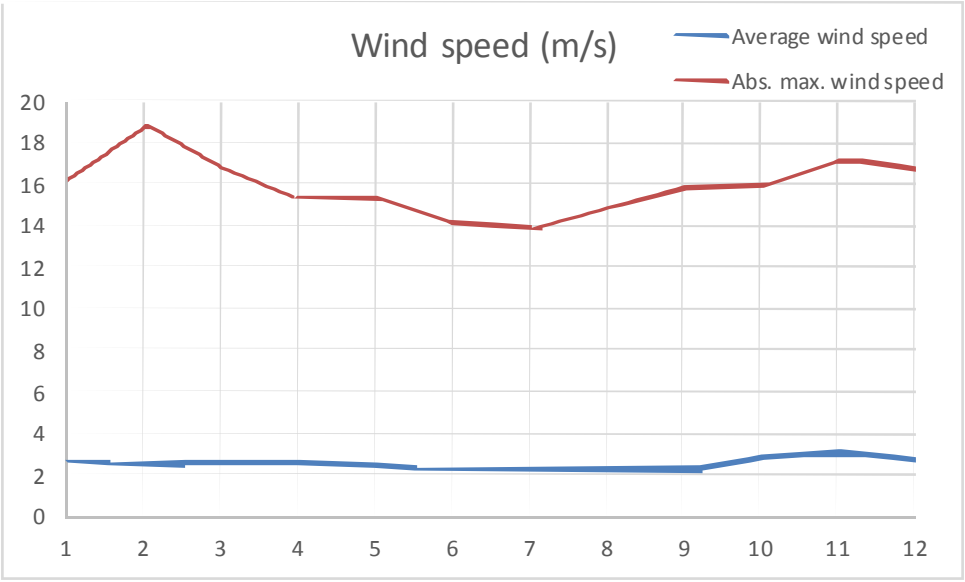


Figure 4.2.5: Monthly Average Wind Speed Variation and Gust Speeds at 10 m AGL (1994 -2013)

Based on the long term data (1938-2013) the frost-free period ranges from 100 to 150 days. The average depth of snow in open areas is not more than 15-50cm during snow cover periods. The snow cover lies for 105-150 days. On average, snow cover is present between 8 November and 2 April.

Figure 4.2.6 has been generated from data collected between Jan 1994 and Dec 2013 [8]. The average depth of snow by month is illustrated as recorded at the Shalabay weather station.

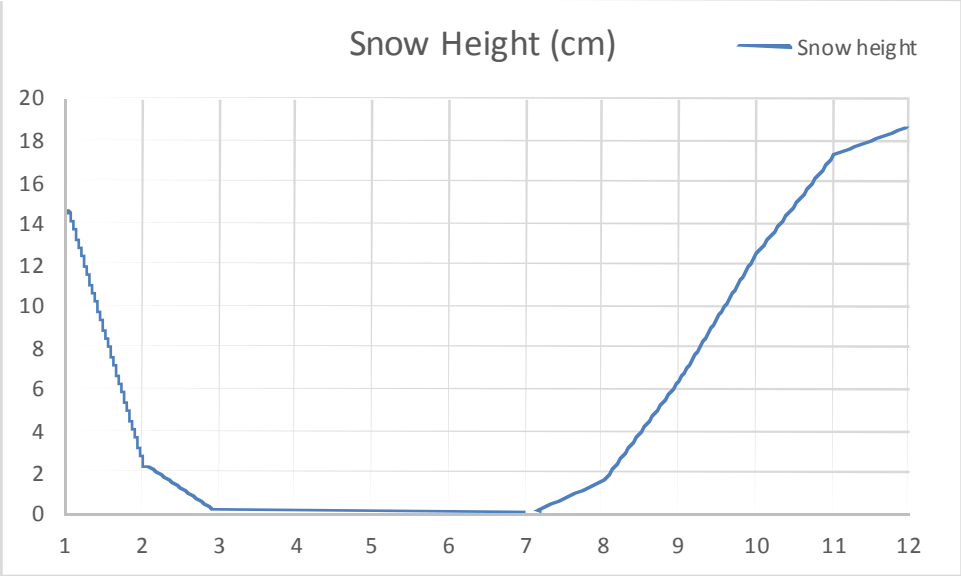


Figure 4.2.6: Variation in average monthly snow heights at Shalabay (1994-2013)

4.2.4 Long-Term Climate Trends

Seasonal precipitation trends in Kazakhstan are statistically insignificant, except for the increase in winter precipitation, which is a clear trend. Records observed since 1941 (Figure 4.2.7) confirm that the climate of Kazakhstan is becoming progressively warmer, with increasing temperatures recorded across the country and across all seasons. The information presented in this section is based largely on the report, "*III-VI National Communication of the Republic of Kazakhstan to the United Nations Framework Convention on Climate Change*", 2013.[9]

Particularly rapid rates of warming have started to occur over the last 35 years, and this has resulted in a higher frequency of warm years. Annual average air temperatures in Kazakhstan during each year between 1997 and 2010 (i.e. over 14 consequent years) were higher at the mean than a climatic normal rate calculated over the period of 1971-2000. For these years the mean was exceeded by between 0.3 – 1.4°C.

[8] "*Hydrometeorological Survey at the Construction Site of the Mining and Processing Infrastructure at Bakyrchik Mine*" The Ministry of Investments and Development Republic of Kazakhstan LLP "EK Geological Survey Center", Ust-Kamenogorsk, 2014

[9] The III-VI National Communication of the Republic of Kazakhstan to the UN Framework Convention on Climate Change (UNFCCC) - Astana 2013, prepared as a part of the joint project of the UN Development Program in Kazakhstan and the Ministry of Environment Protection of the Republic of Kazakhstan with the support of the Global Environment Facility

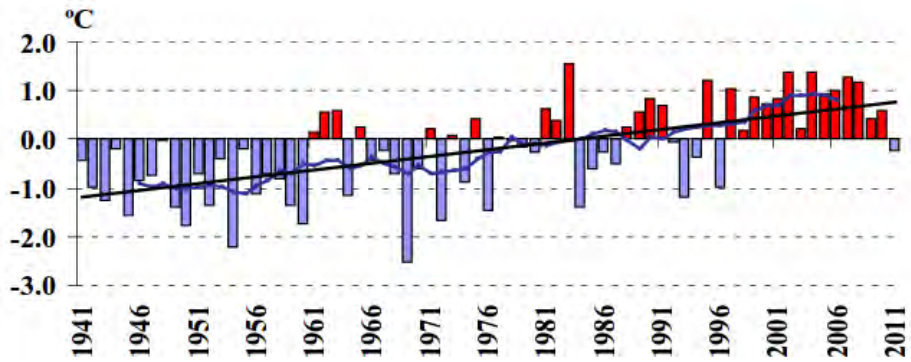


Figure 4.2.7: Time Series and Linear Trend of Annual Average Air Temperature 1941-2011 Averaged Over Territory of Kazakhstan[10]

The maximum daily ground air temperature was observed to increase at most of the meteorological stations within Kazakhstan. An average increase of daily temperature maximums was reported up to 0.40°C every 10 years, with some stations recoding increases in excess of 0.60°C/10 years[11]. Statistically significant trends were generally common for north-east, east and south of the Republic. In the region of the site the average increase in daily temperature maximums was in the range of 0.2-0.4°C.

Across the Republic the number of successive warm days (when daily maximum temperatures exceeded the 90th percentile) increased by 1-2% every 10 years, while cold nights (daily minimum temperatures below the 10th percentile) decreased by 1-3% every 10 years. The lengths of heatwaves (defined as more than 6 successive days with daily maximum air temperatures above the 90th percentile) across Kazakhstan were also seen to increase by 1-3 days/10 years.[12]

This warming effect, which is statistically significant across all of Kazakhstan, is expected to be observed at the site, where temperatures are expected to increase 0.21-0.40 °C every 10 years.

Trends of frost days (when daily minimum temperature falls below 0°C) where observed to decrease. The effect was most pronounced in the foothills and mountainous regions of the south of Kazakhstan but across the rest of the Republic the decrease was 1-4 days/10years. [13]

There was no well-defined trend in the variation of annual and seasonal precipitation rates observed in Kazakhstan between 1941 and 2011 (Figure 4.2.8). There was a slight decrease in the average annual amount of precipitation throughout Kazakhstan of 0.5mm/10 years (0.3% of the normal rate/10 years). There was also an observed decrease in the seasonal amount of precipitation of 1mm/10 years

[10] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013 pg 29
[11] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 30
[12] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 31
[13] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 32

(1% of the normal rate/10 years) in spring, summer and autumn. However, there was evidence of an increase in precipitation of 1.7mm/10 years (2.2% of the normal rate/10 years) during winter. [14]

Precipitation decreased by 1 to 5% of the normal rate/10 years throughout the major part of the territory of Kazakhstan except for the south-eastern mountainous regions in summer and autumn. On the contrary the amount of precipitation mostly increased in winter; persistent trends were observed in the northern and central regions as well as north-western, eastern, south-eastern mountainous and foothill regions of the Republic – by 1 to 10% of the normal rate/10 years. In spring period the positive trend as to precipitation was observed in the north-western half part of Kazakhstan while the negative trend – throughout the entire remaining territory.[15]

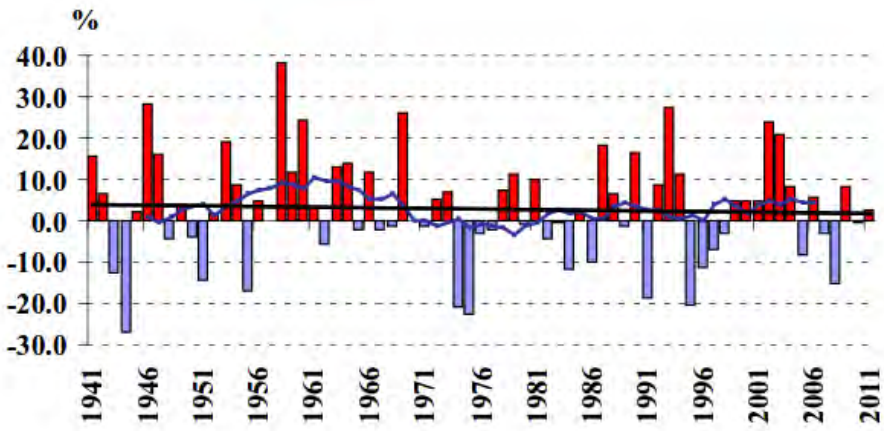


Figure 4.2.8: Time Series and Linear Trend of Annual Amount of Precipitation 1941-2011 Averaged Over Territory of Kazakhstan[16]

Whilst there is some evidence of statistically significant increases in precipitation in winter across Kazakhstan, and within East Kazakhstan itself, trends highlighted in the report suggest that the evidence collected from meteorological stations closest to the site show little evidence of statistically significant increases. On an annual basis the closest weather stations to the site reported no statistically significant trend in the variation of precipitation levels, with some nearby stations reporting decreases.

4.2.5 Conclusions

The national climate of Kazakhstan is described as continental with warm summers and cold winters. Water resources are limited. The majority of Kazakhstan lies in the arid zone and is represented by four natural climatic zones: forest-steppe, steppe, semi-desert and desert. The Project lies in a steppe area, with extreme continental climatic conditions.

[14] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 32
[15] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 32
[16] From III-VI National Communication of the Republic of Kazakhstan to UNFCCC, 2013, pg 29

The climate in Kazakhstan is seen to be warming. This in itself is unlikely to have a significant impact on the operation of the mine other than to slightly reduce its requirement for heating. It is arguable that emissions from the mine might accelerate the effects of climate change and to address this further consideration is given in the Greenhouse Gas section of this ESIA (see Chapter 5.4). There is currently no statistically significant trend in the overall variation of precipitation levels expected in the region. Although winter precipitation levels have risen slightly and some of this increase has been statistically significant in areas of East Kazakhstan, there is no clear evidence of such a trend in the immediate vicinity of the site. On this basis and with the currently available evidence, hydrological conditions at the mine are not expected to vary directly as a result of climate change.

Climate conditions local to the site of the Project are as follows:

- mean precipitation between 1938 and 2013 was seen to be 335mm;
- mean annual air temperature was recorded as being 2.6 °C;
- annual evaporation rate is 500mm;
- prevailing wind directions are south-east (38%) and north-west (15%);
- the annual average wind velocity is 2.7m/s;
- snow fall occurs between beginning of November and beginning of April; and
- the depth of winter freezing varies from 1.65m to 2.0m.

4.3 Topography, Land Coverage and Landscape

The Republic of Kazakhstan covers an area of 2,724,900km[21] and includes considerable topographical variation. At an elevation of +7,010 meters the highest mountain peak is Khan Tengri, on the Kyrgyz border in the Tian Shan range; whilst the lowest terrain occurs within the Karagiye depression at -132m, in the Mangystau province east of the Caspian Sea. The majority of the country lies at between 200 and 300 meters AOD.

The gentle sloping steppe within Kazakhstan are continuous from central Europe to Siberia, whilstto the north the terrain is characterised by norther forest steppe and to the south the high mountains, with over 12% of the land mass described as mountains. The majority of the mountain ranges are located in the Altay and Tian Shan ranges, although the Ural Mountains extend southward from Russia into the east and northeast the northern part of west-central Kazakhstan.

The Bakyrchik Project is located in Sharskogo area in the East Kazakhstan region. The area is split into three landscape types. The western area is hummocky with the eastern area low and hummocky from eroded spurs from the Kalba ridge, the centre of the area comprises plains and valleys.

The western area comprises small ridges of hills and a few low mountains, these alternate with valleys hosting seasonal streams, which commonly dry up during summer months. Upland areas exhibit smooth rounded hills and ridges of eroded terrain. This area generally comprises Paleozoic sediments of quartzite, limestone, sandstone and shale, and Precambrian rocks forming low mountains comprised of sedimentary rocks, granites and granodiorites. Hills are typically covered with quarternary talus deposits, with bedrock commonly outcropping on hill tops. Slope gradients range from 8°-18 to a height of 400-500m AOD; typically hills rise in the order of 50-100m elevation above the surrounding terrain.

To the East the landscape is defined by the Kalba ridge and its foothills which rise to >500 AOD. To the northwest of the Kalba ridge are a range of hills from 500m to 781m AOD. Lowland areas are dominated by granitic terrain.

The central area between the two landscape types has a predominantly flat relief. In the north lies the south-eastern edge of the West Siberian Plain (Irtysh Plain). This area comprises Paleozoic rocks, which are overlain by Tertiary sediments. This is covered by alluvial sediments of sand and sandy loam. The plain is typically flat and has an elevation of between 150-350 m. Land use of this area is mainly suited to agriculture

The Bakyrchik Project area is characterised by undulating hilly terrain of rounded hills and valleys. Absolute elevations range from 350m to 488m, and relative elevations - from 20-39m to 50m. Land coverage is predominantly small shrubs and bushes.

[1] CIA World Factbook 2012 https://www.cia.gov/library/publications/the-world-factbook/

4.4 Air Quality

4.4.1 Introduction

Air quality is defined as a measure of the condition of the atmosphere relative to the requirements of one or more biotic species or to any human need or purpose. Air quality parameters of interest to Project implementation include those which have the potential to affect human health or the environment, namely suspended particulate matter (PM_{10} and $PM_{2.5}$ and larger particle size nuisance dust), nitrogen oxides (NO_x) and sulphur dioxide (SO_2).

Particulate Matter (PM_{10} and $PM_{2.5}$) and Dust

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. Particles up to 10µm that are inhalable into the upper respiratory tract are known as PM_{10} and particles up to 2.5µm, which are respirable deep into the lungs, are known as $PM_{2.5}$. These particles are of concern as they are small enough to enter the respiratory system and at certain elevated concentrations can affect human health. PM_{10} and $PM_{2.5}$ can travel in excess of 1km from the point of release and, unlike larger dust particles, their dispersal is not dependent upon wind direction. As such, monitored $PM_{10/2.5}$ levels tend to be fairly consistent both up and downwind of a source [1]. The principal sources of $PM_{10/2.5}$ are combustion activities, such as vehicle exhausts, woodstoves, power plants, etc. Because particles originate from a variety of mobile and stationary sources their chemical and physical compositions vary widely. $PM_{10/2.5}$ can be directly emitted or can be formed in the atmosphere when gaseous pollutants such as SO_2 and NO_x react to form fine particles.

Larger mineral dust particles, between 10 and 75µm in size, do not pose the same health effects as smaller $PM_{10/2.5}$ particles and are generally referred to as nuisance dust, as human concerns generally relate to the soiling of surfaces. Mineral particles between 30 and 75 µm have a relatively high mass and settling velocity and tend to deposit naturally within 100m of the point of release, however 30µm particles can travel up to 300m from the point of release. Particles in the size range of 10-30µm tend to fall out of the atmosphere between 100m and 250m from the point of release, under normal meteorological conditions. Modelling studies have also shown that deposition rates decrease significantly (in an almost logarithmic manner) with increasing distance from the source. Deposition of these larger dusts may have detrimental effects on plant growth due to the obscuring of leaf surfaces leading to reduced photosynthesis and growth rates.

Arsenic in Suspended Particulates (As)

From a toxicological point of view arsenic can be classified into inorganic arsenic compounds; organics arsenic compounds; and arsine gas. Due to the sulphide ores at the mine, there is the potential for an increased concentration of arsenic in suspended dust particles compared to what is typically expected

[1] "Do particulates from open cast mining impair children's respiratory health?" ('The Newcastle Report', HMSO, 1999)

in rural and urban areas globally. This source of arsenic falls within the inorganic arsenic category. Organic arsenic and arsine gas are not considered a risk for the Project.

Typical concentrations of arsenic in suspended particulate is quite varied across the globe, depending on location. In their meta-study of toxic elements associated with airborne particulates, Schroeder *et al*[2] list arsenic concentrations in air ranging from 0.007 to 2320ng/m^3, depending on how remote or urbanised the monitoring location was.

WHO (2000)[3] describes typical levels in the USA as 1 to 3ng/m^3 in remote areas, and 20 to 30ng/m^3 in urban areas. WHO states that concentrations near nonferrous metal smelters can exceed 1000ng/m^3.

Nitrogen Oxides (NO_x)

Nitrogen oxides (NO_x) is a term used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2). These are inorganic gases formed when oxygen and nitrogen (both readily available in the atmosphere) combine, and are also a by-product of combustion of fossil fuel by vehicles, industrial processes and power generation. There is some evidence that long-term exposure to NO_2 at concentrations above 40–100µg/m^3 may decrease lung function and increase the risk of respiratory symptoms. Oxides of nitrogen are also a precursor for ozone formation, which at ground level can have potential effects on human health and damage to vegetation.

Sulphur Oxides (SO_x)

The term sulphur oxides (SO_x) refers to a range of sulphur and oxygen containing compounds, the most common of which is sulphur dioxide (SO_2). The largest anthropogenic source of SO_x is the combustion of sulphur containing fossil fuels (particularly coal and oil); however SO_x are also produced during metal smelting and other industrial processes. Sulphur oxides also occur naturally through volcanoes, forest fires, the oceans and decaying plant matter. The oceans, wetlands and lakes act as natural sinks for SO_x.

Both chronic and acute exposure to SO_x can cause damage to the respiratory system; there is also a link between chronic high-level SO_x exposure and heart disease. SO_x can dissolve in moisture in the atmosphere forming sulphur acids (commonly known as "acid rain"). These attack the outer protective waxy coatings of leaves, effecting plant growth. Sulphur acids may also acidify soils and waterways, causing wider environmental effects.

[2] W. H. Schroeder , M. Dobson , D. M. Kane & N. D. Johnson (1987) Toxic Trace Elements Associated with Airborne Particulate Matter: A Review, JAPCA, 37:11, 1267-1285, DOI: 10.1080/08940630.1987.10466321

[3] WHO air quality guidelines for Europe, 2nd edition, 2000 (CD ROM version), Chapter 6.1 Arsenic, http://www.euro.who.int/__data/assets/pdf_file/0014/123071/AQG2ndEd_6_1_Arsenic.PDF?ua=1, accessed 24/08/2015

4.4.2 Existing Emission Sources

The Bakyrchik deposit and existing mining infrastructure are currently in care and maintenance and this is reflected in the baseline conditions. Specifically, infrastructure that will be not be required for the Kyzyl Project is being dismantled, with salvageable materials being sold to third parties and removed from the site. Fugitive dust emissions from these salvage activities, which may contain iron and manganese oxides as a result of cutting scrap metal to more manageable sizes.

The Auezov coal-fired boiler house, used for building heating in Auezov village and the mine administration buildings, is a source of NO_2, SO_2, CO, CO_2, and suspended particulates. Coal ash dust is blown from the coal-ash stockpiles, and disturbed during rehandling when ash is disposed. Fugitive windblown dust is generated from exposed surfaces around the mine site, including unrehabilitated waste rock dumps, and concentrate stockpiles.

Domestic emission sources also contribute to the baseline conditions. The roads in Auezov are predominantly unpaved, causing fugitive dust from vehicle entrainment, particularly during the dry summer months. Based on visual observations, this is likely the main source of particulate emissions within Auezov.

Due to close proximity of the Auezov to the Bakyrchik Mine, the village is industrial. However due to the period of time that the mine has remained in care and maintenance the baseline conditions are not specifically influence by industry and can be defined as residential in character. There is presently very little road traffic (refer to Chapter 4.11), and thus there are limited SO_2 and NO_2 emissions from road vehicles at present, with very low car ownership in the area. Emissions are predominantly from trucks and buses.

4.4.3 Ambient Air Quality Standards

As per IFC guidance, when selecting impact assessment thresholds and criteria, consideration must be given to both International Standards and local standards, with preference given to the most stringent criteria.

Table 4.4.1 lists the ambient air quality guidelines that were considered, and highlights those that will apply to the Project.

Table 4.4.1: Ambient Air Quality Guidelines Considered Guidelines Applicable to the Project Highlighted		
Pollutant	**WHO Guideline[4]**	**Kazakh Standard (MPC)**
TSP		150µg/m^3 daily mean 500µg/m^3 one-time
Arsenic in dust	0.006µg/m^3 in PM_{10}, annual mean* 100µg/m^3 in PM_{10}, 8-hour time-weighted average**	3µg/m^3 in TSP, daily mean 30µg/m^3 in TSP, one-time
PM_{10}	20µg/m^3 annual mean 50µg/m^3 24 hour mean	
$PM_{2.5}$	10µg/m^3 annual mean 25µg/m^3 24 hour mean	
SO_2	20µg/m^3 24-hour mean 500µg/m^3 10-minute mean	125µg/m^3 daily mean 1250µg/m^3 one-time
NO_2	40µg/m^3 annual mean 200µg/m^3 1-hour mean	40µg/m^3 daily mean 200µg/m^3 one-time

*EU EC Directive 2004/107/EC, For the total content in the PM10 fraction averaged over a calendar year

** HSE Workplace Exposure limit, EH40/2005

WHO focuses on PM_{10} and $PM_{2.5}$ as, according to the scientific studies their guideline references, these size particles present the most serious risk to human health. Total suspended particulates is not considered to present the same health risks, and so no WHO guideline value has been published. The Kazakh standard for TSP will be applied.

Kazakh standards do not exist for PM_{10} and $PM_{2.5}$ particulates. The WHO guideline limits will be applied.

For SO_2, the WHO guideline is more rigorous, setting lower thresholds for both the 24-hour mean and short-term exposure limits. For NO_2, the WHO and Kazakh standard use the same threshold values, but the Kazakh standard applies more shorter exposure timeframes to the concentration limits, making the Kazakh standards more stringent.

WHO has not published a guideline target with respect to arsenic concentration in ambient air, but published a range of concentrations that equate to increased lifetime cancer risk. Preference is for a set limit, so reference is made to EU EC Directive 2004/107/EC and the UK's HSE Workplace Exposure limit, EH40/2005. The workplace exposure limit is not suitable for ambient air quality monitoring purposes, but is included for comparison. The EU emission target applies to arsenic contained in the PM_{10} size fraction of particulates, while Kazakh MPCs are set for arsenic contained in the TSP sampled. Baseline data has been collected in compliance with Kazakh requirements, and there is no data recording arsenic in the PM_{10} fraction of dust, so Kazakh standards will be applied for the purpose of assessment.

[4] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005

4.4.4 Monitoring Methods and Locations

Monitoring to RoK Requirements

The Environmental Code of Republic of Kazakhstan requires monitoring of ambient air quality on the boundary of the designated SPZ, according to the approved industrial environmental control programme. Presently monitoring takes place on a quarterly basis on the boundary of the previously approved SPZ for historic mining activities. The monitoring requirements on the boundary of this SPZ are still mandatory.

Sampling takes place on a quarterly basis at 12 points along the current SPZ boundary, and at a thirteenth location beyond the SPZ, using a Migunov M-852 aspirator.

The Migunov M-852 is fitted with the appropriate accessories to either sample nitrogen (IV) oxide (NO_2) or sulphur dioxide (SO_2), provide a real-time result, and record averaged results on analogue media. Alternatively, the equipment can be fitted with a filter to collect dust, samples of which are later analysed for total suspended particulates and arsenic content at a laboratory.

For more detail with respect to the sampling methodology, refer to Appendix 4.4.1.

The approved environmental control programme does not require continuous air quality monitoring in order to meet RoK norms. The sampling period for each determinand at each location is 20 minutes. The average over 20 minutes is compared to the one-time Maximum Allowable Concentration (as shown in Table 4.4.1).

The legislated monitoring locations are shown in Drawing 4.4.1.

Monitoring at Receptor Location (Auezov)

To meet the expectation of GIIP, continuous 24 hour monitoring of the ambient air quality is required. A location was selected on the eastern boundary of Auezov settlement to represent a potential residential receptor location, also shown in Drawing 4.4.1.

Gas Monitoring

The GANK-4 gas analyser is capable of sampling for both SO_2 and NO_2 simultaneously. A GANK-4 gas analyser was used to collect SO_2 and NO_2 samples, with sample collection taking place once per week for a period of 8 hours, during the month of June 2015.

These 8-hour sampling period results were then compared with the shorter 20-minute sampling period results taken along the boundary of the SPZ to establish whether the long-term monitoring was representative of the baseline air quality conditions around the site.

Photo 4.4.1: GANK-4 Aspirator in Use

Particulate Monitoring

The MicroDust Pro Aerosol Monitoring System was used to sample PM_{10} and $PM_{2.5}$ particle sizes at the single Auezov receptor location. The equipment uses a forward light scattering principle to make measurements of dust concentration. The sampling probe can be fitted with filters to allow for gravimetric analysis of total suspended particulates, respirable (4µm), PM_{10}, or $PM_{2.5}$ dust fractions.

The MicroDust Pro is capable of real-time PM_{10} and $PM_{2.5}$ readings, and the equipment was set to save hourly averages.

Figure 4.4.1: MicroDust Pro Aerosol Monitoring System

Sampling was carried out once a week during July 2015 for a 24 hour continuous period.

4.4.5 Monitoring Results

Gas Monitoring

The averages of quarterly monitoring results for SO_2 along the current SPZ are summarised in Table 4.4.2.

Table 4.4.2: Summary of Kazakh Regulatory SO_2 Results

Monitoring point	Average of quarterly results from Q1 2013 to Q4 2013 and Q1 2014 (µg/m³)	Q2 2015 results (µg/m³)
1	102.80	3.20
2	84.80	1.30
3	88.60	6.70
4	112.24	125.00
5	122.24	10.00
6	102.28	2.00
7	120.60	2.38
8	102.28	3.90
9	94.28	NA
10	90.26	1.28
11	100.26	10.20
12	128.24	8.20
13	130.20	2.00
Average	106.08	14.68
Median	102.28	3.55
Std	15.29	34.90

During 2013 to 2014, SO_2 concentrations were elevated above what would be expected in an urban area for 24-hour mean measurements. But because these measurements were taken to compare against Kazakh one-time MPCs, the readings cannot be directly compared. However the time period when samples were taken coincides with the period of time when the ore roaster would have been in operation. The ore has high concentrations of pyrite and arseno-pyrite, and so oxidising this ore through the roasting method would expect to generate SO_2 and so increase background levels around the site.

In comparison, the Q2 2015 results (in the third column of Table 4.4.2) were taken some time since ore roasting activities had ceased. With the exception of the outlier at monitoring point 4, these concentrations are typical of what would be expected in an area without active heavy industry.

In both cases, because the sampling lasts for 20 minutes, all concentrations lie well below the Kazakh one-time and International 10-minute thresholds (as shown in Table 4.4.1).

The Q2 2015 results also lie within the same order of magnitude as the 8-hour continuous monitoring for SO_2, undertaken in June 2015, and are lower than concentrations expected in industrial areas (Table 4.4.3).

Table 4.4.3: Summary of SO_2 Continuous Monitoring at Auezov Receptor Location

Sampling date	Average over 8 hour sampling period (µg/m³)
04 - 05 June 2015	8.47
11 - 12 June 2015	7.28
18 - 19 June 2015	3.53
25 - 26 June 2015	7.17
Average	6.61
Median	5.17
Standard deviation	6.96

NO_2 quarterly monitoring results of samples taken along the current SPZ, are presented in Table 4.4.4.

Table 4.4.4: Summary of SO_2 Continuous Monitoring at Auezov Receptor Location

Monitoring point	Average of quarterly results from Q1 2013 to Q4 2013 and Q1 2014 (µg/m³) *	Q2 2015 results (µg/m³)
1	30.67	82.00
2	32.29	20.00
3	10.50	7.20
4	11.37	53.50
5	11.00	39.00
6	10.20	35.60
7	21.29	80.10
8	8.84	7.00
9	9.84	16.00
10	10.75	11.60
11	10.75	21.50
12	10.50	56.00
13	10.75	75.00
Average	14.52	38.81
Median	10.75	35.60
Std	8.13	27.88

* Results are not available for monitoring point 1, 3, 5, 10, 11, 12, 13 in Q1 2014; site 3, 5, 6, 8, 9, 10, 11, 12, 13 in Q2 2014; site 3, 5, 6, 8, 9, 10, 11, 12, 13 in Q3 2014

NO_2 concentrations are notably higher in Q2 2015 than the average of previous quarters, at almost every sampling location.

The levels measured do not exceed the Kazakh one-time MPC for NO_2 (200µg/m³).

Table 4.4.5 summarised the continuous 8-hour monitoring results that were collected at the Auezov receptor location during June 2015.

Table 4.4.5: Summary of NO_2 Continuous Monitoring at Auezov Receptor Location	
Sampling date	**Average over 8 hour sampling period (µg/m³)**
04 - 05 June 2015	12.23
11 - 12 June 2015	15.40
18 - 19 June 2015	12.82
25 - 26 June 2015	20.53
Average	15.25
Median	14.80
Standard deviation	13.08

Table 4.4.5 shows that the NO_2 concentration are quite variable, averaging 15.25µg/m^3 but with a standard deviation of 13.08. If the 8-hour sampling runs are assumed to be representative of a full 24 hour sampling run, NO_2 levels at the Auezov receptor location are within acceptable limits and do not exceed the daily average MPC for Kazakhstan. These results reflect the range of the historic NO_2 monitoring data shown in Table 4.4.5.

Particulate monitoring

The quarterly monitoring programme provides data on TSP, but PM_{10} or $PM_{2.5}$ particulate fractions have not been recorded. More recent quarterly monitoring results (since Q1 2014) have also included analysis of inorganic arsenic content in dust. Table 4.4.6 shows the average of all quarterly results in the chosen dataset (Q1, Q2, Q3, Q4 2013; Q1, Q2, Q3 2014; and Q2 2015), and the average of all results where arsenic analysis was carried out.

Table 4.4.6: Summary of Kazakh Regulatory Results: TSP and Arsenic Content in TSP			
Monitoring point	TSP: Average of all quarterly results (µg/m³)	Average of Q1 to Q3 2014 and Q2 2015 results	
		TSP (µg/m³)	Arsenic in TSP (µg/m³)
1	100.50	93.50	2.05
2	145.88	176.75	2.35
3	117.88	113.25	2.13
4	111.00	117.00	1.83
5	120.50	131.00	2.30
6	114.75	117.00	1.90
7	118.00	121.00	1.93
8	116.41	125.33	1.63
9	124.13	143.25	2.03
10	128.50	147.00	2.00
11	122.44	127.38	1.58
12	170.89	239.28	1.58
13	106.44	112.88	1.44
Average	122.87	135.74	1.90
Median	118.00	125.33	1.93
Std	18.12	37.10	0.28

A series of weekly 24 hour particulate monitoring tests were carried out at the single Auezov receptor location. A summary of the PM_{10} and $PM_{2.5}$ results are shown in Table 4.4.7.

Table 4.4.7: Summary of Dust Particulate Results from July 2015 24 Hour Sampling		
Sampling date	PM_{10} 24 hour average (µg/m³)	$PM_{2.5}$ 24 hour average (µg/m³)
09 -10 July 2015	39.54	2.25
16 - 17 July 2015	25.46	2.13
23 - 24 July 2015	27.58	2.08
30 - 31 July 2015	26.17	2.63
Average	29.69	2.27
Median	30.00	2.00
Standard deviation	13.18	1.19

The monitoring site is situated near an unpaved road, and monitoring took place during July – the dry, hot season when conditions are likely to be most dusty. All results for each of the 24 hour sample runs are below WHO guidelines for 24 hour averages for PM_{10} (50µg/m³) and $PM_{2.5}$ (25µg/m³).

Arsenic

As seen in Table 4.4.6, daily mean arsenic concentrations in total suspended particulates along the boundary of the current SPZ range from 1.44 to 2.35µg/m³ (that is 1440 to 2350ng/m³). These levels lie within the Kazakh MPC of 3µg/m³.

4.5 Noise and Vibration

4.5.1 Baseline Noise Environment

The noise environment around Auezov settlement is quiet and residential in nature. It is influenced by the presence of animals, mostly dogs and cattle. The main source of noise in the settlement is from occasional traffic flowing to and from the mine facilities in the industrial area in the north of Auezov. Noise from the industrial area of Auezov, where current mine plant and support facilities exist, is generated as a result of the plant wrecking and salvage.

By June 2015, most large capital items were already removed from the plant buildings, and salvage activities consisting of dismantling the metal skeleton holding up the empty enclosures. Current noise sources in the industrial area are generally associated with mobile plant and equipment.

The elderly, teachers, and shift workers have made up the majority of residents in Auezov. Those not working at the mine assisting with the Care and Maintenance Activities are predominantly occupied with domestic activities, or small scale subsistence vegetable farming or animal herding.

4.5.2 Vibration and Air Overpressure

Vibration is transmitted through the ground, particularly rock strata and can result from three main sources:

- instantaneous events such as blasting or a seismic event;
- some construction activities involving impacts at or within the ground, such as piling; and
- movement of heavy goods vehicles on roads, especially if travelling at speed.

No blasting is required for current operations, therefore the baseline will have little or no ground vibrations induced through mining and related operations.

4.5.3 Baseline Noise Monitoring

No environmental noise monitoring has been carried out to quantitatively determine the baseline noise conditions in and around Auezov at potential noise receptor locations.

4.6 Geology, Seismology and Geotechnical

4.6.1 Regional Geology

The Bakyrchik gold deposit forms part of the Kyzl Gold Project along with the Bolshevik gold deposit which are both owned by Polymetal International Plc. Bakyrchik lies in the Kyzl district of mineralisation, and is situated within the northwest trending Western Kalba metallongenic belt, part of the Paleozoic East Kazakhstan Gold Province in northeastern Kazakhstan.

Northeastern Kazakhstan is underlain by a continuous belt of Paleozoic sedimentary and volcanic rocks, running from the eastern flank of the southern Ural Mountains, east into western Mongolia and southern Siberia (Russia). This belt is surrounded to the north, west, and south by Tertiary marine sediments and in the east by Lower Paleozoic intrusives and Mesozoic rocks. Figure 4.6.1 shows a geological map with the location of the Kyzyl project within Kazakhstan.

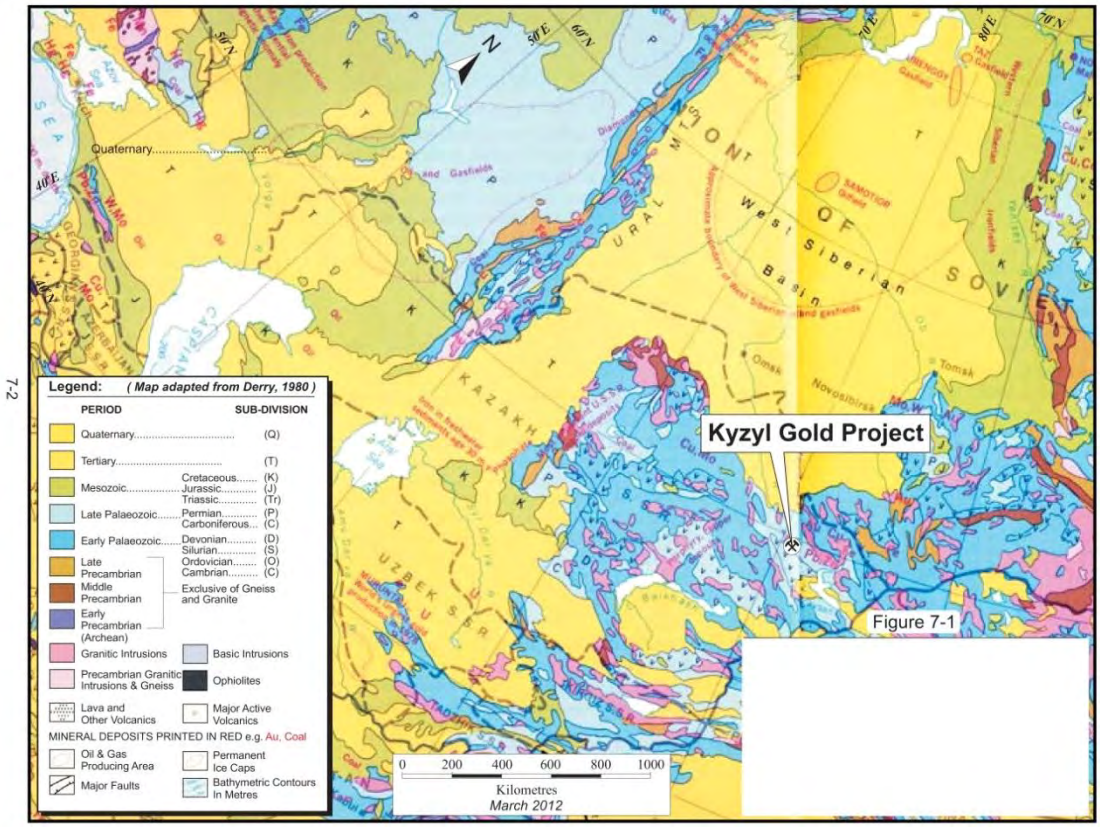


Figure 4.6.1: Metallogenic Regional Map

The Kyzl project is located in the central portion of the Kalbinsky synclinorium in lower and middle Carboniferous sedimentary rocks within the Kalba-Narymsk structural zone. A series of northwest trending metallogenic zones cross the region and contain three parallel zones of gold mineralisation. The project occurs in the easternmost Western Kalba metallogenic belt, which extends across most

of East Kazakhstan. This is part of the Late Paleozoic Eastern Kazakhstan gold province, where both orogenic and intrusive related gold deposits occur.

4.6.2 Local Geology

The Kyzyl district comprises a succession of tightly folded sedimentary rocks of the lower and middle Carboniferous these are underlain by granitic basement rocks. Tectonism combined with syn and post-tectonic intrusions, resulted in the formation of the Bakyrchik gold deposit. Stratigraphic units in the Project area, from youngest to oldest, comprise:

- Bukon Formation – c. 1000m thick comprising interbedded coarse polymictic conglomerate, sandstone, siltstone, mudstone and carbonaceous mudstone.
- Kokpekty Formation – c. 1800m thick and unconformably underlies the Bukon Formation and comprises the Upper Kokpekty Formation (carbonaceous siltstone, sandstone and mudstone) and the Lower Kokpekty Formation (sandstone, carbonaceous clayey siltstone, mudstone and conglomeratic lenses).
- Arkalyk Formation – <600m thick and comprises limestone, sandstone, siltstone and conglomerate.
- Granite Basement - underlie the sedimentary rocks at depths of one kilometre in the west of the lease area and three to four kilometres in the east.

Neither the Arkalyk Formation, nor basement rocks are exposed at surface. Tectonic activity has been extensive in the region with significant folding and numerous faults cutting through the bedrock. Folding occurs predominantly along northwest trending axes, however, the intensity and orientation of the folding is not consistent throughout. Four structural domains, each with varying degrees of folding, are partly defined by two main shear zones, the Kyzyl Shear Zone (KSZ) and the Parallel Shear Zone (PZ). Most of the gold deposits and occurrences in the Kyzyl District are hosted in the Kyzyl and Parallel shear Zones. Figure 4.6.2 shows a basic geological map of the Kyzl region.

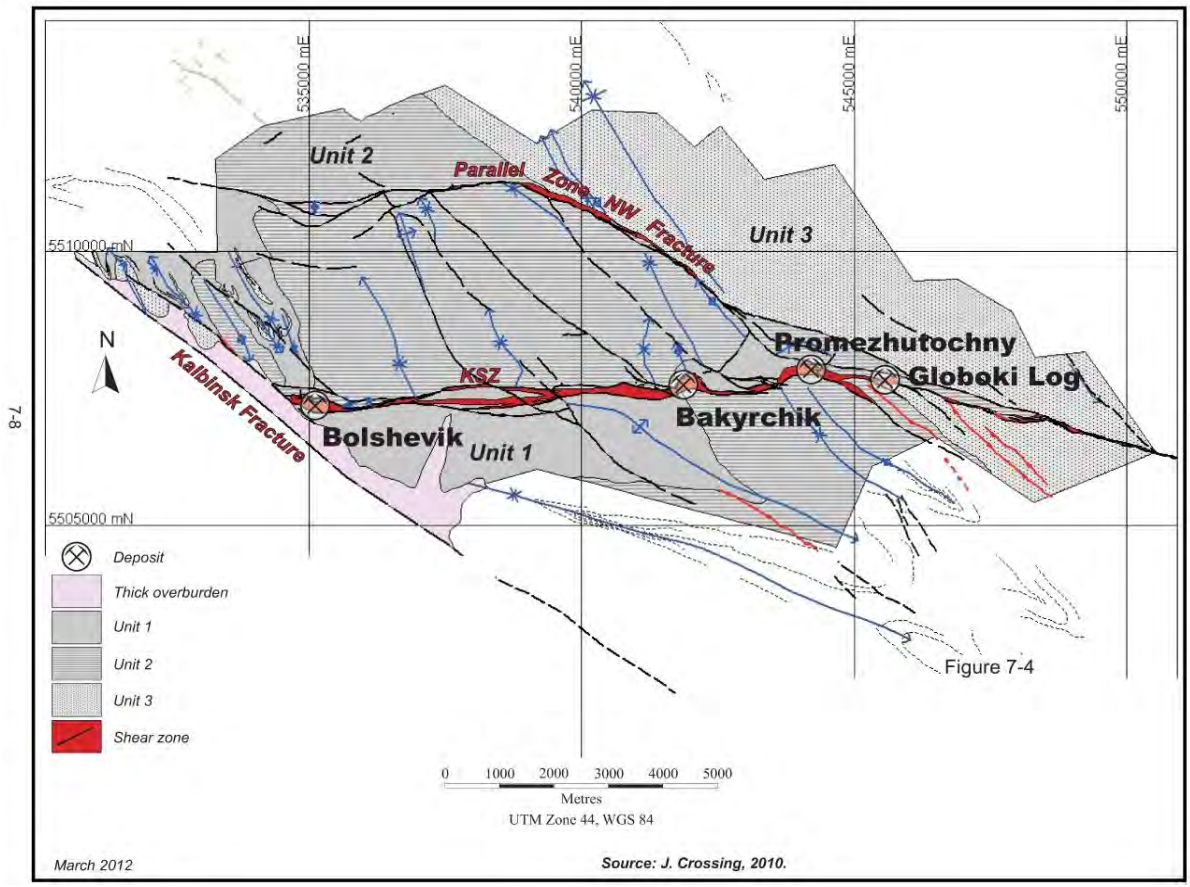


Figure 4.6.2: Basic Geological Map of the Kyzyl Region

4.6.3 Structure

The Kyzyl project is situated between two major faults, the Kalbinsk and Northwest Faults which trend N40˚W and dip 60º to 70º towards the northeast. These parallel faults are approximately nine kilometres apart, with sinistral movement forming zones of east-west brittle-ductile deformation. These zones are referred to as the Kyzyl Shear Zone (KSZ) and the Parallel Shear Zone (PZ). Most of the gold deposits and occurrences in the Kyzyl District are hosted in the KSZ, and at the intersections with the PZ and with the Kalbinsk and Northwest Faults.

Kyzyl Shear Zone

The Kyzyl Shear Zone is a broad shear zone approximately 11.5km long and with widths ranging between 10m and 240m. Hosted within the KSZ are the Bolshevik, Bakyrchik, and Promezhutochny mineralisation. The KSZ appears to split and re-join to enclose areas of un-sheared host rock. Thin anastomosing structures occur in the hanging wall, and to a lesser extent in the footwall.

The KSZ is identified in drill core by shear foliation, brecciation, alteration, sulphides, white quartz veining, folding, and a gouge zone at its hanging wall contact. The KSZ has been traced to depths of 1km to 1.5km in the west and 3km to 3.5km in the east.

Parallel Shear Zone

The Parallel Shear Zone is located approximately five kilometres north of the KSZ. The PSZ like the KSZ also strikes east-west and dips 40° north between the Kalbinsk and Northwest Faults. Its width, however, is limited to tens of metres or less.

4.6.4 Mineralisation

The Bakyrchik deposit is epigenetic, shear-hosted lode gold-sulphide type mineralisation. Gold is typically very fine grained and is held predominantly in arsenopyrite and, to a lesser extent, pyrite. Historically it has been reported that a small percentage of the gold occurs free. However, free gold has not been identified in recent studies.

It is considered that structural controls are of significant importance, with the tectonised rocks acting as conduits for hydrothermal fluid movement during deformation, with the location of mineralised lenses indicating the presence of high-permeability dilational zones. This is combined with lithological control, where preferential mineralisation occurs in more permeable, coarser grained sediments. Intrusive rocks are considered to act as a metal source and/or heat engine and influence the location of mineralization.

Gold-sulphide mineralisation within the KSZ typically occurs in foliated mudstones, siltstones, fine- to coarse-grained sandstones, interbedded units, and dioritic porphyries. Collectively, the mineralised zones have a planar shape due to the KSZ control. At a local scale mineralised zones are irregular in shape and thickness, and are associated with silicification, quartz veining, and stockwork quartz veins. Arsenopyrite is always associated with anomalous gold values. Gangue minerals include quartz, carbon, siderite, clay, barite, and less abundant alteration minerals including sericite, chlorite, calcite, albite, and biotite. Figure 4.6.3 shows a typical geological section of the mineralisation.

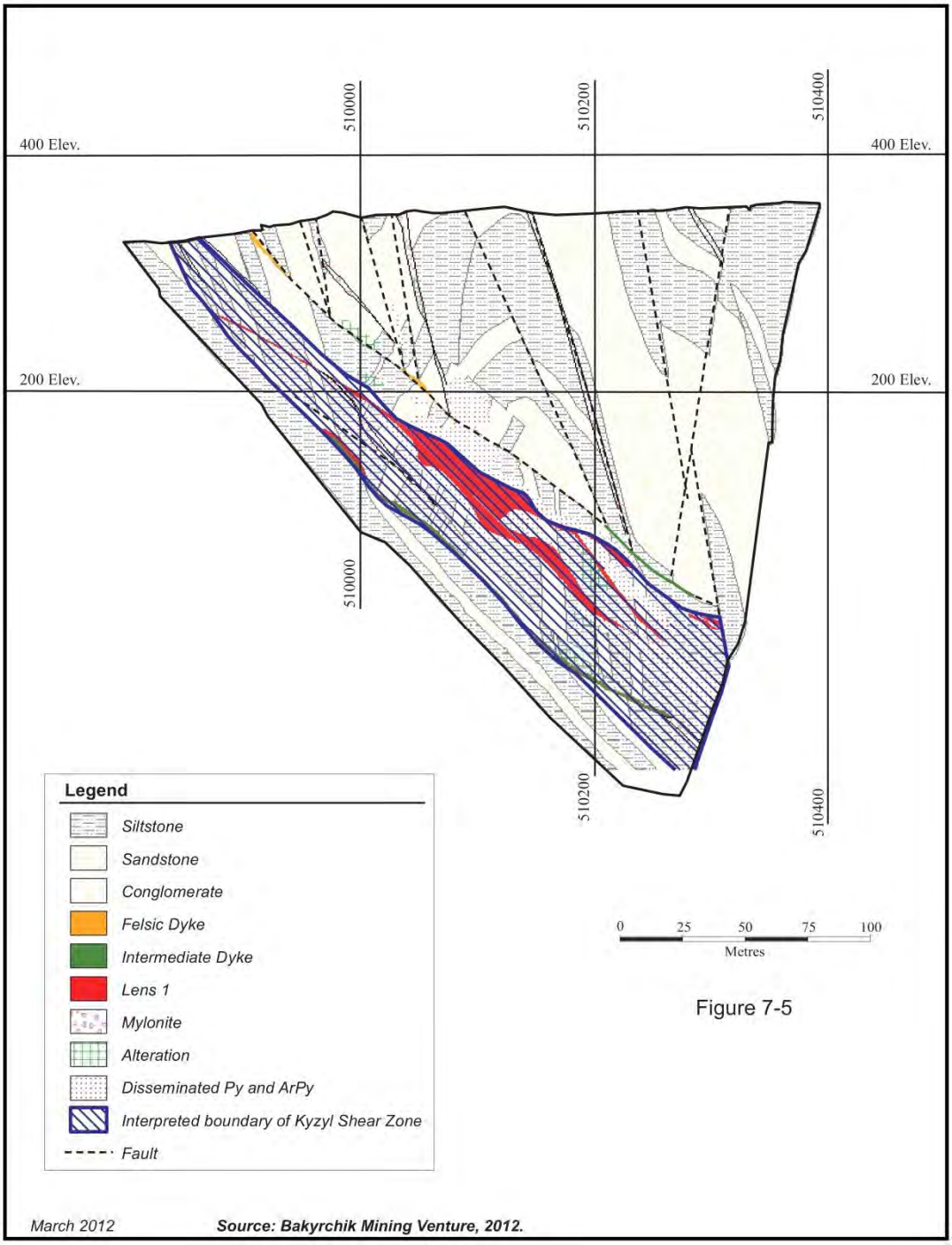


Figure 7-5

7-11

Figure 4.6.3: Typical Geological Section of Bakyrchik Mineralisation

Sulphide distribution appears to be related to host rock permeability. Coarser-grained sandstones tend to exhibit higher sulphide and gold concentrations. Historical studies identified five generations of veining and four stages of pyrite development. Two early generations consisted of veinlets of barren medium to coarse grained brecciated quartz, accompanied by the first stage of minor pyrite mineralisation. Third generation quartz was deposited in stockworks, cross cutting shear foliation and

older veinlets. This was the main gold-sulphide mineralising event that involved the second-stage development, and major phase of pyrite and arsenopyrite mineralisation. This phase is thought to contain 70% to 80% of gold mineralisation. The fourth generation is associated with the deposition of polymetallic minerals and medium-grained pyrite. This fourth mineralising phase is barren of gold. The final generation is identified by grey-white to milky quartz veining ranging from millimeter scale upto metre scale. This veining carries low values of remobilised gold.

4.6.5 Geotechnical

Introduction

This section describes the existing baseline conditions at Bakyrchik that influence, or are influenced by the geochemical environment; and gives the results of investigations into site geochemical characterisations. These studies help to define the potential for acid generation and metal leaching from the waste rock and ore and exposed by the surface and underground mining.

Study Area

The study area, for the purposes of this assessment, has been defined as the area within the perimeter of the surface mine footprint and their immediate vicinity within which soils and water could possibly be affected directly or indirectly by the mine project, taking into account all biogeochemical processes that determine soil conditions and water quality.

Impacts may extend outside the perimeter of the works as a result of run-off from the mine area into adjacent land and the baseline therefore extends to cover this area (taken to be up to 3km outside the perimeter). Information on baseline conditions in this wider area also provides context for assessing the impact of reduction in quality of water and soils within the mine project footprint.

Geology

The Bakyrchik gold deposit is located in the central portion of the Kalbinsky synclinorium in Lower and Middle Carboniferous sedimentary rocks within the Kalba-Narymsk structural zone. The deposit occurs in the easternmost of three parallel gold mineralization zones in a series of northwest trending metallogenic zones that cross the region. The primary gold mineralisation is associated with quartz veining, with high grade ore lenses in a shear zone within folded Carboniferous sandstones, conglomerates and turbiditic carbonaceous mudstones to siltstone. The gold ore is associated with fine grained pyrite and arsenopyrite, is mainly refractory, and largely hosted by the arsenopyrite. Mineralization is characterized by quartz veining, with fine pyrite and acicular arsenopyrite disseminated in the rock matrix, and coarse grains aggregated in more altered patches and bands. All vein types may be associated with abundant arsenopyrite and elevated gold grades. Gangue minerals include quartz, carbon, siderite, clay, barite, and less abundant alteration minerals including sericite, chlorite, calcite, albite, and biotite. Sulphide distribution appears to be related to host rock

permeability. Coarser-grained sandstones tend to be higher in sulphur and gold. There is occasional calcite, but not in all lithologies. Arsenopyrite is always associated with anomalous gold values.

Past History

There has been over 60 years of exploration at the Bakyrchik site, covering 237,474m ^{3} of trenching (1953-76); 837,110m core drilling (3 phases); and 17,990m of underground workings (1953-97). Open pit mining started in 1956 with 5 satellite open pits and 4 smaller pits in the surrounding area, and continued until 1994, in lens 12 and 1. Underground mining of near surface oxidized ore started in 1963 from lens 9 and 10 (upper) and stopped in 1997, having extracted most of the oxidized ore. Consequently, only sulphide ore remains at the site. A pilot plant was constructed at the site in 1994 but only ran until 1996. A pilot roaster plant operated from February 2009 to September 2010.

Proposed Mining

The proposed plan for the restart of mining at the Bakyrchik would extent the open pit mining, followed by proceeding to underground mining, accessed through the base of the open pit. The design of the open pit will extend the footprint to approximately 2,400m long by 860m wide, and 320 to 390m deep. The pit will be excavated with 30m benches and 10m berms, giving a pit wall slope angle of 41-48° and bench angles of 50-80°. Ore from the pit will be hauled by truck to the ROM plant stockpile while overburden waste rock will be trucked to the engineered waste rock dump (WRD). The underground mining method will be cut and fill stoping with cemented backfill, using flotation process tailings for backfill. Mine water inflows vary from 60 to 303m^3/hr seasonally, mainly from spring melt-water and occasional summer heavy rain.

Processing

The Bakyrchik ore is to be processed using flotation methods, potentially with additional gravity separation of the flotation products. The ROM ore will be crushed to <250mm before further reduction using a SAG mill and screening to <0.8mm. Initial carbon flotation will produce a carbon concentrate and a carbon float tailings. The carbon concentrate will be thickened and filtered to produce a carbon cake which will be stacked in separate carbon cake storage facilities (CCSF). The carbon float tailings feed into sulphide flash flotation to produce a Sulphite concentrate. Secondary grinding of the sulphide flotation tails to <71um will provide feed for a second sulphide float of the grind product, including rougher, scavenger and three cleaner stages. There is a possibility of further gravity separation of the combined flash float- and tertiary cleaner concentrates, to produce High- and Low-C concentrates. This would be followed by separate filtration and drying of both concentrates. Sulphide flotation tailings will be thickened and pumped for discharge to the tailings storage facilities (TSF). Later in the Project life, during transition from open pit (OP) to underground (UG) mining, part of the tailings will be transported to the mine backfill plant for cement addition and preparation for pumping underground.

If gravity separation is not used, the combined sulphide Au float concentrate will be transported to the metallurgical plant for processing. However, if concentrate separation is used, the High-C concentration product will go to metallurgical plant, while the Low-C concentration will be processed through a hydrometallurgical plant.

Geochemical Risk Analysis

Given the presence of sulphur in the Bakyrchik deposit, coupled with high levels of potential metal contaminants, there is a risk of acid generation and/or metal leaching from the Project.

Acid rock drainage (ARD), also referred to as acid mine drainage (AMD) or metalliferous drainage, occurs when sulphide minerals, particularly pyrite (FeS_2), chalcopyrite ($CuFeS_2$) and arsenopyrite (FeAsS), oxidise on exposure to oxygen (from air) and water. Mining and extraction of sulphide-bearing minerals tends to increase the potential for ARD, with rock being broken up and thereby greatly increasing surface area of exposed sulphide minerals to accelerated weathering processes and oxidation. Under these conditions, the rate of sulphide oxidation, and availability of neutralising material, will largely determine whether there is a significant potential for ARD. Sulphide oxidation produces sulphuric acid and ferric hydroxide, as summarised below:

$$FeS_2 + 3.75\ O_2 + 3.5\ H_2O \Rightarrow Fe(OH)_3 + 2\ SO_4^{2-} + 4\ H^+$$

Iron sulphide + Oxygen + Water $\Rightarrow$ Ferric hydroxide + Sulphate + Acid

As this acid migrates through a site (for example, through pit wall rock, waste rock dumps, ore stockpiles and deposited tailings), it reacts with minerals in the surrounding soil or rock and may dissolve a range of metals and salts. ARD can therefore display one or more of the following chemical characteristics:

- Low pH (typical values range from 1.5 to 4).
- High soluble metal concentrations (such as iron, aluminium, manganese, cadmium, copper, lead, zinc, arsenic and mercury).
- Elevated acidity values (50 to 15,000mg/l $CaCO_3$ equivalent).
- High (sulphate) salinity (typical sulphate concentrations range from 500 to 10,000mg/l; typical salinities range from 1000 to 20,000µS/cm.)
- Low concentrations of dissolved oxygen (such as less than 6mg/l).

Under the normal pH range of soils and water (pH 5 to 7), metals released by weathering of minerals generally precipitate and are relatively immobile. However, under lower pH conditions typical of ARD, these can remain in solution and be transported off site where they may have adverse effects on groundwater, soils, aquatic ecosystems and other downstream environmental values.

Migrating acid generated by this process may be neutralised by the minerals it dissolves, which has the effect of increasing pH. This neutralising capability is increased if carbonate minerals occur and

ARD may be completely neutralised by the dissolution of common carbonate minerals if available in sufficient quantity. Since the solubility of many toxic metals is pH-dependent, the neutralisation process can lead to precipitation of metals, including Al, Cu and Pb, and their consequent removal from the drainage. However, even at near-neutral or alkaline pH, such drainage may still contain elevated concentrations of metals/metalloids such as Zn, As, Nr and Cd.

The primary geochemical risk under consideration for the Project is that of potential ARD from sulphides, and, given the known high arsenopyrite content of the Bakyrchik deposit and As mobilisation properties, contamination from arsenic, in combination with other metals leaching.

Understanding of S and As

While the drilling and sampling from 1954 to 1967 only included a limited number of analyses for As or S, after 1967, pre-screening defined the gold content and from this, ore pulps were sent for 'full assay'. In addition, a total of 7,400 core samples have been analysed by SGS, Canada, using ICP and AAS for arsenic analysis, and the LECO furnace method for total S and C. The range for arsenic from these samples was given as 3.75ppm to 10,993ppm. For total sulphur, the range was 0.16% to 7.87%. Although there is a good analysis of the As and S levels from this data collection, it is nevertheless based on limited sampling.

The most recent geological work, for the 2015 Feasibility Study, has given open pit gold reserves which average 1.6% sulphide sulphur; 1.7% total S; and 0.7% As. This is consistent with the average arsenopyrite As content of 46%, and suggests that most of the sulphide and As in the shallower deposit is from arsenopyrite. Underground reserves average 1.2% sulphide S; 1.2% total S; and 0.7% As.

The average ROM feed head grades give a calculated arsenic content of 1.33% As, with total sulphur at 1.86% TS. The pilot plant float tails analyses gave a range of 0.16 – 0.29% S and 0.13% As, which reflects that most of the sulphides, and arsenopyrite in particular, would have reported to the float. The 'carbon product' is generally higher in %S than the tailings.

Apart from the specific ARD studies, there is currently little analytical data for the open pit waste rock, but given that the bulk of the sulphides, and arsenic in arsenopyrite, will report with gold as ore material, hauled to the ROM pad, the waste rock is expected to have low S and As content.

While the block model currently only defines the ore and waste based on Au assays, further iterations will include data on S% and As%. The Feasibility Study, and on-going orebody block modelling, should therefore provide an indication of the lithological composition of pit shells through various stages of open pit operations to final pit wall composition.

Sources of Information

The baseline geochemical conditions were assessed through review of available data on climate; regional and mine-site geology; water quality; soils; and land use in the area of the mine.

Studies undertaken to provide additional baseline information included testwork programmes for assessment of geochemical risk including acid rock drainage and metal leaching; and laboratory tests to understand the characteristics of materials that will be exposed to weathering and oxidation as a result of mining.

In addition to the baseline studies completed to-date, the Project will implement an on-going programme of site-specific surveys and studies to further define geochemical conditions. For subsurface formations, drilling of the orebody will continue over the life of the mine, and that data will be used to update the understanding of the geochemistry of the deposit.

Climate

Climatic conditions need to be considered in the understanding of potential geochemical risk. This includes continental temperature extremes of 40°C to -40°C, and an annual average precipitation of 250mm and evaporation of 500mm. Summers are hot, dry and dusty, with occasional heavy rainstorms, while winters are cold and snow bound with high winds (>15m/s). The fact that much of the precipitation is in the form of snow, that for 6 months of the year most water is frozen, and that evaporation is greater than precipitation, suggests that ARD risk is likely to be reduced, given the need for water/rock interaction.

Baseline Water Quality

Surface water - is discussed in more detail in Chapter 4.8 Water Resources, however for the purposes of geochemistry a brief summary is included here – The hydrological network of the district is represented by streams that are right bank tributaries of the Kyzylsu River, flowing to the Irtish River. The Kyzylsu River is the main waterway of the region with a catchment area of 1,067km2. River flow is almost entirely formed by seasonal snow-melt and rain water. Mineralization and chemical composition of melt water depend on the geographic position and the geological settings of the area, contamination by soil dust and the level of stream erosion. Mineralization of the snow melt and then stream water generally ranges within 17-50mg/l with the maximum value in individual years reaching 78mg/l. As the snow melts, the water streams running down the catchment slopes form a micro stream system. Prior to entering larger water courses and water bodies, the micro stream water forms its own chemical composition in a thin soil layer. The micro stream water has approximately the same composition as the melt water, but with higher mineralization due to dissolved bicarbonates. Mineralization of the micro stream water increases downstream due to the increasing depth of creek erosion and the longer the contact with the soil. Mineralization of the micro streams in the surveyed area ranges 40-30mg/l. The water in the river and streams is fresh with the mineralisation from 0.3

to 1.0g/dm^3, the chemical composition of magnesium-calcium bicarbonate, and at higher salinity - sulfate-bicarbonate, calcium-sodium

Groundwater - as above groundwater is discussed in more detail in Chapter 4.8 Water Resources, but for the purposes of geochemistry and summary is included here - According to the results of long-term trial pumping, the possibility of constructing site facilities of high-output production boreholes (about 10dm^3/s) was determined. The boreholes will be drilled in zones of high tectonic fracturing of water-bearing Palaeozoic rocks. In general, the groundwater formation in the region is as follows. In areas of hummocky terrain, accumulations of snow in the winter melt with the onset of higher air temperatures, and there is infiltration of meltwater. The intensity of this process is geographically uneven in the area. Hydrochemical conditions in the aquifer are determined by natural factors, including soluble salt content in the water-bearing rocks (chemical and mineralogical composition), permeability and groundwater filtration rate. Ion-salt composition of groundwater is formed by the processes of dissolution and leaching of mineral mass from rocks. Due to intensive water exchange and low residence time, the water in the aquifer tends to be low-mineralized freshwater, of bicarbonate calcium-sodium ion composition type, neutral or slightly alkaline, and with dry residue of 0.2-0.4g/dm^3. The water is clear, colourless and odourless, and has a good taste.

Mine water - In areas widely manifested in the area of the Bakyrchik ore occurrences and scattered gold-sulphide mineralization zones, fissure water, due to dissolution of oxidized sulphides, is enriched with sulphates, mobile forms of arsenic, iron, manganese, as well as minor amounts of copper, lead, zinc, cadmium and other microelements. In terms of chemical composition, the water is hydrocarbonate and hydrocarbonate-sulphate calcium, calcium-sodium with mineralisation 0.2 to 0.6g/dm^3. Water hardness varies from 2.1 to 5.3mg-eq/dm^3, and pH varies from 6.7 to 7.9. In the majority of indicators, the groundwater meets the Kazakhstan Regulatory requirements. The content of toxic elements, in mg/dm^3 is as follows: iron 0.1-0.25; Mn 0.01; As 0.005; F 0.1-0.15; Mo 0.0025; Cu 0.7-0.87. Content of Zn, Pb, Cd, Al is below the permissible levels. Chemical analyses of mine water from dewatering of 'Capital' shaft show considerably higher contaminant levels, especially of As and Cd, and sulphate often over the regulatory limit of 500mg/dm^3. However, the shaft dewatering water annual averages for pH since 2002 has not been less than 7.5.

Local Soils and Land-Use

The area is characterized by abundance of dark chestnut medium and lightly loamy soil occupying the west, north and southern parts of the range at the height up to 800m. Above that height the dark chestnut soil is replaced with the mountain black soil which also covers the entire east elevated part of the Kalba range. In the central part of the Kalba range there is mountain-silvogenic grey soil with occasional spots of mountain-meadow rocky soil. In the low areas of the range there are small areas covered with light chestnut clay and heavy loamy soil. In terms of salinity, the soil in the survey area is normal nonsaline valley soil on loose rocks, typical of dry, freeze-thaw regions. There are also other typical 'dry' soils including southern black soil, dark-chestnut and light-chestnut soil usually developed

on thick loam sediments. Soil fertility is generally low, and soils in the area are used mainly for pasture and hay. Detailed soil description of the Project area is presented in Chapter 4.7 Soils and Land Cover.

Geochemical Studies

Several studies have been undertaken on the geochemical characterisation of the ore, waste rock and tailings from the Bakyrchik operation, to assess the potential ARD and metal leachate that could derive from exposed pit walls, surface stored waste rock and ore stockpiles, surface tailings facilities and the waste backfilled into mined out stopes. The following reports and documents have been used as part of this assessment of the current status of ARD and metals leaching understanding:

- EGi Ltd - Geochemical Assessment of Waste Rock and Ore, Doc no: 8553/920, August 2010;
- EGi Ltd - Geochemical Assessment of Tailings, Doc no: 8553/991 March 2011
- EGi Ltd – Project Status Summary, July 2012;
- Sample site locations Drawing;
- Polymetall Engineering JSC - Acid Neutralisation/Generation Potential of Waste Rock (sample T-357), January 2015; and
- Bakyrchik Acid Generation Report Appendices.

While these studies provide an indication of the geochemical conditions at the mine, continuous work is required to better understand the potential acid generation and metals leaching risk for the Project, both through additional sampling, analysis and testwork.

EGi Studies

The objectives of the initial study undertaken by EGi in 2010 was to assess the potential for ARD at the site, to identify the main ARD issues, to provide recommendations for materials management, and for further work required. The work carried out for the study included a review of the 1996 database; selection of suitable waste rock and ore samples for the investigation; design of a test programme for the process tailings, to be undertaken by Hazen Research; and geochemical characterisation of these main mine products. While assessment of the pre-existing mine waste materials at the site was not part of the original scope of the study, as some of the old waste rock may have been used as backfill in the proposed new underground operations, samples of this material were collected and testwork undertaken.

The rationale for the target lithologies, depths and spatial distribution of sample locations was based on providing a good representation of the rocks to be extracted by the proposed mining operation. Following identification of potential ARD sources from such an operation (open pit and underground workings, development waste, ore stockpiles and tailings), samples were selected using the Bakyrchik geological and assay database to represent the variety of rock types to be mined; to assess variation in S, carbonate minerals and As for the waste materials from an open cut operation, rock that would

make up hanging and footwalls, and examples of ROM- and low grade ore (LGO). This produced a suitable range of samples for the testing programme.

A total of 186 samples were collected from the 8 boreholes from the 1996 drilling programme based on the geology, ore/waste designation, and assays. Given the location/distribution of the sample boreholes, 186 samples from 8 drill holes was sufficient for this study. Sampling for ARD assessment should reflect both the range and relative abundance of the different lithological units encountered in the mine rock mass, and ideally a minimum of 1 sample per 1Mt should be collected to represent the mine rock units. In addition, a further 24 grab samples were collected from pits excavated in old waste rock material from an open pit which exploited an extension of the current ore lens target. The total 210 samples therefore included 160 samples of waste rock and 50 of ore material. The sample collection, labelling, handling and preparation procedures are well documented and rigorous. The QA/QC was thorough and any errors identified and accounted for.

The testing programme for the waste rock and ore samples was designed for the objectives and used appropriate standard methodologies. This included pH, electrical conductivity (EC), acid base accounting (ABA) using Leco Total S% analyses, acid neutralising capacity (ANC) and single addition net acid generation (NAG) tests, with additional acid buffering characteristic curve (ABCC) for selected samples; sequential NAG with S tracking and kinetic NAG on higher S% samples; sulphur speciation; multi-element analysis; and batch leach kinetic tests. The labs used for all of the testing and analyses are reputable and accredited.

The tailings testing was undertaken on a composite CIL Roasting pilot plant tailings sample and is therefore not applicable to the flotation processing tailings proposed for the current Project. Nevertheless, there are some relevant conclusions from this study that inform the current baseline studies.

The second EGi study was a further characterisation of the CIL process tailings and therefore only limited useful data can be drawn from the study.

The final study was the 2015 Polymetal Engineering JSC mineralogical and ARD investigation of waste rock materials. In this study, composite samples were made up from drill core to represent 5 lithology types that will make up the project waste rock, and these samples used for mineralogical analysis by thin section microscopy, with accompanying micrographs. ARD studies included ABA, NAG and single stage batch leach using pulverised sample and distilled water.

Study Results and Conclusions

The EGi ARD tests gave paste pH for all samples that range pH7.3 – 9.4, and EC of 0.12 - 0.98 dS/m with low salinity. Analyses of total sulphur gave results that ranged from 0.01%S to 6.5%S, with ore samples generally higher than for waste material. The median total sulphur result for ore samples was 0.8%S, while the median for waste was less than 0.2%S.

Acid neutralisation capacity is determined through testwork, by adding excess hydrochloric acid to the sample, and heating to ensure complete neutralisation. Any unconsumed acid is then titrated with sodium hydroxide to pH 7.0 to provide a measure of how much acid has been consumed by the sample, expressed as kg H_2SO_4 / t. The ANC results for the Bakyrchik samples were generally high, reflecting the common occurrence of carbonate minerals in the deposit, with maximum ANC of 204kgH_2SO_4/t. There was little difference in ANC between the waste and ore samples, the median for both being 45kgH_2SO_4/t.

The acid producing potential (APP) is calculated from the analysed %S content and the theoretical amount of sulphuric acid that could be produced from complete oxidation of the material, assuming that all S% is in the form of pyrite, based on the stoichiometric reaction for pyrite oxidation. This calculation therefore generally overestimates the potential acid production. Net acid producing potential (NAPP) is the difference between the APP and ANC of a sample, with negative results indicating that the sample may have sufficient ANC to prevent acid generation. Conversely, a positive NAPP value indicates that the material may be acid generating. Results show that 93% of the waste samples gave negative NAPP values, while 69% of the ore samples were negative. It should be noted that there is a range of NAPP results of <20 and >-20 kg H_2SO_4/t, that are subject to a degree of uncertainty.

The NAG test involves the oxidation of all reactive sulphides in a sample, by the addition of hydrogen peroxide, with the final pH of the solution giving the balance between acid producing and neutralising reactions. Single addition NAG tests showed that 200 of the Bakyrchik samples had NAG results consistent with NAPP estimates, while 10 were inconsistent.

These tests indicate that 180 of the samples are non-acid forming (NAF), 20 are potentially acid forming (PAF) and are 10 uncertain. Significantly, 28 of the NAF samples were >0.5S% and mod-high ANC suggesting possibly incomplete oxidation of the material.

Sequential NAG testing of higher S samples was undertaken to ensure oxidation of all pyrite and improve predictions of total acid potential. Of the 20 >1%S samples tested, 10 were likely NAF and 10 slightly PAF.

Acid buffering characteristic curve (ABCC) testing of selected samples to define the relative availability of the ANC measured indicated that all neutralising mineralisation was ferroan dolomite-dolomite, and that 100% of ANC was likely effective but some may be slow reacting.

Sulphur speciation showed that most of the %TS occurs as pyrite and mineralogy investigations shows pyrite and arsenopyrite are the most common sulphide minerals.

The kinetic NAG tests of higher %S samples were undertaken to check pyrite reactivity and to indicate lag times. Results suggested lag times varied from less than 2 months to more than 2 years, with most

tests predicting a 2-6 months delay to acid production. Generally, the lag time decreased with increasing %S.

Multi-element analysis of all the samples showed a strong As and Sb enrichment with some other elements raised above average crustal abundance. Analysis showed that As>Sb>S>Be, Se>Ag, W.

Batch leaching with water gave extracts from all samples with pH>7, non- to slightly saline, and EC of <0.8dS/m. There was some mobilisation of arsenic even under alkaline pH, with most As >100ug/l, up to 1230ug/l. The amount of arsenic in water extracts increased with increasing solids As. Three samples had slightly elevated Mo contents, but Sb, Be and Se were not mobilised.

Polymetal Mineralogy Results

All 5 lithological types are similar altered sedimentary rocks, with superficial material from less than 35m depth, more oxidised. The 5 composite samples show the same mineral composition and diversity, but with slightly different quantitative ratios. The main minerals are quartz, mica, chlorite and serpentine, with lesser carbonates, feldspars and carbonaceous material. All 5 samples studied contained less than 0.3%S, mostly as pyrite with some pyrrhotite, arsenopyrite and sphalerite. Carbonates made up 4-14%, mostly as calcite and dolomite, with common magnesite-siderite and ankerite.

Polymetal 2015 ARD Results

Given the low sulphur content of these composite samples, the calculated APP was from <0.15 to 8.9kgH_2SO_4/t. Similarly, the carbonate contents gave rise to relatively high ANC results of 45 to 73.6kgH_2SO_4/t. This in turn resulted in all samples having a negative NAPP. In the NAG test, where a NAG pH less than 4.5 indicates the sample is acid producing, the final pH from all samples ranged 5.74-7.27. The batch leaching with distilled water gave extracts of pH 7.92-8.41 and low EC of 286-443uS/cm. Iron was elevated in all leachates, especially in the superficial sample, but arsenic was only elevated in 1 sample, probably reflecting the low amount of arsenopyrite in this material.

Overall Waste Rock and Ore Conclusions

- the ore material higher in S% (and sulphides) than waste rock;
- 94% of waste samples were NAF;
- 38% of ore samples were PAF or in the 'uncertain' acid forming range;
- all of the old WRD grab samples had low sulphur, <0.5%S, and all were NAF;
- the low proportion of potentially acid forming waste rock is likely to show a time lag of 2-6 months before start of ARD production;
- total S can be used as an indicator of potential ARD (0.5%S cut-off NAF/PAF);
- CO_3 is not a suitable parameter for assessing ANC from the database;

- arsenic is elevated in almost all samples, and may be mobilised even in neutral/alkaline pH; and
- ore material may generate acid depending on how long it is stored prior to processing. This may be a particular issue for any low grade stockpiles.

Thorough mixing of waste rock is likely to give a net NAF waste, but further delineation of higher risk waste rock will be needed to ensure this material is not placed in the outside of the WRD.

CIL Tailings

All of the roasting pre, and post CIL, tailings were low in sulphur, but significantly enriched in As. While the ARD testing results of this material are not relevant or applicable to the flotation tailings from the proposed processing circuit, there are some conclusions from this work that have implications for the cemented tailings to be used for backfill.

The roasted pre-CIL composite tailings material was split and used for various % cement additions, followed by 28 days curing. A similar programme of geochemical characterisation was undertaken on the 4 cement addition samples, as well as TCLP testing and single stage batch leach tests using deionised water and simulated groundwater, with analysis of all extracts.

Results that have significance to the proposed flotation tailings are that leach extracts, for both distilled- and simulated ground-waters were alkaline, with pH 8.1-12.5 increasing with cement content. Sulphur content appeared to be stabilised in cement so was not removed in water. Around 50% of As was removed from raw tails by both waters, and although As decreased in extracts with increasing cement, it was still leaching out from the cured cemented mixes. The TCPL test leachates exceeded USEPA maximum limits for As in all samples by 20-40 times, regardless of cement %. All other elements were below USEPA ML. Modelling and test results indicate that while cement addition may delay As release it may not stop it. Cement stabilises As under high pH but atmospheric conditions and continuous flushing could release As loads.

Similar results for the post CIL tailings, showed water batch leach extracts from the raw tailings giving 20,000ug/l As, while cemented tailings extracts had 100-200ug/l As. Similar trends were seen for Sb extraction. Sequential batch extraction showed continuous As release even from cemented samples, though of lower values (75-240ug/l). The TCPL results also showed As exceeding the USEPA maximum, by 7 times for raw tails and by 2 times for cement mixes. Column leach testing showed a gradual continuous increase of As release from raw tails, while Sb extraction was initially high but decreased with time, and boron was slightly elevated and increased over time. The same trend for As was seen in column leaching of the cemented samples, but order of magnitude lower. Arsenic leaching increased as alkalinity and pH decreased.

While these test results are from a very different tailings material, they illustrate the very high solubility and mobility potential of arsenic in various forms, and even when in cemented, high alkaline backfill.

Conclusions

- ARD is not considered to be a major issue at Bakyrchik, but ongoing geochemical studies and regular monitoring are required to continually assess and update this conclusion;
- total S% can be used for ARD prediction, using a 0.5%S cut-off, but this needs further study to confirm;
- there could be a 2-6 month time lag on ARD initiation from waste rock with high enough S%;
- ore in the ROM and Low Grade stockpiles could be ARD producing if left too long;
- high S% rock exposed in pit wall faces for extended periods may also generate acid;
- there have not yet been any geochemical studies on the flotation tailings. While they are expected to have low ARD potential, there may be As and other metals leaching risk; and
- backfilled cemented tailings and waste rock may release As after time and needs further investigation.

Ongoing production and exploration drilling and analyses will continue to inform and improve the understanding of the distribution of higher S%, PAF rocks in the project orebody, and the proposed >0.5%S can be used as a guide for management of potentially acid forming waste rock.

Further geochemical characterisation of the flotation process tailings will be undertaken to determine the residual sulphide and arsenic content and thus the potential ARD and leaching risk from the TSF.

The project mining and processing description has changed considerably since much of the geochemical testwork was undertaken. While the site-wide sampling and general ARD testing is still applicable, considerably more waste rock will be produced with the new mine plan that previously anticipated. Similarly the tailings testwork will have to be repeated using samples of flotation tailings from the pilot plant work.

Although ARD is unlikely to be an issue, the understanding of tailings waste geochemistry remains incomplete, therefore, conservative mitigation measures will be considered to address potential impacts in the Geochemistry Impact Assessment Chapter 5.5.

4.7 Soils and Land Cover

4.7.1 Introduction

This chapter describes the soils present in the Project area. It begins with a general desk study using published information and then reports results of the soil survey carried out to describe morphological characteristics of the soils. Chemical properties of the soil are presented based on analysis of samples collected during the surveys and data from the ongoing soil monitoring.

4.7.2 Published Information

According to the 1:25 000 000 World Resource Base Map of Soil Resources[1] the Project lies within Kl4-2b and Kh1-2b soil associations, Luvic Kastanozems and Haplic Kastanozems, respectively, in a stony phase (area where significant soil stoniness occurs). Kastanozems are also called chestnut soils because of their dark brown colour. The associations comprise medium textured soils on a rolling to hilly terrain, without any other associated soils or inclusions. The 1:2 500 000 Soil Map of the Kazakh SSR[2] classifies the soils as mountain Kastanozems soils.

A typical soil profile comprises dark brown Ah (humic topsoil) horizon rich in organic matter over a brown to cinnamon cambic (weakly developed) or argic (of increased clay content) B-horizon and with lime and/or gypsum accumulation in or below the B-horizon. Kastanozems can be used as arable land, they are often irrigated. Many Kastanozems are used for extensive grazing. Drought (wind and water erosion are serious limitations).

4.7.3 Soil Survey

In order to describe soil horizons, trial pits were dug to 1m depth or bedrock. Trial pit inspections were carried out in July 2015 (survey points 1–34) and in September 2013 18 monitoring points (survey points M1–M18). The location of points in relation to existing and proposed mine layout are shown in Drawing 4.7.1 and Drawing 4.7.2, respectively, which include the main mine infrastructure required to develop the open pit.

Soil horizons closely relate to land use, which is described in depth in Chapter 4.15 of this baseline report. In particular, anthropogenic influences on soil horizons are most prominent in areas used for grazing by herders (Drawing 4.12.4).

[1] Available online at: http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/other-global-soil-maps-and-databases/en/ (accessed 6 September 2015).
[2] Available online at: http://eusoils.jrc.ec.europa.eu/library/maps/country_maps/metadata.cfm?mycountry=KZ (accessed 6 September 2015).

Soil samples were collected in July 2015 from the 34 trial pit locations. The samples obtained from July 2015 were analysed for pH, organic matter content, cyanide, petroleum hydrocarbons and the following elements: As, B, Be, Cd, Co, Cr total, Cr (III), Cr (VI), Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, V, Zn.

Samples from the 18 monitoring points were analysed for: pH, Dry residue, Ca, Mg, Na, K, HCO_3, Cl, SO_4, NO_3; total content of: Cu, Pb, Zn, As, Mn, Cd, V, Hg, F, Ni. Samples from year 2010, 2012, and 2013 were additionally analysed for water soluble forms of: Cu, Pb, Zn, As, Mn, Cd, V, Hg, F, Ni; and mobile forms of: Cu, Pb, Zn, As, Mn, Cd, V, Hg, F, Ni.

4.7.4 Soil Characteristics

Soil profile descriptions from trial pits are presented in Appendix 4.7.1. The topsoil in majority of the sampling points has fine loamy texture, weak, single grain structure, and loose consistence. Subsoil, in general, begins at 15–30 cm, it has sandy and gravely texture, with clay present in places, it is generally distinguished by strong increase in shattered rock or gravel, content of which abruptly increases with depth (see Table 4.7.1).

Table 4.7.1: Main Soil Types Present in the Project Area

Generalised soil type	Sampling points	Similar profiles, exceptions
Shallow topsoil (15-30 cm) over rocky subsoil.	1, 3, 5, 8, 10, 11, 14, 15, 16, 19,21, 23, 24, 26, 27, 31, 32 M1, M2, M3, M5, M6, M7, M8, M9, M10, M11, M14, M18	M16 (35 cm to rocky horizon), 34, M40 (40 cm to rocky horizon), 4 (rocky throughout)
Topsoil removed	2, 7	M4 – building rubble present
Deeper soils (over 40 cm to rock or rocky horizon)	17, 18, 22, 25, 28, 29, 30, 33	12, 13, 20, M12, M13 (chernozem-like), 6 (waterlogged)

Soils over the majority of the Project footprint are low in organic matter (ranging from 1.4 to 9.5%, 3.5% on average, see Appendix 4.7.3), organic matter rich soils (7–9.5%) tend to be located in stream valleys.

4.7.5 Soil Chemical Properties

Detailed results of chemical analysis are presented in Appendices 4.7.2 and 4.7.3, they comprise data for the 18 monitoring points for samples collected in years: 2010, 2011, 2012, 2013, 2014 (points M1–M18) and for the 34 samples collected in July 2015. They are summarised in Table 4.7.2 and Table 4.7.3.

Most recent pH measurements (July 2015 for points 1–34 and September 2013 for points M1–M15) show that topsoil in undisturbed areas (within the footprint of the waste rock dump (WRD), tailings storage facility (TSF), and processing plant, see Drawing 4.7.2) is slightly to moderately alkaline, pH ranges from 7.5 to 8.1 (points 7–33, M12 and M13). Strongly alkaline areas are present where pH <8.9

was recorded (see results for points M8 and M9); however, for these sampling points inconsistency with pH in nearby points suggests a local anomaly. Values >pH 9.0 were recorded in two points, M10 and M17 and only during the samples obtained up to 2013. This data, therefore may have been a consequence of greater local variability resulting from disturbance and inclusions of bedrock in the topsoil and has not been corroborated by sampling in 2015.

Nitrate concentrations do not exceed the Kazakh maximum allowable concentration (MAC) value. Increased concentrations of sodium and sulphate compared to average background values (point M18) were recorded only in samples from point M4, this could be explained by presence of construction waste or/and local soil disturbance which exposed gypsum accumulation which occurs in this soil type.

To assess the content of potential contaminants the Kazakh MAC and background (sampling point M18) were used. For comparative purposes, the concentrations were also compared to the United Kingdom General Assessment Criteria (GAC) guidelines. The GAC guidelines conform to EU directives and are continually updated. They provide values for specific groups of uses which vary in exposure pathways and therefore provide more informative assessment than comparison with the general Kazakh MACs.

The UK Environment Agency (EA) have published their recommended approach on undertaking human health risk assessments in the UK, their revised Contaminated Land Exposure Assessment technical guidance (CLEA model), in January 2009. In addition, the EA have released Science Reports SC050021/SR2 and SC050021/SR3 along with a new CLEA Model (Version 1.06) to calculate revised Soil Guidance Values (SGV). At the time of writing, SGVs for a number of potential contaminants have been published (i.e. benzene, ethylbenzene, toluene, xylene, phenol, mercury, selenium, arsenic, nickel, cadmium and dioxins).

The Chartered Institute of Environmental Health (CIEH) and Land Quality Management (LQM) produced a set of Generic Assessment Criteria (GAC) using the CLEA model in 2009. This report provided GAC (i.e. screening values or trigger concentrations) values for a number of potential contaminants including:

- Aliphatic and aromatic hydrocarbon fractions;
- Individual Polycyclic Aromatic Hydrocarbons (PAH);
- Selected volatile organic compounds and semi-volatile organic compounds; and
- Metals and non-metals - beryllium, boron, cadmium, chromium, copper, vanadium and zinc.

Additionally, members of the Environmental Industry Commission (EIC) undertook an initiative to produce a further set of GAC values in December 2009 to complement the SGVs published to-date by the EA and GACs published by CIEH/LQM. This report has provided GAC values for a number of potential contaminants including:

- Metals - antimony, barium and molybdenum;
- Phthalates;
- Halogenated organics;
- Selected hydrocarbons; and
- Selected phenols.

More recently, in January 2015, CIEH and LQM produced Suitable for Use Levels (S4ULs); a further set of assessment criteria to support generic quantitative risk assessment (GQRA) which are "intended to provide a complete and updated replacement for the 'old' LQM/CIEH GAC." These, most recent, values for residential areas with plant uptake (RPU) and allotments (ALLOT) were used in this assessment. These values are much lower than limits for commercial and industrial sites, but they were deemed appropriate due to largely undisturbed and uncontaminated character of the Project area.

Table 4.7.2: Reference Values and Sampling Points in which they were Exceeded, see Appendix 4.7.2 for Individual Sample Results

Analyte	Form	MAC	GAC		Background[3]
			ALLOT[1]	RPU[2]	
	Concentration mg/kg				
Copper (Cu)	Total	-	520 None	2400 None	40
	Labile	3 None	-	-	<0.01
Lead (Pb)	Total	32 M1, M3–M7, and M9	80 None	200 None	22
	Labile	6 None	-	-	0.06
Zinc (Zn)	Total	-	620 None	3700 None	80
	Labile	23 None	-	-	0.97
Arsenic (As)	Total	2 M1– M7, M9–M12, 2, 6, 11, 17, 21, and 25	43 None M1, M2	37 None M1, M2	<2.0
Manganese (Mn)	Total	1500 None	-	-	984
Cadmium (Cd)	Total	-	1.9 M1, M2, M4, M7, M5, M6, M9, M10, (M18 one event)	11 M2, M7, M10*	1.3
Vanadium (V)	Total	150 M1, M2, M3, M5, M6, M9, M10, M11, M12, M14, M17, 28	91 All except point 20	410 None	129
Mercury (Hg)	Total	2.1 None	21 None	1.2 None	<0.0002
Fluorine (F)	Labile	2.8 M4, M6, M7*	-	-	<4.0
Nickel (Ni)	Total	-	53 M2, M5, M16	130 None	41
	Labile	4 None	-	-	-

1 – maximum values for use as allotments (gardens)
2 – maximum values for residential use with plant uptake
3 – average for survey point M18 of values for year 2010, 2011, 2012, 2013, 2014 (not all records)
* – on single sampling events only, possibly anomalous result

Table 4.7.3: Reference Values and Sampling Points in which they were Exceeded, Measured in July 2015 Samples (Points 1–34) Only, See Appendix 4.7.3 for Individual Sample Results

Analyte	Form	Kazakh MAC	GAC		Average[3]
			ALLOT[1]	RPU[2]	
		Concentration mg/kg			
Boron (B)	Total	-	45 None	290 None	<50
Beryllium (Be)	Total	-	35 None	1.7 None	<1
Cobalt (Co)	Labile	5.0 (no data)	-	-	16 (total)
Chromium	III (labile)	6.0 (no data)	15300 None	627 None	<50
	VI (total)	0.05 (no data)	1.8 (no data)	6 (no data)	<50
Iron (Fe)	Total	-	-	-	42284
Molybdenum (Mo)	Total	-	-	670* None	2.5
Antimony (Sb)	Total	4.5 None	-	550* None	2.1
Selenium (Se)	Total	-	88 None	250 None	2.1
Cyanide (CN)	Total	-	-	-	0.01 or lower (detect. limit)
Petroleum hydrocarbons	Total	-	1200** None	1600** None	0.01

1 – maximum values for use as allotments (gardens), UK GAC standard
2 – maximum values for residential use with plant uptake, UK GAC standard
3 – average for all July 2015 sampling points
* – EIC values for residential use without plant uptake, ALLOT and RPU S4UL values were not available
** - S4UL values for Aliphatic + Aromatic EC >44-70 hydrocarbons

Total Pb content of agricultural soils lies between[3] 2-200mg/kg and all the results were within that range (the highest recorded concentration was 58 mg/kg). Total Pb content exceeded the Kazakh MACin points M1, M3–M7, and M9. Results were generally stable over the years.all the points except point M9 are located in areas of industrial activity, which may have exposedlead containing bedrock. In all sampling points the concentrations were below GAC limits.

In soils Zn is typically present in the range of 10–300mg/kg, its concentrations in the Project area were up to half this range. Concentrations of Zn were elevated in points M2, M5, M6, and M7, located in areas of industrial activity, the exceedances were up to 1.7 times the concentration specified in the Kazakh MAC limit. Similarly to Pb they can be explained by exposure of weathered bedrock. This is corroborated by high natural background concentrations of Zn in the Project area, with most recent record being 101mg/kg compared to the 100mg/kg MAC limit. In all sampling locations the concentrations were below GAC limits.

[3] Mengel and Kirkby, 1978 Principles of Plant Nutrition, Der Bund AG, Bern, Switzerland.

Total As concentrations exceeding the Kazakh MAC values were recorded in points M1– M7, M9–M12 and points 2, 6, 11, 17, 21, and 25. The concentrations in points M3, M6, and M9 were up to 2.8mg/kg compared to the MAC limit of 2mg/kg, they were similar to exceedances in the group of points from July 2015 sampling where the highest concentration was 2.6mg/kg. The exceedance points from July 2015 are located in undisturbed areas, which suggest that such concentrations are a natural characteristic of the area. Concentrations in those points were below GAC limits.

The concentrations of As in points M1, M2, M4, M5, M7, and M10–M11, were higher, which may indicate anthropogenic source but they were below both GAC limits. The highest concentrations were recorded in points M1 and M2, they were up to 112 and 165mg/kg, respectively, which exceeds GAC limits. The reason for increased concentrations is probably introduction of As containing minerals from mining.

There are no Kazakh MAC values for Cd, the lower GAC limit was exceeded in points M1, M2, M4, M5, M6, M9, M10, (M18 one event), they were up to 8.5mg/kg. Location of the points where the concentration was the highest indicates they may be due to local exposure of bedrock as a consequence of mining activity. The concentrations were above the higher GAC limit in points M2, M7, M10, up to 17mg/kg, on a single sampling event (year 2014), they should be treated as an anomalous result, which may be due to low measurement precision as the limit of detection for the method used was 10mg/kg. There was no concomitant increase in the mobile Cd form. If further monitoring shows increased Cd concentrations this should be investigated further.

Total concentrations of V exceeded MAC value of 150 mg/kg in sampling points M1, M2, M3, M5, M6, M9–M12, M14, M17, and 28, and the lower GAC limit of 91 in all sampling locations except point 20. These results indicate high background V content, which suggests that the exceedances are due to bedrock inclusions.

Concentrations of the mobile form of F were exceeded in single sampling events, in points M4, M6, M7. The exceedances may be due to local sampling anomaly, for example due to contamination of sample with the bedrock dust, as increased concentrations were not recorded on other sampling occasions.

There is no total Ni MAC limit, labile Ni concentrations were below MAC value. Total Ni concentrations were above the lower GAC limit of 53mg/kg in points M2, M5 and M16, up to 59mg/kg, and they were not consistent for different sampling events. The background Ni levels were 44mg/kg on average, which suggest elevated natural Ni concentrations in the bedrock.

No exceedances of any of the limits used in this assessment were recorded for Cu, Zn, Mn, Hg, B, Be, Co, Cr, Mo, Sb, Se, and petroleum hydrocarbons. There are no MAC or GAC values available for cyanide, but its content in all samples from July 2015 was equal or below the detection limit.

4.7.6 Summary

Main soils in the area are mountain chestnut soils, prevalent across large areas of steppe grasslands located at this altitude. They are generally characterised by organic matter rich topsoil over subsoil with high rock content. Soil chemistry was compared with typical soil background values (for the area and general), the Kazakh MACs and similar UK standards applicable for areas used to grow food crops. Soil sampling took place in areas close to previous mining activity (monitoring points) and areas of the proposed mine facilities, such as WRD and TSF. The results showed that concentrations of the potential contaminants were within the safe values (GAC UK standards) for the most demanding land use which is small scale gardening, where direct human contact with the soil is most frequent and food is produced. The exceptions were concentrations of As, Cd, V and Ni. Concentrations of As, Cd, and Ni were increased in areas where soil was disturbed by mining activity and where bedrock or rock dust could have been introduced, while the concentrations of V are naturally high in the area. Results have been provided for the soil samples within the areas of proposed facilities (WRD, TSF, and processing plant), the content of the analysed substances in these samples does not exceed the natural background concentrations, which indicates that they are uncontaminated.

4.8 Water Resources (Hydrology and Hydrogeology)

4.8.1 Previous Investigations Undertaken

Hydrogeological investigations in the general area of the Bakyrchik mine were carried out as early as 1967. During the period 1967 to 1969, six boreholes were drilled and pump-tested to estimate the groundwater resources available. The investigations estimated that a volume of groundwater of 3,110m^3/day may be available.

In 1996, a desk study was undertaken using the results of the 1967-1969 investigations to assess the available options for the supply of groundwater to the mine site. Three zones were selected, as follows: the Central zone, covering the catchments of southern exposure; the Eastern zone, coinciding with the watershed of the Alaigyr headwaters; and the Northern zone. To meet the current demand for water in the Central zone, four wells No. 1E-4E were constructed and have been operated since 1998.

Between 2004 and 2006, an investigation was carried out regarding the dewatering of the mine infrastructures. Nine exploratory wells were constructed and pump-tested during the investigations.

In 1997 Semeygidrogeologia JSC carried out some exploration for the water supply of the village of Auezov in the valley of the Kyzylsu River. 14 exploratory wells and seven production wells were constructed in the fractured Carboniferous bedrock and the overlying alluvial aquifer. The wellfield is located near the surface water reservoir, but it is currently not in use.

In 2011, RPS Aquaterra carried out an investigation to better understand the potential for migration of arsenic released from the underground paste backfill. Hydraulic testing of diamond core drill holes, and installations and testing of piezometers was carried out.

In 2013, a hydro-meteorological investigation was carried out to characterise the surface water flow regime in the vicinity of the mine site.

4.8.2 Hydrology

Drawing 4.1.1 shows the various water features relevant to the project in the vicinity of the mine site. These include the following:

- The Kysylsu river;
- Several seasonal brooks;
- The three existing open pits (West, Central and East) and the Dalneye Pit;
- The Kysylsu surface water supply reservoir; and
- The Alaaigyr reservoir.

The Hydrographic Network

The river system in the general area of the Bakyrchik mine is well developed with a number of streams draining the project area. The Kyzylsu River is the main river. It originates from the southeast and flows 4km southwest of the village of Auezov in a northwestly direction to join the Irtysh River further downstream. The length of the Kysylsu River from its origin to the village of Shalabai is 94km and its drainage area is 1,067km^2.

There are several streams in the vicinity of the mine site: the Kysyltu Brook, the Akbastaubulak Brook, the Jumataybastau Brook, the Mayranbastau Brook and the Alaaigyr Brook. There are another three small streams, which are unnamed. All these brooks are right-bank tributaries of the Kysylsu River. Most of the existing mine infrastructures are mainly located in the Akbastaubulak Brook catchment, while the existing tailings storage facility is located in the Alaaigyr Brook catchment.

Of all the local streams, only the Kyzylsu River is sufficiently described in terms of hydrology. Hydrological information has been recorded on the Kyzylsu River for more than 30 years at the village of Ostrikovka. A summary of the parameters recorded is as follows:

- River flow of 95% exceedance probability (m^3/s) 0.037
- Average flow velocity (m/s) 0.47
- Channel bending factor 1.03
- Average width (m) 15.8
- Average depth (m) 0.25
- Maximal depth (m) 1.00
- Factor of channel roughness 0.03
- Factor of roughness of lower ice surface 0.02

Surface Water Bodies

There are four open pits in the vicinity of the mine site: the West, Central and East pits, as well as the Dalneye pit:

1. The Western Pit (or Pits 5 and 6) is located near the Western Ventilation Shaft. In June 2015, it contained standing water and it was observed that it received some surface run-off probably originating from the Akbastaubulak Brook running nearby;
2. The Central Pit (or Pit 4) is located near the Capital Shaft. In June 2015, it contained no water, probably due to its proximity to the Capital Shaft where mine dewatering takes place on a permanent basis;
3. The Eastern pit (or Pit 2) is located one km northeast of the Eastern ventilation Shaft. In June 2015, it contained standing water; and
4. The Dalneye pit is located 4.0km to the northwest of the Central Pit. It also contained standing water in June 2015.

The standing water contained in the open pits probably originates both from surface run-off and groundwater inflows.

The Kysylsu surface water supply reservoir is located on the Kyzylsu River about 8km south of the mine site and regulates the flow of the Kyzylsu River. It is used as a surface water intake to supply potable water to the current mine infrastructure and the Auezov settlement via a water pipeline.

The Alaaigyr reservoir is located about 3.6km southwest of the mine site and has an area of 7.6ha. It receives water from the Alaaigyr Brook. The lake is used by the locals for fishing and boating (pers. Com. Polymetal ecologist). The reservoir is constructed on Alaaygyr Brook.

Surface Water Monitoring Network

Surface water monitoring points were installed by the Bakyrchik Mine as early as 2004. Two of them, GP18 and GP25, are located north of the Kyzyltu wellfield (Drawing 4.8.1).

An extensive network of 16 surface water monitoring points was set-up in 2015 to monitor stream stage and surface water quality in the vicinity of the mine site. The monitoring points are located on the Kyzylsu River and on several of its right-bank tributaries (Drawing 4.8.1), as detailed in Table 4.8.1 below:

Table 4.8.1: Details of the Surface Water Monitoring Network Set-up in 2015		
No	**Corresponding Stream**	**Description of Location**
1	Mayranbastau	Mayranbastau brook, the mouth;
2	Mayranbastau	Holodniy Klyuch brook, the mouth;
3	Akbastaybulak	Akbastau brook, upstream section line, the sources;
3a	Akbastaybulak	Akbastau brook, downstream section line, the mouth;
4	Zhumataybastau	Kyzyltu brook, upstream section line, the sources;
4a	Kyzyltu	Kyzyltu brook, downstream section line, the mouth;
5	Akbastaubulak	Akbastaubulak brook upstream of the road Auezov-Shalabai and discharge from wastewater treatment facility;
6	Akbastaubulak	Akbastaubulak brook, downstream of the discharge from wastewater treatment plants;
7	Brook No 1 southwest of Auezov village	brook №1 with no name in Auezov village, the mouth;
8	Alaaygyr	Alaaygyr brook, upstream section line;
9	Brook No 2	brook №2 with no name left-bank tributary of Alaaygyr brook, the mouth;
10	Brook No 3 (Bezymyanny Brook)	brook №3 with no name right-bank tributary of Alaaygyr brook, the sources;
11	Brook No 3 (Bezymyanny Brook)	brook №3 with no name right-bank tributary of Alaaygyr brook, the mouth;
12	Alaaygyr	Alaaygyr brook, upstream of the reservoir;
13	Alaaygyr	Alaaygyr brook, the mouth;
14	Kyzylsu	Kyzylsu river near Shalabai village

The morphometric and hydrologic characteristics of the water courses for 13 of the surface water monitoring locations set-up in 2015 are presented in Table 4.8.2 below.

Table 4.8.2: Morphometric and Hydrologic Characteristics of Water Courses in the Survey Area

№ No.	Description	Catchment area km²	Length, km	Average catchment altitude, m BS	Cross-section elevation, m BS	Long-term average annual water flow, m³/s	Average annual flow volume, Mm³	Flow rate of low-water period in a year with 95% probability, m³/s drying and freezing are possible in individual years
1	Mairanbastau creek - mouth	4.02	2.77	420	385	0.002	0.063	0.0004drying, freezing
2	Holodny Klyuch creek - mouth	21.4	4.38	410	348	0.011	0.35	0.002drying, freezing
3	Akbastau r. - upstr. cross-sect.	5.8	1.89	425	395	0.003	0.10	0.001drying, freezing
4	Kyzyltu r. - mouth	7.14	3.46	440	395	0.004	0.13	0.001drying, freezing
5	Akbastau r. in front of the Auezov-Chalobai road	15.7	5.7	420	360	0.008	0.25	0.002drying, freezing
6	Akbastaubulak creek - mouth	32.6	11.4	410	350	0.017	0.54	0.003drying, freezing
7	Nameless creek 1 in Auezov set. - mouth	3.78	2.4	415	380	0.002	0.063	0.0004drying, freezing
8	Alaaigyr r. - upstr. cross-sect.	18.2	8.7	520	430	0.015	0.47	0.002drying, freezing
9	Nameless creek 2 left-side tributary of the Alaaigyr - mouth	23	9.5	520	430	0.018	0.57	0.002drying, freezing
10	Nameless creek 2 right-side tributary of the Alaaigyr	9.56	2.31	450	430	0.006	0.19	0.001drying, freezing
11	Alaaigyr r. upstream the water storage	63.1	12.9	465	425	0.037	1.17	0.006drying, freezing
12	Alaaigyr r. - mouth	110	14.8	440	365	0.17	5.36	0.011
13	Kyzylsu r. in Chalobai set.	1010	101	600	350	1.35	42.5	0.10

Stream Flow and Stage Monitoring Data

Stream flow was recorded on a monthly basis at monitoring points GP-18 and G-25 between April 2004 and March 2014. Stream flow data are presented in Table 4.8.3 below.

Stream stage has been recorded weekly at the 16 surface water monitoring locations set-up in 2015 since June 2015. Stream stage data for the period 10 June to 5 August 2015 are presented in Appendix 4.8.1.

Surface Water Quality Monitoring Data

One single set of water quality data is available for Brook 3 (Bezymyanniy Brook) for both 2012 and 2013. The 16 surface water monitoring locations were sampled in July 2015. All available surface water quality data are presented in Appendix 4.8.2.

Flow Measurements

The maximum Kyzylsu river flow recorded during the flood of 1960 reached 90m³/s, while the minimum flow recorded was 0.03m³/s above the mouth of Alaigyr brook in the winter time. The mean annual flow of the brooks located on the right bank of the Kyzylsu river range between 0.02 and 0.05m³/s.

In 1959-1960, a hydrological study was carried out in the catchment of the Akbastaubulak brook. The minimum and maximum flow of the brook was estimated as 0.06 and 0.147m³/s, respectively. The minimum design water discharge of the brook of 97% exceedance probability does not exceed 0.002m³/s.

Surface water runoff data are available for the period 2004-2014 in the Kyzyltu water catchment at two flow gauging stations: GP-18 located on the Jumataybastau stream and GP-25 located on the Akbastaubulak stream. The measurements at these two water-gauging stations were generally made between April and June/July only, as from July/August to December the streams were dry. The data are presented in Table 4.8.3 below.

Table 4.8.3: Surface Water Runoff at GP-18 Located on the Jumataybastau Stream and GP- 25 Located on the Akbastaubulak Stream

Station No	Measured flow rate (l/s)												Mean value for the period		Year
	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	l/s	m^3/day	
18	3.6	3.6	1.4	0.7	0	0	0	0	0	0	0	0	0.8	69	2004
	0.9	0.6	0	0	0	0	0	0	0	0	0	0	0.1	9	2005
	1.6	1	0.6	0	0	0	0	0	0	0	0	0	0.3	26	2006
	1.9	2.4	2.8	0	0	0	0	0	0	0	0	0	0.6	52	2007
	1.6	2.2	1.7	0	0	0	0	0	0	0	0	0	0.5	43	2008
	1.8	2.4	1.5	0	0	0	0	0	0	0	0	0	0.5	43	2009
	2	3.1	2.2	0.5	0	0	0	0	0	0	0	0	0.7	60	2010
	0.53	1.21	6.22	0.5	0	0	0	0	0	0	0	0	0.71	61.3	2011
	1.2	0	0	0	0	0	0	0	0	0	0	0	0.1	8.6	2012
	1.0	1.33	5.70	0.62	0	0	0	0	0	0	0	0	0.72	62	2013
	0.6	1.2	3.5	0.5	0	0	0	0	0	0	0	0	0.48	41.6	2014
25	1.8	1.8	1.0	0.6	0	0	0	0	0	0	0	0	0.4	35	2004
	0	0.4	0	0	0	0	0	0	0	0	0	0	0.03	3.0	2005
	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	2006
	0.5	0	0	0	0	0	0	0	0	0	0	0	0.04	3.6	2007
	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	2008
	0.4	0.3	0	0	0	0	0	0	0	0	0	0	0.06	5	2009
	0.9	0.7	0.3	0.1	0	0	0	0	0	0	0	0	0.2	17	2010
	0.24	0.27	0.85	0.04	0	0	0	0	0	0	0	0	0.12	10.4	2011
	0.30	0	0	0	0	0	0	0	0	0	0	0	0.025	2.2	2012
	0.25	0.38	0.15	0	0	0	0	0	0	0	0	0	0.07	6.30	2013
	0.8	0.4	0	0	0	0	0	0	0	0	0	0	0.1	8.6	2014

Surface Water Quality

Surface water quality data are presented in Appendix 4.8.2. A Piper diagram, showing surface waters relative ionic quantities for the July 2015 water quality sampling, is shown in Figure 4.8.1. Arsenic concentration are above the Maximum Permissible Concentration at monitoring locations 5, 6 and 12. Locations 12 is downstream of the existing tailings dam, while locations 5 and 6 are located on the Akbastaubulak brook downstream of the mine site.

Waters of the Kyzylsu River and its right-bank tributaries are fresh. In July 2015, TDS (Total Dissolved Solids) was in the range of 200 to 1,200mg/l, while pH was slightly alkaline and is in the range of 7.8 to 8.4. In terms of chemical composition, surface waters are of the magnesium-calcium bicarbonate type, but at higher salinity of the sulfate-bicarbonate, calcium-sodium type.

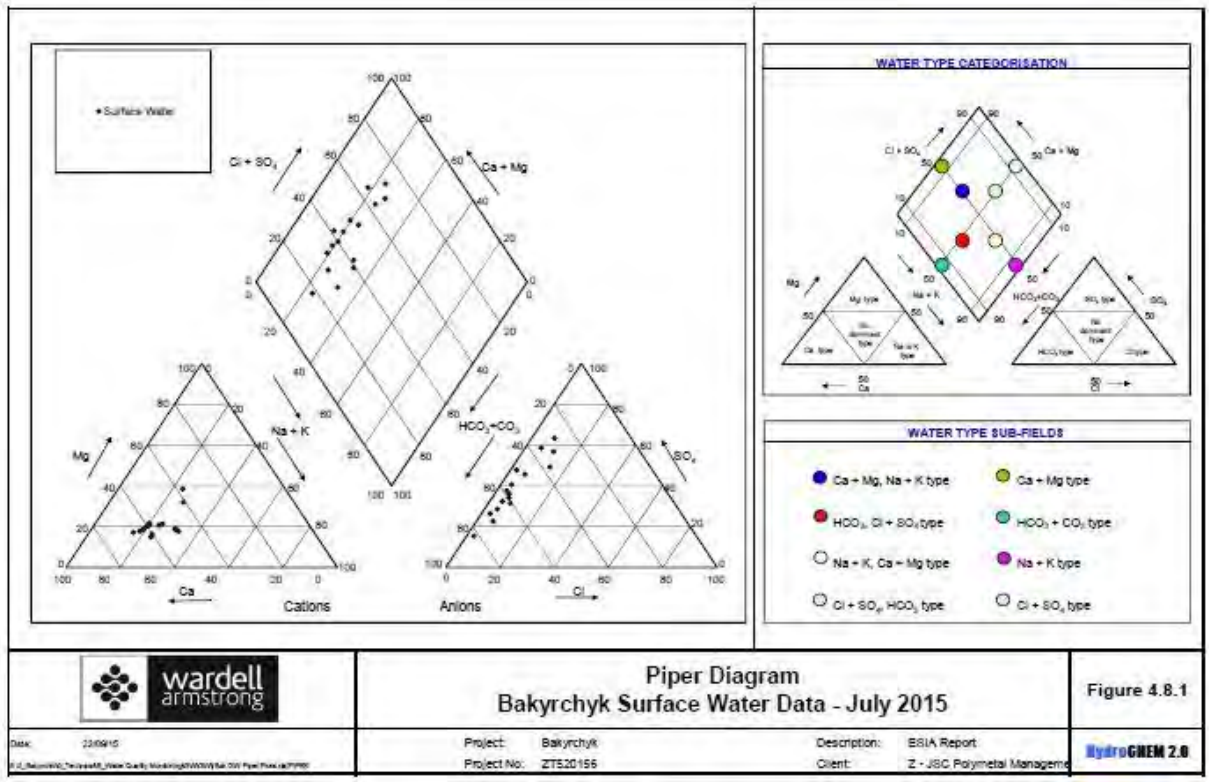


Figure 4.8.1: July 2015 Surface Water Piper Diagram

4.8.3 Hydrogeology

Groundwater Occurrence

The geology in the general area of the mine site consists in a succession of tightly folded sedimentary rocks of the lower and middle Carboniferous these are underlain by granitic basement rocks. Considerable portions of the region, primarily associated with drainage channels, are covered by recent unconsolidated strata including modern to Quaternary fluvial and proluvial deposits. The south west of the region has a thick covering of Neogene clays. The solid and drift geology in the vicinity of the mine site is presented in Drawing 4.8.2. A hydrogeological cross-section is presented in Drawing 4.8.3.

Three hydrogeological units are present in the general area of the Bakyrchik mine, as follows:

1) The superficial alluvial aquifer;
2) The Pavlodar Clay aquitard;
3) The bedrock aquifer consisting of Lower Carboniferous sedimentary units;

1) The Superficial Alluvial Aquifer

The superficial alluvial aquifer (also referred as ''aQ'' in the geological maps and sections) is developed in the valley of the River Kyzylsu and in the lower valleys of its right-bank tributaries. The width of the aquifer across the valleys ranges between 100-150m and 810-1,200m and its thickness from 1-2 to 3-5m. The aquifer is associated with recent fluvial deposits and generally contains various proportion of gravels, pebbles, sand and sandy loams. It can be sub-divided further into three types of superficial aquifers based on their age and mode of deposition, as follows:

- The Mid-Quaternary Alluvial Aquifer
  It comprises predominantly gravel and sand with loam with a thickness of 3 to 6m and is found alongside the Kyzylsu River. The aquifer is unconfined and groundwater levels range between 1.5 and 3mbgl;

- The Modern Alluvial-Proluvial Aquifer
  It consists of sand and sandy loam 3 to 5m in thickness and is found in association with the tributaries of the Kyzylsu River. The aquifer is unconfined and groundwater levels range from 2.5-3.5mbgl;

- The Modern Alluvial Aquifer
  It comprises gravels with some sand and forms a narrow strip along the Kyzylsu River. The aquifer is unconfined and the groundwater levels range between 1 and 2.5mbgl.

The superficial alluvial aquifer is unconfined. Due to its limited extent, the superficial alluvial aquifer has limited storage and is considered as a minor aquifer not suitable for the water supply of the mine site.

2) The Miocene-Pliocene Pavlodar Clay Aquitard

The Pavlodar Clay (also referred as ''N_{1-2}'' in the geological maps and sections) is most developed to the southwest of the Kyzylsu River. In the vicinity of the mine site, it is present in the valley of the Kyzylsu River and at the mouth of valleys of the Kholodny Kluch brook, the Akbastau-Bulak brook and the Alaigyr brook. The Pavlodar Clay is very homogeneous and consists of brown clay with gravels of Paleozoic rocks and sometimes some lenses of gravel. It rests unconformably on the Lower Carboniferous sedimentary rocks and the thickness of the sediments can reach several tens of meters. The Pavlodar Clay acts as an aquitard.

3) Lower Carboniferous sedimentary units

The bedrock aquifer (also referred as ''C_1'' in the geological maps and sections) consists of folded and faulted Lower Carboniferous sedimentary rocks dipping at 60 to 80˚ to the northwest, predominantly

sandstone and siltstone with occasional bands of shales and limestone lenses. The total thickness of these units may be up to 2,800m.

The majority of the groundwater flow is likely to be in fractures and within fissures in the weathered zone, which extends up to c. 100m below the top of the unit.

The bedrock aquifer is generally unconfined, except in the south-west of the site and along the Kyzylsu River and some of its tributaries, where it is partially confined by the overlying Pavlodar Clay aquitard. It is considered that there is a high degree of connectivity between the superficial alluvial aquifer and the bedrock aquifer except where the Pavlodar Clay Aquitard is of sufficient thickness to act as a vertical barrier to groundwater flow.

Due to its large extent, its significant thickness and its good groundwater storage, the bedrock aquifer is an important aquifer for the water supply of the mine site. It is currently exploited by the four production boreholes of the Kyzyltu wellfield to supply the village of Auezov with potable water.

Groundwater Monitoring Boreholes

The Bakyrchik Mine has set-up a network of 58 boreholes to monitor groundwater level and groundwater quality at and in the vicinity of the mine site. They are classified in three main categories, as follows: ''Environmental Monitoring Programme'', ''Water" and ''Mine Water". The ''Water" category can be sub-divided further into three sub-categories depending on whether the borehole is a Production borehole in operation or not or a monitoring borehole.

Table 4.8.4 below gives a list of the monitoring boreholes according to their category. Details of these boreholes are presented in Appendix 4.8.3. The location of these boreholes is presented in Drawing 4.8.4; each monitoring borehole category is differentiated by a label colour:

- The monitoring boreholes belonging to the'' 'Environmental Monitoring Programme" category were constructed to monitor the water level and water quality in the general area of the mine. Some boreholes were installed specifically to monitor the area around the arsenic burial site (6H) or the existing tailings storage facility (1H, 2H, 3H, 16H, 17H and 18H);
- The monitoring boreholes belonging to the ''Water'' category were constructed as part of the development and monitoring of the Kyzyltu wellfield. 13 production wells were constructed by only four are installed with submersible pumps and currently in use (two are operational and 2 are on standby). Eleven monitoring boreholes were constructed as part of the scheme; and
- The five monitoring boreholes belonging to the ''Mine Water'' category were constructed north of the open pits on the side of the hanging wall to monitor any water level fluctuations in the bedrock aquifer resulting from the dewatering scheme.

Table 4.8.4: List of the Mine Monitoring Boreholes According to their Category			
Category No	**Category Name**	**No of Wells**	**List of Boreholes**
1	Environmental Monitoring Programme (EMP)	29	1H, 2H, 3H, 4H, 5H, 6H, 7H, 7P, 8P, 9H, 9P, 10P, 10H, 11H, 11P,12H, 13H, 14H, 15P, 15H, 16P, 16H, 17P, 17H,18H, 18P,19P, 19H and 20P
2	Water (Production Wells Equipped In Use at the Wellfield)	4	1E, 2E, 3E, 4E,
3	Water (Monitoring Wells)	11	1H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H, 10H, 11H, 12H, 13H and 14H
4	Water (Production Wells Not Equipped - Not In Use at the Wellfield)	9	1p-e, 2p-e, 3p-e, 15p-e, 16p-e, 17p-e, 18p-e, 19p-e and 20p-e
5	Mine Water	5	1sh, 2sh, 3sh, 4sh and 5sh

Groundwater Level Monitoring Data

All the available water level data recorded in the mine monitoring boreholes are summarised in Table 4.8.5 below and presented graphically in Appendix 4.8.4.

The daily water level data in mbdat for the four Kysyltu wellfield production boreholes for the period 2001 to 2006 are presented graphically in Figure 4.8.2 and Figure 4.8.3, together with daily abstraction and total rainfall.

All available water level data in mASL for the four Kysyltu wellfield production boreholes are presented graphically in Figure 4.8.4.

Table 4.8.5: Groundwater Level Data Recorded in the Mine Monitoring Boreholes			
Category No	**Category Name**	**Period of Record**	**Frequency of Measurements**
1.	Environmental Monitoring Programme (EMP)	• June, July and August 2015	• Monthly
2.	Water (Production Wells Equipped In Use at the Wellfield)	• May 2001 to Oct 2006 • Jan to Dec 2014 • June, July and August 2015	• Daily • Monthly • Monthly
3.	Water (Monitoring Wells)	• Jan to Dec 2014 • June, July and August 2015	• Daily • Monthly
4.	Water (Production Wells Not Equipped - Not In Use at the Wellfield)	• Jan to Dec 2014 • June, July and August 2015	• Daily • Monthly
5.	Mine Water	No data available	

Groundwater Quality Monitoring Data

One single set of water quality data is available for boreholes 1n, 2n, 3n, 4n, 16n, 17n, 18n for both 2012 and 2013. Monthly groundwater quality data are available for the Kyzyltu wellfield boreholes2

and 3 for 2014. The 58 groundwater monitoring locations were sampled in July 2015. All available groundwater quality data are presented in Appendix 4.8.2.

Kyzyltu Groundwater Supply Wellfield

The existing Kyzyltu wellfield was constructed in 1996. It consists of four production boreholes (1E, 2E, 3E and 4E) located in the Kyzyltu river floodplain along a line running in an east-southeast/west-northwest direction, parallel to the valley (Drawing 4.8.4). The spacing between the boreholes is about 400m. The Auezov village is partially supplied with fresh water from the four production wells of the Kyzyltu wellfield. Daily water intake at the Kuzultu wellfield is between 1,000 and 1,600 m^3/day.

Boreholes 2E and 3E are operational boreholes, while Boreholes 1E and 4E act as standby boreholes. Data collected during the four boreholes construction and testing are not available.

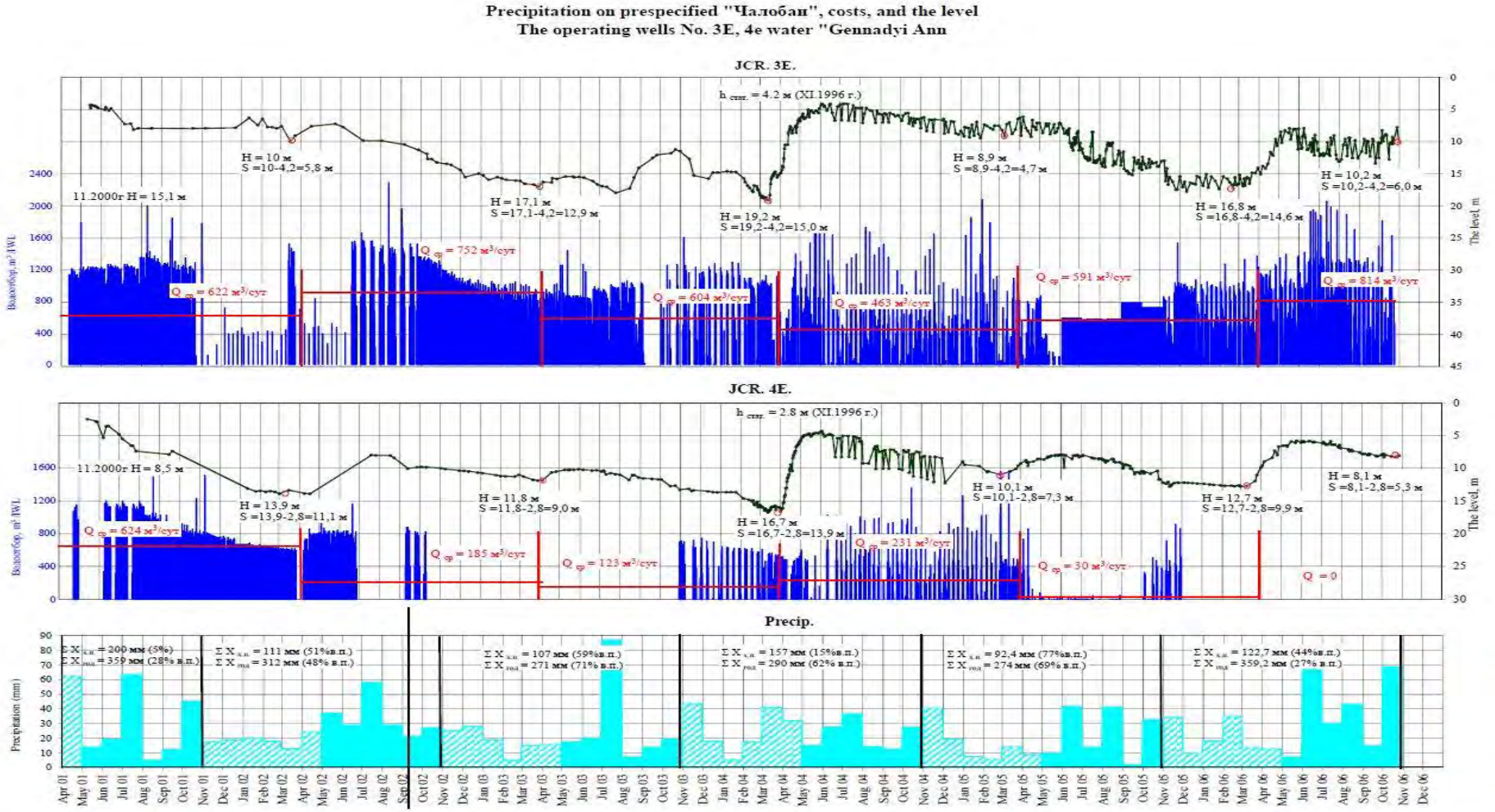


Figure 4.8.2: Water Levels (mbdat) for the Kyzyltu Production Boreholes 1E and 2E together with Daily Abstraction and Total Rainfall for the Period April 2001 to October 2006Kazakhstan

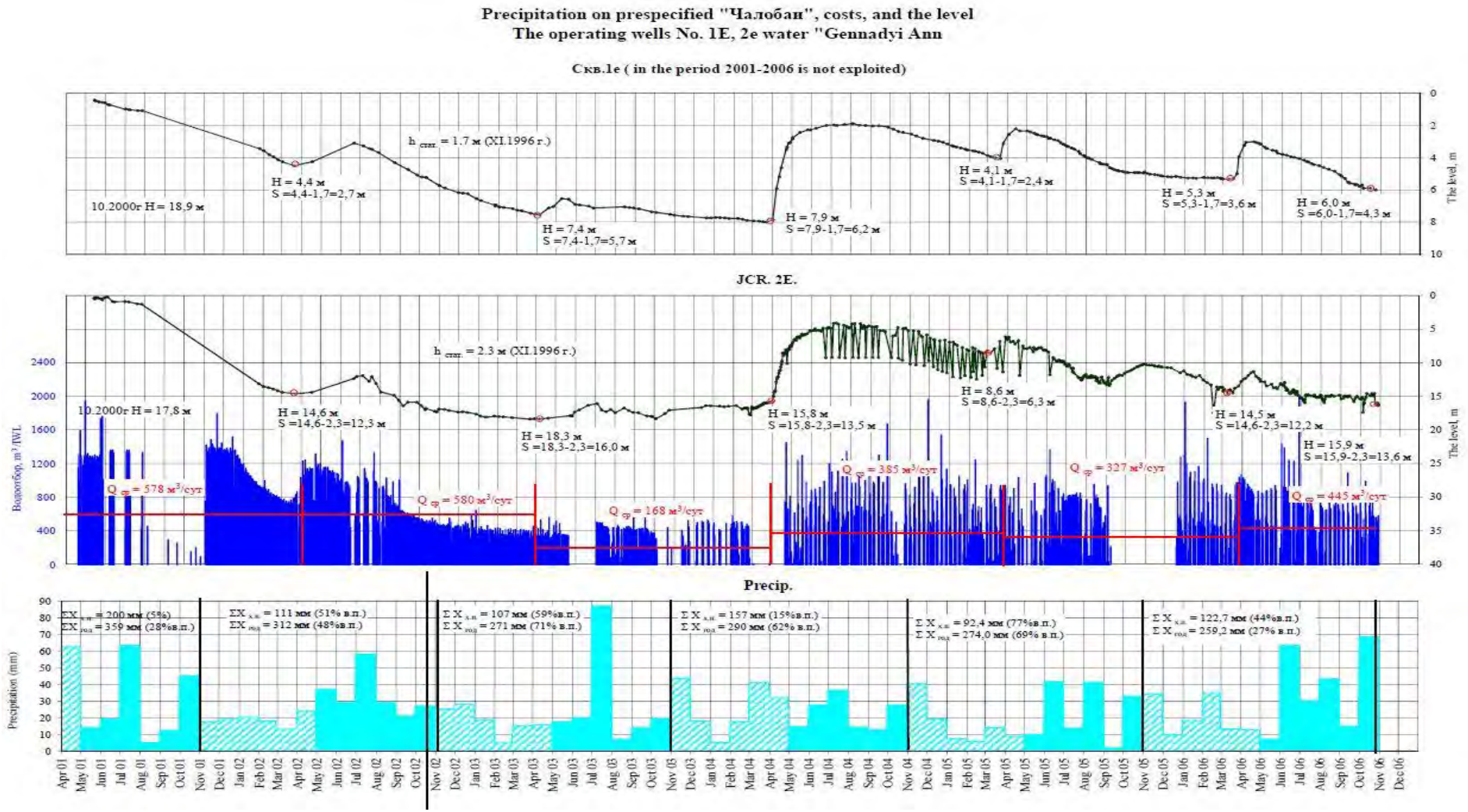


Figure 4.8.3: Water Levels (mbdat) for the Kyzyltu Production Boreholes 3E and 4E together with Daily Abstraction and Total Rainfall for the Period April 2001 to October 2006

The production boreholes are between 35 and 50m deep and penetrate the bedrock aquifer. The drilled diameter is 295mm. The wells 1E, 2E, 3E are equipped with holed screens to a depth of 23-40m, below that the well was left open hole. Well 4E is not equipped with a screen. According to the resistivity logging the lower limit of the water inflow intervals in the wells is at the following depths: 1E-20m; 2E 34m, 3E-26m; 4E -21 m.

The Operational Boreholes 2E and 3E are equipped with submersible pumps with a nominal capacity of 40m^3/h at 150m head. The wells are each located in a wooden building. The first zone of sanitary protection zone in each well (except number 1E) is fenced with the grid with the entrance gate. To measure the flow rate the collars are equipped with flow meters of WP 100 brand with measurement limit of 60m^3/h. Groundwater levels are measured with electric level meters in the wellbore.

Piezometry, Groundwater Movement and Groundwater Level Fluctuations

Water levels in the bedrock aquifer generally range between 1 and 3mbgl, although in some boreholes water levels were found to be as deep as 20mbgl (boreholes 11n and 11H).

Water level data suggest that locally the direction of groundwater flow is from the more elevated ground towards the various drainage channels which traverse the area and in the downflow direction of the drainage channels. Regional groundwater flow across the mining area seems to be towards the south-west in the direction of the Kyzylsu River, which is consistent with the wider surface water flow regime. The regional groundwater gradient is in the order of 0.01 – 0.02 however localised gradients on the valley fringes can be much higher.

The general pattern of water level fluctuations is similar in most of the monitoring boreholes. On an annual basis, water levels fall steadily from May-June up to March and then rise sharply between April and June 2004.

Kyzyltu Wellfield Piezometry

Table 4.8.6 below presents a summary of the water level data for the Kyzyltu Wellfield for the period 2001 to 2006.

Table 4.8.6: Water Level Summary for the Kyzyltu Production Boreholes

Borehole No	Range of Long Term Water Level Fluctuations (2001 to 2006) (mbgl)	Water Levels on 22 March 2004 (mASL)	Range of Short Term (Daily) Water Level Fluctuations due to Abstraction at the Borehole (2001 to 2006) (mbgl)
1E	0.5 - 8	404.11	N/A
2E	0 – 18.4	401.5	c. 5
3E	4.1 – 19.2	413.5	c 2.5
4E	2.5 – 16.7	419.37	c 4

In 1996 during borehole construction, groundwater levels were relatively shallow and ranged between 1.7 and 4.2mbgl. Comparison of groundwater levels in late March 2002 gives some indication of piezometry. The water levels at Boreholes 2E, 3E and 4E were 401.5, 413.5 and 419.4mASL, respectively. The water level at Borehole 1E was 404.1mASL, which is higher than at Borehole 2E, certainly because Borehole 1E was not abstracted (Figure 4.8.4).

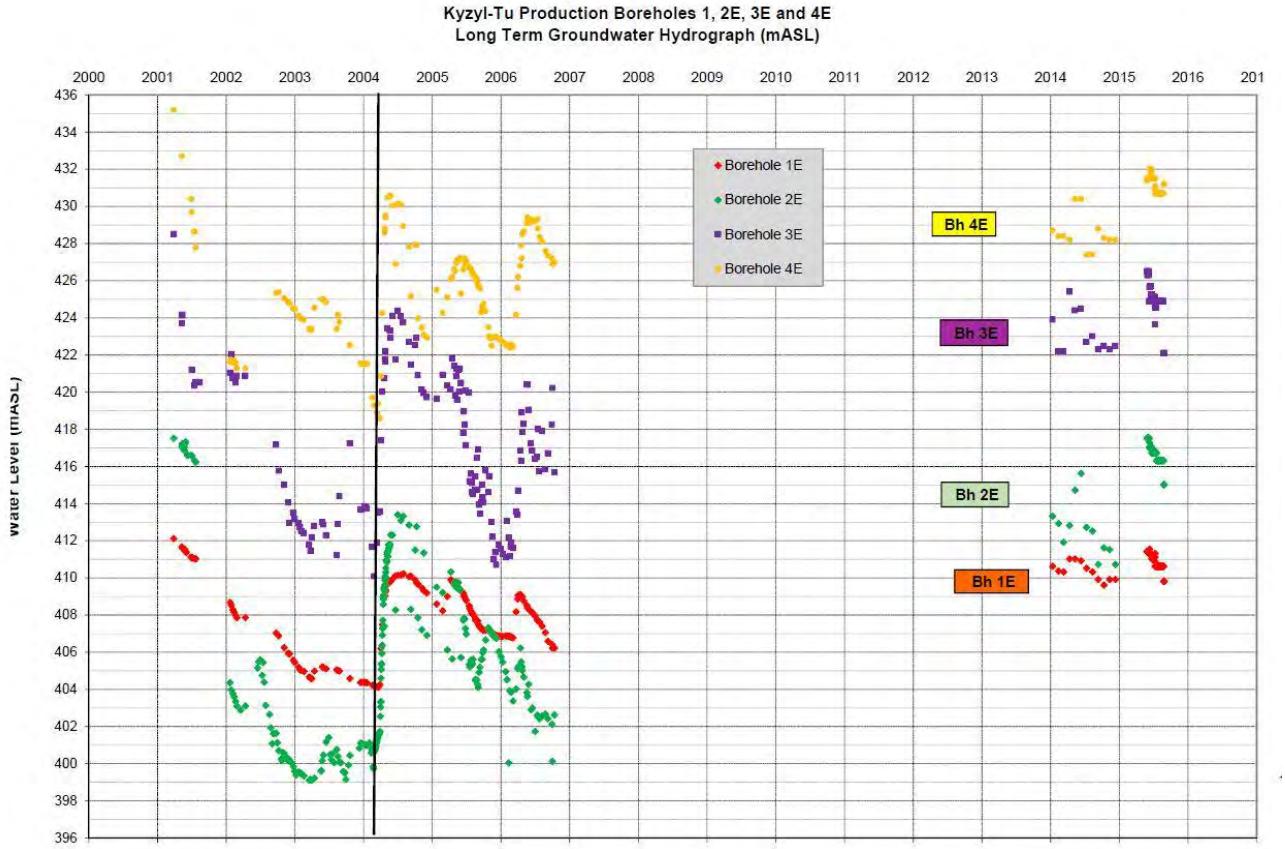


Figure 4.8.4: All Available Water Level Data (mASL) for the four Kysyltu wellfield production boreholes

Boreholes 2E and 3E were the most abstracted boreholes during the period 2001 – 2006. Borehole 4E was abstracted mainly in 2001, 2002 and 2004, while Borehole 1E was never abstracted.

Long term water level fluctuations at Boreholes 2E, 3E and 4E are greater than at Borehole 1E, probably because these boreholes were pumped on a regular basis.

Between April 2001 and March 2004 water levels show an overall steady fall. Between April and June 2004 water levels rose sharply. Between July 2004 and November 2006, water levels again fell steadily.

Superimposed on the long term water level fluctuations, are the daily fluctuations resulting from the intermittent abstraction at the operated production boreholes.

Borehole Yields

Borehole yields in the superficial alluvial aquifer range between 0.6 and 3l/sec, which generally results in a drawdown of 2 to 3m. Borehole yields in the bedrock aquifer range from 1-5l/s up to 15-20l/s, which generally results in a drawdown of 15 to 25m.

At the Kyzyltu wellfield, typical yields at the four boreholes ranged in 1996 between 12.4l/s (1,071m^3/d) for Borehole 4E and 18.6 l/s (1607m^3/d) for Borehole 1E. The corresponding drawdown ranges between 8 and 15.6m. The specific capacity ranges between 1.1l/s/m in Borehole 3E and 2.3l/s/m in Borehole 1E.

Aquifer Hydraulic Parameters

Hydraulic conductivity in the superficial alluvial aquifer ranges between 5 and 15m/day. Hydraulic conductivity for the more weathered zone of the bedrock aquifer is in the range

1 x 10-1m/d to 1 x 10-3m/d while the hydraulic conductivity of the deeper, moderately weathered and unweathered material significantly lower is in the range 1 x 10-4m/d to 1 x 10-5m/d.

Using the Logan Approximation and the specific capacities quoted in Section 4.8.3.5, transmissivity for the Kyzyltu wellfield production borehole ranges between 114 and 238m^2/dm. Hydraulic permeability therefore ranges between 5 and 11m/d for the bedrock aquifer.

Recharge and Discharge Areas

The recharge to the aquifer system is primarily from snowmelt water in the spring and to a much lesser extent by rainfall in the summer and autumn months.

Shallow groundwater piezometry suggests that surface water features are fed in part by groundwater flow from the shallow groundwater systems. Based on surface elevations and limited piezometric data it is anticipated that discharge from deeper flows within the Carboniferous strata into the surface water drainages would be limited.

Groundwater Quality

Groundwater quality data are presented in Appendix 4.8.2. A Piper diagram, showing groundwaters relative ionic quantities for the July 2015 water quality sampling, is shown in Figure 4.8.5.

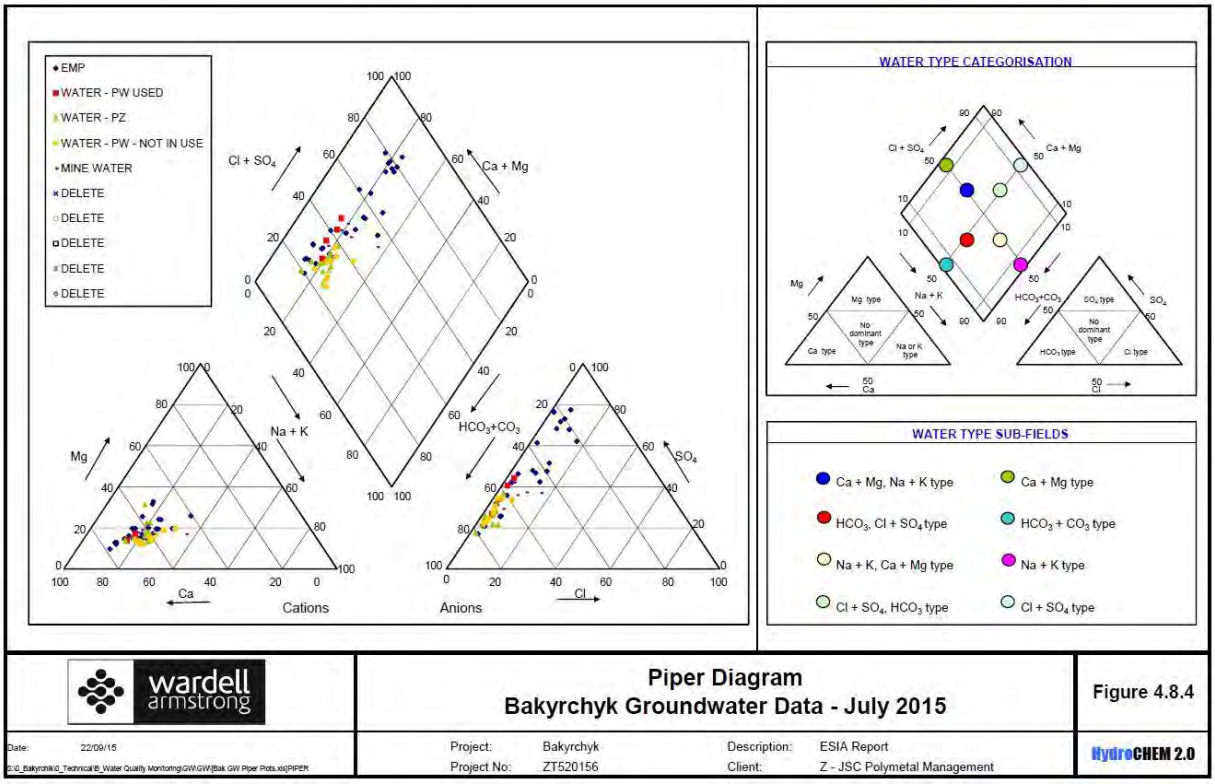


Figure 4.8.5: July 2015 Groundwater Piper Diagram

Concentrations were above the Maximum Permissible Concentration at a number of boreholes for arsenic, sulphate, manganese, cadmium and nitrate.

The groundwater of the superficial alluvial aquifer is fresh. TDS (Total Dissolved Solids) is generally in the range 400 to 500mg/l, but in some areas with less groundwater movement TDS increases to between 1,000 and 1,500mg/l. The chemical composition of the groundwater is bicarbonate-sulfate, sulfate-bicarbonate calcium-sodium.

The groundwater of the bedrock aquifer has a TDS of 300 to 800mg/l, but can sometimes rise to 1,000 to 1,500mg/l.

4.8.4 The Dewatering System and Mine Inflows

The Bakyrchik mine is currently not in operation, but has been in Care and Maintenance since 1997. Dewatering of the underground workings is still being carried out with the existing infrastructure until the mine resumes production.

The Bakyrchik Mine Dewatering System

The dewatering system of the mine is centralised at the Capital Shaft. The groundwater entering the pit and the upper levels (+330 m, +290m) of the underground workings is pumped out to the 400m^3

sump of the main pumping station, located at the level +250 in the Capital Shaft lateral drive. The main pumping station is equipped with three centrifugal pumps of CNS 180-297 type. To pump out the groundwater of the deeper levels, there is a sump equipped with two CNS-60-297-type pumps on level +10. From this sump the water is pumped to the main pumping station sump. The groundwater pumped out is transferred to the tailing dam via a pipeline. The mine drainage layout plan is shown in Drawing 4.8.5.

The volumes of mine drainage water pumped out from the Capital Shaft is recorded and logged on daily basis. Until 2008, the volume of groundwater pumped out was determined by an indirect method based on the pump capacity and its operation time. Since 2008 the volume of groundwater pumped out is measured using BMX–200 flow meters.

Mine Dewatering during Previous Operation

During continuous operation of the mine, the mine drainage water was pumped into the tailing dam via a pipeline. Following the cessation of the mining operations in 1997, the mine drainage water was temporarily discharged to the ground and flowed by gravity into the Akbastaubulak Brook. From 1998 onwards, the mine drainage water was discharged into the tailing dam via the existing slurry pipeline, where it either evaporated or percolated down to the aquifer water table. A small portion of the water from the tailing dam seeped through the dam into the holding tank of the drainage pumping station and was pumped back into the tailing dam. In 2015, the mine drainage water was being discharged to the Akbastaubulak Brook. It is not known when discharge of mine drainage water to the Akbastaubulak Brook re-occurred.

Groundwater Inflows during Previous Operation

The Bakyrchik mine groundwater inflows originates from the fractured bedrock aquifer. Water enters the mine workings through their walls and roof mainly from individual cracks and fissure zones, less so in the form of dripping from exploration drill holes intersecting the underground workings. A hydrogeological map and sections of the mine drainage area are presented in Drawings 4.8.6 and 4.8.7.

Groundwater seepages decrease with depth as hydraulic permeability decreases. Groundwater inflows occur mainly down to a depth of about 150mbgl. The numerous waste dumps and non-economic ore stockpiles together with the open or backfilled open pits (between 20 to 80m deep and with a total length of 1,200m) within the mine area contribute to increase the amount of surface run-off, which contribute to groundwater recharge and subsequently to groundwater inflows to the mine.

The volumes of drainage water pumped out of the Capital Shaft for the period 1998 -2013 are presented in Figure 4.8.6 together with annual effective rainfall and total monthly rainfall.

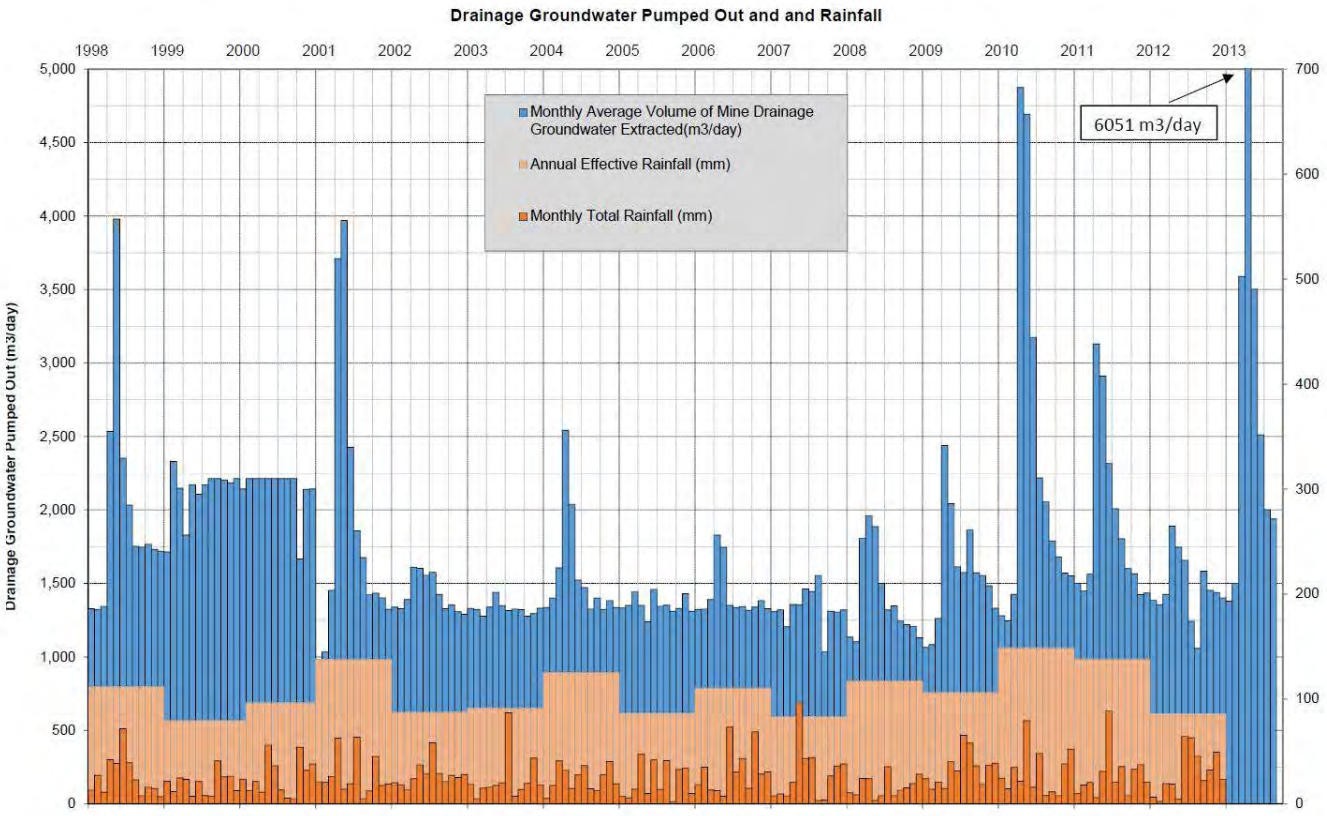


Figure 4.8.6: Volume of Drainage Water Pumped out together with Monthly Total Rainfall and Annual Effective Rainfall for the Period 1998 to 2013

The total catchment area of the mine is 6.1km^2. The mine groundwater intake recorded from January 1998 to June 2013 showed a minimum of 967m^3/day (January 2001), a maximum of 6,051 m3/day (April 2013) and an average of 1,680m^3/day. Groundwater inflows reach a maximum in springtime. There is no increase in groundwater inflows in response to summer rainfall.

The highest values of water inflows are recorded in the flood period of April and May, while the minimum average monthly water inflows have no correlation with the annual profile. The average annual water intake in 1998 was 1,971m^3/day. It increased gradually to reach 2,149m^3/day in 2000. However, this increase in mine drainage water pumped out was not caused by a change in effective rainfall. In 1997 and early 1998, mine drainage water was discharged to the ground and then flowed by gravity into the Akbastaubulak Brook. The mine drainage water inflow may have increased due to the infiltration of the water into the aquifer and its recirculation.

Between 2001 and 2009, the volume of mine drainage water pumped out was less and ranged between a minimum of 1,332m^3/day in 2007 and a maximum of 1,575m^3/day in 2009. The variations were related to the changes in the amount of effective rainfall. In 2010 and 2011, there was a significant increase in the volume of mine drainage water pumped out (2,308 and 1,901m^3/day, respectively) due to the increase in effective rainfall (148.7 and 137.9mm, respectively).

There has been no distinct trend of permanent reduction or increase in the annual water intake during the observation period of 1998 to 2013, it mainly depended on the amount of effective rainfall, as it can be clearly seen in Figure 4.8.6.

Mine Dewatering Monitoring Boreholes

Five observation wells (1sh, 2sh, 3sh, 4sh and 5sh) were constructed north of the open pits on the side of the hanging wall to monitor any water level fluctuations in the bedrock aquifer resulting from the dewatering scheme. Water level data are available for the period 2002 to 2013 and are presented in Drawing 4.8.8 together with monthly total rainfall and volumes of mine drainage water pumped out.

Hydrochemistry of Groundwater Inflows

One single set of water quality data is available for the mine drainage water for both 2012 and 2013. Arsenic, sulphate and cadmium concentrations were above the Permissible Concentration Limit in 2012 and 2013.

Due to the interaction of the groundwaters with the rocks of the ore-body, the mineralisation of the groundwaters is greater than that of the groundwaters abstracted at the Kysyltu wellfield, presented in Section 4.8.3.8. Mineralisation, hardness and sulphates are in the range 900 to 1,500mg/l, 808-196.7mg-eq and 415-684mg/l, respectively.

Maximum permissible concentrations were found to have been exceeded for the following parameters: arsenic, cadmium, selenium, manganese, total iron, lead and strontium.

4.8.5 The Bakyrchyk Mine Groundwater Flow Model

A groundwater numerical flow model was developed for the Bakyrchyk mine by SRK in 2015. For that purpose, all the available hydrogeological data were collected, reviewed and incorporated into the groundwater flow model.

The purpose of the groundwater flow model was to predict the changes in a) surface water flow and quality and b) groundwater level and quality in the vicinity of the mine site during the construction, operation and closure phases.

The output of the groundwater flow modelling was used to carry out an assessment of the impact of the mine activities on the water environment. This formed the basis for the water resources Impact Assessment section.

The site conceptual model for the calibration envisages a four-layer groundwater flow system, having thicknesses of 70m, 70m, 100m and 120m, while for the forecast a nine-layer system was considered. The layers are conceptualized as having horizontal bases.

Each layer of the model was broken into 61,236 numerical cells, the size of which varied from 50m x 50m in the water intake zones and pits to 300m x 300m near the external borders of the model.

Detailed digitization of the model grid takes place:

- near the zones of convergence of streams (of open-cut and underground mines); and
- in the zones of a significant underground water level gradient.

A map of the model is presented in Figure 4.8.7.

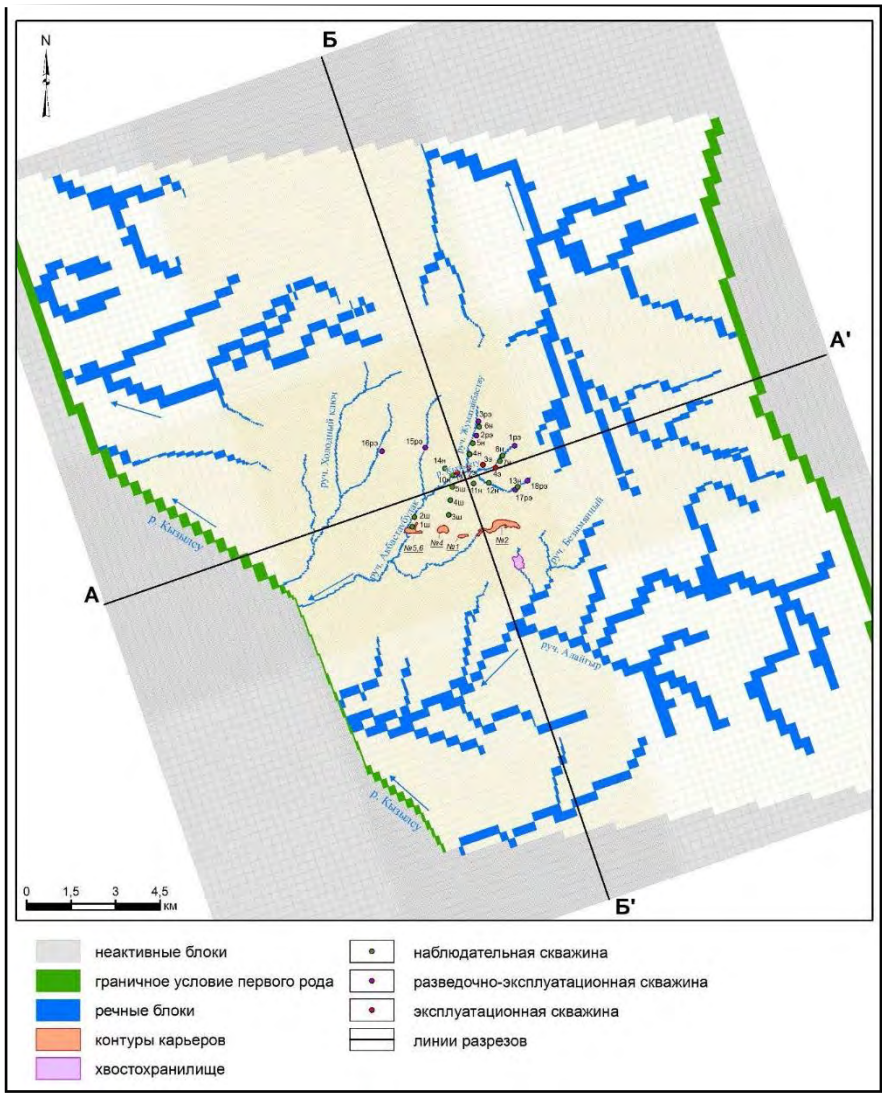


Figure 4.8.7: **Map of the Model Area and Numerical Breakdown**

4.9 Biodiversity

4.9.1 Biodiversity Context

This section provides a general description and overview of the biodiversity in the Republic of Kazakhstan (RoK) and a detailed description of the baseline within the Project study area. This section considers the importance of the Project study area for nature conservation at a local, national and international level.

The continental position of Kazakhstan in the centre of Eurasia is reflected in the physical and geographical make-up of the territory, as well as its plant and animal life. The RoK's position between the Siberian taiga and Central Asian deserts, and between the Caspian Sea and the high mountains of the Tien-Shan, results in a wide range and diversity of natural landscapes and ecosystems.

The RoK has the greatest diversity of landscape types among the Central Asian Republics, and is one of the most important countries in Central Asia for biodiversity conservation.

Five landscape types have been specified for the plains within the RoK: forest steppe, steppe, dry steppe, semi-desert and desert. Whilst seven landscape types have been established for its mountain systems, defined as: nival, mountain meadow, forest, forest steppe, steppe, semi-desert and desert.

The varied terrain and climatic conditions contribute to a wide diversity of ecosystems and species. The fauna of the RoK includes 178 species of mammals, 489 species of birds and 117 species of fish. An estimated range of 6,000 species of vascular plants are found in Kazakhstan. This high biodiversity results from the combination of faunas and floras of different bio-geographical origins.

4.9.2 Legally Protected Areas

The RoK has the following types of legally protected area:

- **State National Parks** – the "key objective of these areas is to conserve unique wildlife sites and provide people with the opportunity to enjoy the beauty of nature, learn more about nature and recover health by breathing fresh air".
- **State National Natural Reserves/Parks** (Zapovedniks) - "Specially protected natural territories, having a status of the nature protection institution and being differentiated by zones depending on the protection regimes, assigned for the multi profile use of the natural, historical and cultural complexes and objects, possessing the special ecological, recreational, scientific or other importance. The key purpose of zapovedniks is the preservation of ecosystems and the species inhabiting them. Zapovedniks are the most strictly protected areas where any economic development is prohibited, while recreation is possible only in the buffer zone. Only conservation and population maintenance activities are permitted in zapovedniks

- **Nature Reserves**
- **Reserve plots/State Zakaznik** - specially protected natural territory with a specific (ordered) protection regime or regulated economic activities assigned to conserve and reproduce one or few objects of the state natural reserved fund (the Law, Article 49). The land within zakazniks is not withdrawn from use and the protection of the objects is carried out in the course of the economic activities - by restricting the scope and timing of this or other types of works.
- **Nature monument (State natural memorials)** - "specially protected natural territories with the reserved regime, assigned for the conservation in the natural shape some of the objects of the state natural reserved fund"
- **Dendrological parks (forest reserves)**
- **Zoological parks**
- **Botanical gardens**

The closest RoK legally protected area is the Zapadno-Altayskiy State Nature Reserve (Zapovednik) which is located approximately 160km to the north east of the Project. The Reserve was created for the preservation and investigation of mountain (mountain meadow, mountain tundra, and the subniveal and nival belts) and taiga forest ecosystems. The total area of the reserve is approximately 56 ha. Therefore potential impacts can be scoped out.

4.9.3 Other Protected Areas

The Project is located within the 'Western and northern foothills of the Kalba Range' International Bird Area (IBA), as shown in Figure 4.9.1 (reproduced from http://www.birdlife.org/datazone/sitefactsheet.php?id=21920). The IBA was created and approved by the Association of Kazakhstan Biodiversity Conservation, Forest and Hunting Committee of Ministry of Agriculture of Republic of Kazakhstan and BirdLife International in 2008 and covers an area of approximately 657,170 hectares.

The IBA supports an estimated 18 breeding pairs of the International Union for the Conservation of Nature (IUCN) 'endangered' Saker Falcon (Falco cherrug) and an estimated two breeding pairs of the 'vulnerable' Eastern Imperial Eagle *(Aquila heliaca);* as well as supporting populations of the 'near threatened' Pallid Harrier *(Circus macrourus)*, Black-tailed Godwit *(Limosa limosa)* and Black-winged Pratincole *(Glareola nordmanni)*. See Appendix 4.9.1 for a full list of the IBA trigger species found within the Western and Northern foothills of the Kalba Range IBA.

Figure 4.9.1: Extent of the 'Western and northern foothills of the Kalba Range' IBA

4.9.4 Species of Conservation Concern

The International Union for the Conservation of Nature (IUCN) Red list identifies 16 species of mammals as critically endangered, endangered or vulnerable within the RoK. There are 21 threatened bird species and 16 threatened plant species.

Diverse and threatened large mammals include Saiga antelope (*Saiga tatarica*), wild sheep and goats, and their predators, including wolf and snow leopard.

Populations of vulnerable species such as Saiga antelope, Caspian seal (*Pusa caspica*), Caspian sturgeon (*Huso huso*), and migratory birds, undertake large-scale annual movements that increase their exposure to risks from anthropogenic and climatic factors. Kazakhstan has a global significance for biodiversity due to the presence of internationally important populations of rare and threatened species of flora and fauna, often with restricted distribution, as well as its importance as a migratory crossroads and wintering area for wildfowl, particularly along the Caspian shore.

Desk study information indicates the possible presence of several IUCN red listed and Kazakhstan Red Book species in the Project Study Area. These species are listed in Table 4.9.1.

Table 4.9.1: Threatened Species Identified through Desk Study

Species	Designation	Observed during field surveys
Birds		
Demoiselle Crane - *Anthropoides virgo*	Kazakhstan Redbook – Cat V (out of danger due to increasing population). IUCN Red list – Least Concern	Yes
Common Crane - *Grus grus*	Kazakhstan Redbook – Cat III (rare). IUCN Red list – Least Concern	No
Corn Crake - *Crex crex*	Not in Kazakhstan Redbook. IUCN Red list – Least Concern	No
Little Bustard - *Otis tetrax* or *Tetrax tetrax*	Kazakhstan Redbook – Cat II (vulnerable). IUCN Red list – Near threatened	No
Sociable Lapwing - *Chettusia gregaria*	Kazakhstan Redbook – Cat I (Endangered) Endemic to southern Russia and Kazakhstan. IUCN Red List - Critically Endangered	No
Black-tailed Godwit - *Limosa limosa*	Not in Kazakhstan Redbook. IUCN Red list - Near Threatened	No
Asiatic Dowitcher - *Limnodromus semipalmatus*	Kazakhstan Redbook – Cat IV (intermediate). IUCN Red list – Least Concern	No
Eurasian Curlew - *Numenius arquata*	NOT red book KZ IUCN Red list - Near Threatened	No
Black-winged Pratincole - *Glareola nordmanni*	NOT red book KZ IUCN Red list - Near Threatened	No
Pallas's Sandgrouse - *Syrrhaptes paradoxus*	Kazakhstan Redbook – Cat IV (intermediate). IUCN Red list – Least Concern	No
Black-bellied Sandgrouse - *Pterocles orientalis*	Kazakhstan Redbook – Cat III (rare). IUCN Red list – Least Concern	No
Golden Eagle - *Aquila chrysaetos*	Kazakhstan Redbook – Cat III (rare). IUCN Red list – Least Concern	Yes
Steppe or Tawny Eagle - *Aquila nipalensis*	Kazakhstan Redbook – Cat V (out of danger). IUCN Red list – Least Concern	No
Eastern Imperial Eagle - *Aquila heliaca*	Kazakhstan Redbook – Cat III (rare). IUCN Red list – Vulnerable	No
Greater Spotted Eagle - *Aquila clanga*	Not listed in Kazakhstan Redbook IUCN Red list – Vulnerable	No
White-tailed Sea Eagle - *Haliaeetus albicilla*	Kazakhstan Redbook – Cat II (vulnerable). IUCN Red list – Least concern	No
Eurasian Black Vulture -*Aegypius monachus*	Not listed in Kazakhstan Redbook IUCN Red list – Near Threatened	No
Pallid Harrier - *Circus macrourus*	Not listed in Kazakhstan Redbook IUCN Red list – Near Threatened	Yes
Saker Falcon - *Falco cherrug*	Kazakhstan Redbook – Cat I (Endangered). IUCN Red List - Endangered	No
Lesser Kestrel - *Falco naumanni*	Not listed in Kazakhstan Redbook IUCN Red list – Least Concern	No
Eurasian Eagle Owl - *Bubo bubo*	Kazakhstan Redbook – Cat II (vulnerable). IUCN Red list – Least Concern	No
European Roller - *Coracias garrulus*	Not listed in Kazakhstan Redbook IUCN Red list – Near Threatened	No

Table 4.9.1: Threatened Species Identified through Desk Study		
Species	**Designation**	**Observed during field surveys**
Yellow-breasted Bunting - *Emberiza aureola*	Not listed in Kazakhstan Redbook IUCN Red list – Endangered	No
Mammals		
Marbled Polecat - *Vormela peregusna*	IUNC Red list (Vulnerable). Kazakhstan Redbook – Cat III (rare).	No
Insects		
Bolivan brachypterous - *Bolivaria brachyptera* Pall.1773.	Kazakhstan Redbook – Cat II (vulnerable). Not yet assessed for the IUCN Red List	No
Predatory Bush Cricket - *Saga pedo* Pall. 1771.	Kazakhstan Redbook – Cat II (vulnerable). IUCN Red List (Vulnerable)	No
Polish cochineal - *Porphyrophora polonica*.	Kazakhstan Redbook Not yet assessed for the IUCN Red List	No
Delightful beetle - *Carabus imperialis.*	Kazakhstan Redbook Not yet assessed for the IUCN Red List	No
Gebler beetle - *Carabus gebleri.*	Kazakhstan Redbook Not yet assessed for the IUCN Red List	No
Steppe Hairy flower Wasp - *Scolia hirta* Schrenk, 1781.	Kazakhstan Redbook – Cat II (vulnerable). Not yet assessed for the IUCN Red List	No
- Large Heath or Common Ringlet Butterfly *Coenonympha tullia.*	Kazakhstan Redbook Not yet assessed for the IUCN Red List	Yes
Plants and Fungi		
Siberian adder's grass - *Erythronium sibiricum*	Red book of Kazakhstan	No
Steppe Peony - *Paeonia hybrid (Pall)*	Red book of Kazakhstan	Yes
Ledobur almond - *Amygdalus ledebouriana (Schlect)*	Status – endemic. Listed as Endangered in IUCN Trees of Central Asia due to narrow geographical range estimated to be less than 5000 km^2.	No
Bent tulip - Tulipa patens	Red book of Kazakhstan	Yes
Calophaca tianschanica – Calophaca howenii Schrenk	Status – endemic, relict species	No
Ludwig's iris - *Iris ludwigii*	Red book of Kazakhstan	Yes
Altai daphne - *Daphne altaica* (Pall.)	Red book of Kazakhstan	No
Adonis spring - *Adonis vernalis* L.	Red book of Kazakhstan	Yes
Root–philic polipirus - *Polyporus rhizophilus* (Pat.) Sacc.	Status - rare	No

4.9.5 Habitats

The Bakyrchik Mining Venture (BMV) and the adjacent territory is located in the Altai North-Western Province and is situated on a spur of Kalba Range and its foothills. The landscape is mainly associated with the lowland dry steppe belt although parts are situated in the foothill draughty steppe belt. A detailed habitat map of the area is included as Drawing 4.9.1, this shows that the existing and

Proposed Development associated with BMV is located in areas of undisturbed pasture and disturbed pasture (lowland dry steppe belt); low hill terrain, river valleys and the existing industrial zone.

4.9.6 Approach and Methods

The baseline for biodiversity and ecosystems that might be affected by the Project has been informed by relevant legal and policy requirements including the laws of the RoK relating to nature conservation and protection as well as relevant international conventions and agreements signed by RoK. The requirements of potential financial lenders (in particular IFC and EBRD) to the Project with respect biodiversity and ecosystem services were also considered.

Baseline data was also informed by Polymetal's position with respect to the conservation and sustainable use of biodiversity, which is to comply with the requirements of national laws, IFC Performance Standard 6 (2012) and EBRD's Performance Requirement. As such it aims to achieve 'no net loss' of natural habitat and a 'net gain' for any residual impacts on critical habitat.

Given these requirements, desk based searches of existing information were carried out to identify the potential presence of:

- Legally protected areas for nature conservation within a potential zone of influence of the Project and areas which are internationally recognised as having high biodiversity, including Key Biodiversity Areas, Global 200 Ecoregions, Endemic Bird Areas (EBAs) and Important Bird Areas (IBAs).
- Species which are protected in the RoK (listed in the Kazakhstan Red Data Book)
- Species which are considered by specialists to be threatened or declining either in the RoK or in the region.
- Areas of natural habitat according to the definition in IFC PS6 or EBRD's PR6.
- Species which might suggest or trigger the presence of critical habitat according to PS6/PR6. This includes species which are listed by International Union Conservation of Nature (IUCN) as being endangered or critically endangered at a global and European level as well as species meeting other criteria listed in the Performance Standards.
- Habitats or ecosystems which might be considered "critical" according to IFC PS6.

To confirm the accuracy of the baseline desk based searches, primary biodiversity data were collected during field surveys during:

- Autumn 2010 (Botanical survey and baseline faunal surveys)
- 23rd to 24th June 2011 (Zoological field survey including breeding bird survey)
- 28th September to 2nd October 2011 (Ornithological field survey - autumn migration)
- July 2013 (Hydrofauna survey)
- July 2013 (Detailed study of Sand lizard populations)

- July 2013 (Invertebrate survey)

Surveys in the field were designed based on literature review and consultation with relevant biodiversity specialists.

Surveys covered the main taxonomic groups and species for which the Project Study Area was considered likely to be suitable. In general, the surveys concentrated around the areas of proposed development (Waste Rock Dump, TSF and Future mine site) and areas within or close to the existing operations at BMV (within the Sanitary protection zone (SPZ)); and areas beyond the SPZ which are considered to be a buffer or control zone which would not be influenced by current operations.

Field survey area and sampling strategies differed according to the taxonomic group being studied. A brief explanation of the methodologies employed is provided within this section, which describes the baseline for each taxonomic group. Surveys were carried out for the Project study area which includes the Project's footprint and also areas that might be exposed to disturbance, pollution or other effects on the Project.

Table 4.9.2: summarises the ecological surveys undertaken in the Project study area.

Table 4.9.2: Summary of Ecological Surveys Undertaken

Date	Survey
Autumn 2010	Review of literature
	Preliminary study - Mammals
	Preliminary study - Birds
	Preliminary study - Reptiles
	Preliminary study - Amphibians
	Geobotanical field surveys
June 2011	Review of literature
	Breeding Bird survey
	Walk through route survey - Mammals
	Walk through route survey – Reptiles
	Walk through route survey - Amphibians
	Walk through route survey - Invertebrates
	Survey of fishermen - Fish
September to October 2011	Additional ornithological survey – autumn migration.
July 2013	Field survey - Aquatic Ecology
July 2013	Field Survey – Sand lizard populations
July 2013	Review of literature and field survey - Invertebrates

4.9.7 Field Survey Results

The following sections provide a brief description of the field survey methods and show where surveys or sampling were undertaken. They then summarise the findings.

Vegetation and Plant Species

The vegetation cover of Bakyrchik Mining Venture (BMV) and the adjacent territory is formed under the conditions of the steppe latitudinal zone (predominantly within the dry steppes subzone). Geographically it belongs to Altai North-Western Province and is situated on a spur of Kalba Range and its foothills. The landscape is mainly associated with the lowland dry steppe belt although parts are situated in the foothill draughty steppe belt.

Information on the floristic composition and vegetation types present within the Project study area was obtained through literature searches and field studies (autumn 2010). The 2010 botanical field survey methodology is not recorded, however the five survey locations are shown as green on Drawing 4.9.2.

Floral composition and diversity can be used as an indicator of the state of an ecosystem. The poor use of natural sources can lead to degradation of the soil-plant ecosystem; a decrease in the biological productivity of the soil; changes in floral composition and species densities; decreases in crop yield; and (where protective vegetative cover is reduced) increased erosion of soils by wind. The 2010 field study therefore investigated the impact of anthropogenic activities (mining and grazing) on the natural plant associations in open pit and dumps areas.

Desk Based Study

Systematic Botanical studies of the Region were undertaken throughout the early- to mid-20th century (V.A Kruger, 1913; S.E. Rozhanets - Kuchugovski 1924; N.V. Pavlov, 1928-1938; A.Y. Bronzov, 1929; K.A. Pashkovski, 1951; N.V. Lysova, 1958 and A. Kalinina 1960). Then in the 1970s and 1980s geobotanists from the Integrated Research Department of the Institute Kazgiprozem compiled Forage Land Maps of state owned farms. The Forage Land Map of the Charsk district of Semipalatinsk (now Semey) was produced between 1988 and 1989. A section of this geobotanic map covering the Study Area, and with the existing and proposed development at BMV overlain, is presented in Appendix 4.9-3. The colour of the mapping indicates the main community / formation types, whilst the text indicates the relative abundance of communities and subcommunities. The legend of the geobotanic map describes three land types/uses: Forage grass fields, lowlands (inter-hilled lows) and river valleys, and other areas (such as residential areas and BMV operational areas); and describes the floristic communities present.

In the Study Area, the desk study shows that steppe vegetation types dominate in the inter-hilled lows and river valleys. The steppes are mainly represented by feather grass-fescue-mixed herb, fescue-feather grass, feather grass- sheep fescue, goat's beard-bunchgrass vegetation. Meadowland in the lowlands and river valleys is represented by graminaceous-mixed herbs, wild rye- gramineous and sheep fescue- gramineous-mixed herbs communities. (Gramineous species also being known as Poaceae or true grasses)

The vegetation cover of the low-hill terrains and foothills has a strongly marked xerophytic character. The most widespread communities are those where steppe bushes dominate (St. John leaf meadowsweet and Sage bush formations), with graniform herbs on the slopes and tops of hills (tyrsa, sheep fescue, feather-grass). (Sagebrush species being members of the genus Artemisia and also commonly referred to as Wormwoods)

Meadowsweet-graniform-gramineous vegetation occurs on all slopes within both the foothills and lowlands. Under the cover of St.John leaf meadowsweet an understory of graniform herbs (tyrsa, sheep fescue and narrow laciniate sagebrush with Austrian sagebrush and herbs such as Stemless cinquefoil, Marshall thyme, Common yarrow, etc.) is formed.

Shrub vegetation on the slopes of the foothills alternates with tyrsa- sheep fescue, sheep fescue-absinthial; and on the stony peaks it alternates with narrow laciniate sagebrush-bunchgrass and fringed sagebrush- bunchgrass vegetation.

The summary results of the aforementioned studies, as well as thorough analysis of regional floristic reports and determinants (Flora of Kazakhstan, 1956-1966, Illustrated Determinant, 1969, 1972) a list of plant species likely to be found within the Study Area was compiled. The list contains 297 species from 97 genera and 56 families (Appendix 4.9.4).

The most multispecific families are composites (Compositae) - 45 species, gramineous (Gramineae) - 30 species, rosales (Rosaseae) - 21 species, legumes (Leguminosae) - 22 species and labiateflorous (Labiatae) - 14 species. The flora of the Study Area is dominated by herbaceous perennials, followed by semi shrubs and herbaceous annuals.

The desk study documents that, on the low hill terrains there is a marked contrast between the floristic communities which develop on the northern and southern slopes. At the same altitude, vegetation on southern slopes (warm and dry) is mostly xerophilic (adapted to grow in dry conditions), whereas on northern slopes (cold and wet) it is mostly mesophilic (growing best at moderate temperatures, between 25°C and 40°C).

Additionally, various edaphic communities, which are influenced by soil type rather than climate, have developed. Pelitfitic communities have developed on loamy soils and petrophilous communities have developed on rocky and gravelly soils. There are practically no psammophyte (adapted to shifting sand habitats) or halophyte (salt tolerant) species described within the Study Area.

Foothill steppe communities also vary according to the relative abundance of their constituent species. In some habitats (on the rocky slopes and tops) communities are monospecific, however on the lower slopes and in lowland areas communities are multispecific.

In general the percentage vegetation coverage (cover of soil with plants) is 60 to 70%, but can be as high as 80 to 90% in places.

Field Study

The botanic survey was conducted in autumn 2010 and the survey areas are identified in Drawing 4.9.2. The survey identified 196 species of vascular plant belonging to 46 families (Appendix 4.9.5). As could be expected in Steppe habitats, the most abundant family was the Poaceae (also known as the Gramineae or true grasses) which accounted for 35 (or 18%) of the species identified. The next abundant family was the Asteraceae (or Compositae, commonly referred to as the aster, daisy or sunflower family), which accounted for 28 (or 14%) of the species identified. The third most abundant family were the Lamiaceae (formerly known as Labiatae and commonly referred to as the mint family) which accounted for 16 (or 8%) of the species identified, see Table 4.9.3. 76% of the identified species were perennial herbs, with annual herbs being the next numerous at 7%. A full list is provided in Appendix 4.9.5. Appendix 4.9.6 provides a photographic record of the survey.

Table 4.9.3: Leading Families of Higher Flowering Plants within the Project Territory

No.	Family	Number of species	% of total quantity
1	Poaceae	35	18
2	Asteraceae	28	14
3	Lamiaceae	16	8
4	Rosaceae	16	8
5	Fabaceae	9	5

Species distribution was dependent upon habitat type and growing conditions. The majority of the identified species were either Mesophytic, 46% (moist habitats, but can tolerate short-lived drought) or Xerophytic, 26% (dry habitats, capable of withstanding prolonged drought). As in the desk based assessment, the Xerophytic species were associated with the low hill terrains. 31 species of aquatic plant (17% of total) were also identified, with the remaining species being intermediates of the above types. Species distribution was also linked to soil fertility and mineral composition with the majority (50%) of species being Mesotrophic (soils with moderate fertility soils) and a high number of Eutrophic species (high fertility soils) (Appendix 4.9.5).

Many plant species identified within the Study Area are of economic importance, for example being used as a food or fodder crop, having medicinal uses, or being used as a raw material (furniture manufacture), etc. This is further identified in Appendix 4.9.5.

Within the region, all unplowed territories with natural vegetation are used as pasture land and have an average output of 2 to 4 hwt/Ha of dry masssummer grazing. Vegetation cover in the area BMV experiences large grazing pressure (cattle), especially in around Auezov and Solnechniy; with additional pressure due to the mining operations and the development of unauthorised tracks and roads. These pressures lead not only to a decrease in ecosystem function, but also to a decrease in biodiversity and an increase in erosion.

The 2010 study identified changes in plant community structure (away from the naturally occurring associations) around the existing open pit and dump areas. At a 50 to 200 m radius around the existing open pits and dumps a modification in the grass sward was identified, with the vegetation being found to comprise Austrian sagebrush mixed with knotgrass (polygonacae sp.). Additionally these areas exhibited a reduction in vegetative cover (40 to 50% cover compared to average coverage of 60 to 70% in undisturbed areas), which was primarily due to the unregulated network of dirt roads crossing these areas. These areas showed no reduction in species diversity (up to 10 to 15 species) when compared to undisturbed areas; however a difference percentage composition was recorded with the Austrian sagebrush dominating the flora.

Mechanical disruption of soil and vegetation cover is connected with the disruption of the soil profile (compacted, disturbed or removed humus layer) and subsequent changes in the floral composition of an area or the complete removal of plant cover. Usually such disruptions are localised and are on small aligned areas.

Research by V.V. Kovalskiy together with VASHNIIL employees showed that organisms and their associations impacted by man-induced factors can actively reconstruct, change and control their surroundings within determined limits; and the organisms themselves can be changed via modification of the surrounding environment.

Microelements are also known as micronutrients or trace elements; and are commonly referred toas vitamins and minerals. They are defined as being 'essential in minute amounts for the proper growth and metabolism of a living organism'. Within plants they account for is less than 1mg per of dry matter and become toxic when occurring in slight excess. Microelements are not used in body construction, but usually participate in various metabolisms.

In general, soil held microelements have an irregular geographical distribution dependent upon geological history, the underlying soil forming rocks and the processes of soil formation. Shortage or surplus of available microelements influences their uptake by, and content within, plants. And therefore plants growing in different areas may exhibit different levels of uptake and content. Consequently, the availability of microelements influences their content within forage plants, which in turn impacts the uptake of chemical elements by fauna. Such movement of chemical elements from soil forming material and water and then through plants and animals, forms the biochemical food chain.

It is necessary to establish upper and lower permissible or critical limits of microelement concentration, which consider the level of each microelement required by animals. Research (supervised by V.V. Kovalskiy – corresponding member of VASHNIL) has shown that threshold levels of potentially hazardous chemical elements in soil and forage can be used as important criteria for determining the livestock demand for microelements

To investigate the possible correlation between vegetation and soil held microelements; and hence the impact of anthropogenic (BMV) activities, vegetation sampling was undertaken in areas here soil sampling results were available. Sampling and analysis were conducted by the EIA department and Kazmekhanobr institution specialists. Four samples were taken in the area of the proposed tailings dam facilityTSF, considered representative of areas which have been subject to anthropogenic impact; and a further (baseline) sample was taken at a distance of 5km from BMV site. The following plants were sampled for zinc (Zn), nickel (Ni), cobalt (Co), copper (Cu), lead (Pb), cadmium (Ca) and chrome (Cr): Feather grass, Couch grass, Furrowed fescue, Marshal thyme and Kentucky bluegrass. Only the top part of the plants were sampled. Depending on the effect to the plants the metals can be ranged down as follows: Pb>Cu>Co>Cr>Ni>Zn. The results of the analysis are shown in Appendix 4.9.6.

The 2010 study results show that average content of copper in the plant samples to be 0.08 of MPL (Maximum Permissible Level), lead – 0.39 MPL, nickel – 0.85 MPL, cobalt – 0.6 MPL, chrome – 0.02 MPL. Therefore none the samples showed an exceedance of the MPL.

As plants take up microelements selectively the levels measured within plant material differ from those within the soil. The level of uptake (measured level in plant material, as a dry weight) compared to that in the soil / rock substrate is described as the *biological uptake ratio* A_x:

$A_x = l_x/n_x$

Where l_x is the content of x element in the plant (dry weight); and n_x is the content of x element in the rock or soil substrate.

However, this indicator reflects the relative biochemical mobility of the elements. A more objective assessment can be made by comparison of plant dry substance and available water soluble mobile elements taken from the soil. This ratio is called *biochemical mobility ratio* B_x. B_x reflects the availability of the microelements to plants and degree of uptake. For many elements B_x is usually higher than A_x.

If A_x or B_x>1 the elements are accumulated in the plants, but if A_x or B_x <1 they are only captured.

Table 4.9.4: Biological Uptake Ratio (A_x) And Biochemical Mobility Ratio (B_x) Ratio Of Vegetation At The Future Tailings Dam Site And The Control Site (5km From BMV)

Location of sampling		A_x/B_x in elements					
		Zn	Ni	Co	Cu	Pb	Cr
Future Tailings Dam	A_x	0.17	0.02	0.03	0.05	0.08	0.001
	B_x	6.45	0.84	0.41	7.93	0.84	0.53
Background sample	A_x	0.08	0.02	0.03	0.03	0.08	0.001
	B_x	7.94	0.37	0.25	3.21	0.47	0.02

Table 4.9.4 shows that Zinc and Copper are intensive and middle accumulation elements; Lead, Nickel and Cobalt are low accumulation and strong capture elements; whereas Chrome is weak capture element.

The data confirm that Copper, Nickel, and Cobalt are naturally occurring in the soils, and that levels of Lead and Zinc have been raised by anthropogenic activities.

It must be noted that the content of microelements in vegetation is determined by the elementary elemental composition of the soils and the constituent plant species.

Rare, Relic and Endemic Plant Species

Eight species listed within the Red Book of Kazakhstan were identified within the Study Area during the 2010 survey: Steppe peony; Spring asphodel, *Hyssopus macranthus Boriss,* Prairie Crocus (*Pulsatilla patens),* Bent tulip, Wild Rosemary (*Ledum palustre* reclassified as *Rhododendron tomentosum), Euphorbia macrorrhiza* C.A. Mey and Ludwig's iris (Appendix 4.9.5 and Appendix 4.9.6).

Wild rosemary was identified in an area close to the new mine, near the river Kyzylsu. The species is rare in Kazakhstan, but widespread across the Russian Altai and therefore its conservation status is listed by the IUCN as being of 'least concern'. However due to its rarity in the region it is recommended that the area is fenced off prior to construction to preserve this population. The remaining seven species have yet to be assessed for the IUCN red list.

Flora and Vegetation of Economic and Functional Role

Many of the plants identified within the Project study area have an economic and functional role (Appendix 4.9.5). Individual species may be listed in more than one category:

- Fodder plants (43 species);
- Medicinal plants (80species);
- Ornamental plants (67 species);
- Poisonous plants (16 species);
- Weed plants (23 species);

- Edible plants (33 species);
- Plants used in manufacturing (31 species).
- Pollen Plants and melliferous plants (11 species)
- Cultured plants (52 species)

These species are represented by the following main life forms: grassy perennials, annual plants, semi-shrubs, shrubs and dwarf shrubs.

4.9.8 Fauna

Mammals

Information on the species of mammal's using the Project study area was obtained through literature searches and field studies (autumn 2010 and June 23rd to 24th 2011).

The methodology for the 2010 surveys is not recorded however the survey locations are shown as green hatching in Drawing 4.9.2 and a photographic log of habitat types, field signs and survey locations is presented in Appendix 4.9.8. In 2011 the main methodological approach was to employ a walk-through route survey to record the species and population size, at the same time taking photos of the biotopes, animals and traces of their activity (Novikov, 1953; Bannikov, 1997; Bibbi, 2000). While performing the 2011 route survey, a 30m wide transect was used to count rodents and inhabited holes (Novikov, 1953). The routes were walked, in the vicinity of the proposed tailings dam, the proposed Waste Rock Dump, the proposed processing plant and Auezov village, as identified as 'transects' (red lines) on Drawing 4.9.2. In total the survey routes covered approximately 6km. To predict population size over the wider area, the number of holes found was divided by the distance covered and then re-calculated per 1 square kilometre. Literary and survey data was used to compose a full list of local mammals.

According to literature research (Afanasyev, 1960; Mammals of Kazakhstan, 1969-1985) and the 2010 and 2011 survey data, including interviews with local residents, the faunal complex of mammals living in the Project area is represented by 49 species belonging to 7 orders: insect-eaters *Insectivora,* bats *Chiroptera,* carnivores *Carnivora,* rodents *Rodentia,* artiodactyles *Artiodactyla,* lagomorphs *Lagomorpha* and ungulates *Artiodactyla* (A full list of species is presented in Appendix 4.9.15). The two most represented orders are rodents (25 species) and carnivores (10 species).

During the 2011 survey, information provided by a local resident, hunter and fisherman, confirmed that Moose (*Alces alces*) and American mink (*Mustela vison*) have been seen entering the floodplains of Kyzylsu. However, neither the literature search nor the field surveys showed these two species to be present within the Project Area.

The Marbled Polecat (*Vormela peregusna)* is included in the faunal complex and is both listed in the Red Book of Kazakhstan and classified as 'Vulnerable' by the IUCN due to declining populations;

however it was not observed within the Project area during either the 2010 or 2011 field survey. The Pond Bat (*Myotis dasycneme*) was observed during the 2010 survey. This species is listed by IUCN as 'Near Threatened' in that it has been evaluated as being either close to qualifying for a threatened category (critically endangered, endangered or vulnerable) or is likely to qualify for a threatened category in the near future. However the IUCN have noted that better knowledge of population trends, particularly in eastern parts of its range (central Russia and China) for which there is currently little information, might result in a downlisting to Least Concern.

Of the potential 49 species, field surveys and interviews with local in 2010 and 2011 identified of the presence of 21 species of mammal which are characteristic for the Project area, Table 4.9.5.

Table 4.9.5: Mammal Species Identified within Project Area during the 2010 and 2011 Surveys

Species			IUCN Red list conservation status
Species	2010	2011	
Rodentia			
Red-cheeked Ground Squirrel (*Spermophilus erythrogenus*)	X	X	Least Concern
Long-tailed Ground Squirrel (*Spermophilus undulanus*)		X	Least Concern
Siberian Zokor (*Myospalax myospalax)*		X	Least Concern
Steppe Pika (*Ochotona pusilla*)		X	Least Concern
Barabinsk Hamster or **Striped Dwarf Hamster** (*Cricetulus barabensis*)	X		Least Concern
Eversman's Hamster (*Allocricetulus eversmanni*)	X		Least Concern
Water Vole (*Arvicola terrestris*)	X		Least Concern
Common Vole (*Microtus arvalis)*	X		Least Concern
Mole lemming or **Northern Mole Vole** (*Ellobius talpinus*)	X		Least Concern
House Mouse (*Mus musculus*)	X		Least Concern
Striped Field Mouse (*Apodemus agrarius*)	X		Least Concern
Common Field Mouse or **Long-tailed Field Mouse** (*Apodemus sylvaticus*)	X		Least Concern
Muskrat (*Ondatra zibethicus*)		X	Least Concern
Brown Hare or **European Hare** (*Lepus europaeus*)	X		Least Concern
Carnivora			
Red Fox (Vulpes vulpes)	X		Least Concern
Siberian Ferret or **Steppe Polecat** (Mustela eversmannii)	X		Least Concern
Grey wolf		X (during bird surveys)	Not yet assessed for Red list
Insectivora			

Table 4.9.5: Mammal Species Identified within Project Area during the 2010 and 2011 Surveys			
Species			**IUCN Red list conservation status**
Species	2010	2011	
Laxmann's Shrew (*Sorex caecutiens)*	X		Least Concern
Small white-toothed Shrew or **Lesser Shrew** (Crocidura suaveolens)	X		
Long eared hedgehog (*Hemiechinus auritus*)		X	Least Concern
Chiroptera			
Water bat or **Daubenton's bat** (*Myotis daubentoni*)	X		Not assessed
Pond bat (*Myotis dasycneme*)	X		Near Threatened

The 2010 survey recorded 16 species of mammals belonging to nine classes within the survey area, as well as two additional species being reported by local residents. The majority of recorded species were rodents, with insect-eaters and small carnivores also being, but in smaller numbers.

Insect eating mammal species were represented by Laxmann's shrew and the Small white-toothed shrew. These species were found at an approximate density of 1-2 individuals per hectare in areas of steppe areas and along the banks of waterbodies.

Common water bats and Pond bats were found within residential areas and technical facilities at a density of approximately 3 to 4 individuals per ha. Both species are insectivorous and belong to the family Vespertilionidae, or evening bats, which is the largest and best known family of bats, containing almost one third of all bat species.

The canidea or dog family is a represented by the Red fox which occurs throughout the territory up to the town edges at an approximate density of 2 to 3 individuals per 1000 ha. A single individual of Steppe polecat was found near the tailings lagoon.

Rodents were the most commonly occurring class of mammal within the study area in 2010. Red-cheeked ground squirrel was found in steppe type wetlands and at the margins of arable land at an approximate density of 4 to 5 animals per hectare.

Members of the hamster family (Barabinsk and Eversmann's Hamsters) were found in dry grassland areas; whereas the Common vole inhabits steppe regions. These species were found at an approximate density of 3 to 5 animals per hectare. Water vole was found on the banks of small ponds. Mole lemming was found within the steppe plains.

Representatives of the mice family are depredators and can spread dangerous diseases. In 2010 the Common field mouse and the House mouse were recorded as inhabiting areas with shrub vegetation and residential areas. The striped field mouse was recorded as inhabiting areas with well-developed grassland vegetation and biotopes with reed and cattail arrays.

The 2010 survey also recorded Brown hare at a low population density along the steppe areas with artificial.

The 2011 survey recorded six species of mammals. During the route survey 3 to 10 ground squirrel holes (Long Tailed or Red-cheeked) were discovered per 1km. In total 28 holes (on average 4.7 holes per 1km, constituting 140 holes per 1 square km) were recorded along the 6km stretch. The highest density was found in the area of the new processing plant (300 holes per 1 square km). Visually, only one Long Tailed Ground Squirrel was observed along the steppe road.

Quite often tiny rodent holes were encountered, belonging, possibly, to Hamsters Cricetidae sp., Jerboas Dipodidae sp. or Mice Muridae sp. (average 198 holes per 1 square km). However it was not possible to differentiate the species from the hole alone and so no definitive identification or count could be made.

In the area of the TSF and processing plant the calls of Steppe Pikas were heard coming from areas of shrub. Calls were heard at a density of one or two per 1km of the route. The average density of Steppe Pikas in the area of the TSF is therefore predicted to be 60 animals per 1 square km.

Seven piles of soil discarded by a Siberian Zokor were discovered in an area of willow-shrubs by a spring. The skin of a long-eared hedgehog which had been eaten by a predator was also found.

One Muskrat was encountered on the water reservoir of the river Kyzylsu (test site). According to information provided by an employee of the tailings dam (security guard) one pair of Muskrats was living in the water reservoir. This is indicative of good water quality being achieved within the existing tailings facility, which is supported by the presence of a pair of Ruddy Shelducks (Tadorna ferruginea) and three pairs of Common Terns (Sterna hirundo) . Muskrats were also observed during the Ornithological surveys in September 2011 at the Karakuga Lake and the Kyzylsu Reservoir (in the area outside the SPZ); Muskrat tracks were observed on the shores of the existing tailings pond; and a lodge was observed in the pond adjacent to the proposed mine site (which would be removed as a consequence of the proposals. Additionally tracks of a Grey Wolf (Canis lupus) were found on the shores of the existing tailings pond (Appendix 4.9.11)

Reptiles and Amphibians

Information on the species of reptile and amphibian using the Project study area was obtained through literature searches and field studies (autumn 2010 and June 23rd to 24th 2011).

The methodology for the 2010 surveys is not recorded however the survey locations are shown as green hatching in Drawing 4.9.2 and a photographic log of habitats and survey locations is presented in Appendix 4.9.8. In 2011 the main methodological approach to determining the species composition of reptiles was to walk transects, indicated in Drawing 4.9.2 as red lines. In areas with bare soil

surfaces, the transect was 8m wide, however this was narrowed to 2m in vegetated areas (Novikov, 1953; Bannikov and others, 1977). Amphibians were registered by water reservoirs.

According to literature research (Paraskiv, 1956; Bannikov et. al., 1977; Iskakova, 1959) and the 2010 and 2011 survey data, the faunal complex of reptiles and amphibians living in the Project area is represented by ten species; four amphibians and six reptiles.

None of the six species identified during the 2010 and 2011 field surveys (Table 4.9.6) are listed in the Red Book of Kazakhstan; and they are all listed as having a conservation status of 'Least Concern' by the IUCN. However the 2011 survey report lists the abundance of the three recorded reptile species was recorded as being 'rare in the survey area'.

The 2010 survey reported that, in general, reptiles are few in number across the survey area and are mainly represented by lizards, which are particularly exposed to human impact. Population numbers are significantly affected by vehicles, disturbance of the surface cover and ground works.

In 2010, Sand lizard (*Lacerta agilis*) was recorded in open steppe areas along the banks of ponds at an approximate density of 3 to 5 individuals per hectare. In 2011, three individuals of this species were observed in the area of the future tailings dam. This species is active from April to September.

Two species of snake were recorded in 2010. Grass snake was recorded at low densities (1 to 2 individuals per ha) in the bottomland and along the banks of ponds. The Common or European viper, also known as the Common or European adder, (*Vipera berus*) inhabits wet zones and only a single individual was encountered during the 2010 survey. Grass snake and Common viper are recorded as being active between April and September, and April and October respectively. The only reptile recorded during the 2011 survey was the Sand lizard.

In 2010 the only amphibian recorded within the survey area was the Common toad (*Bufo bufo*). This species is active between April and October and was observed in meadow areas and along the banks of ponds. The 2010 surveys recorded the abundance of this species throughout the survey area as common and stated that the number of amphibian species depends on the pH of the habitat and the degree of water pollution by fuels and lubricants.

In 2011 the only amphibian recorded was the Moor Frog. Two individuals were recorded on June 24 in the pond in the area of the proposed mine. This feature will be removed as part of the development proposals.

Table 4.9.6: Reptiles and Amphibians Identified within Project Area during the 2010 and 2011 Surveys

Species				IUCN Red list status
Species	2010		2011	
	Amphibia			
Common toad (*Bufo bufo*)	X			Least Concern
Moor Frog or **Altai Brown Frog** *(Rana arvalis)*			X	Least Concern
	Reptilia			
Sand lizard (*Lacerta agilis*)	X		X	Least Concern
Grass snake (*Natrix natrix*)	X			Least Concern
Common viper (*Vipera berus*)	X			Least Concern

Detailed study of Sand lizard populations as a bioindicator Reptiles play a role in food chains by adjusting the number of invertebrates and small vertebrates, as well as being a prey species of a number of other vertebrates. As such, lizards can be used as agents for the biological control of pests and are considered as indicators of the state of the environment and its changes (bioindicators).

The Sand lizard is well adapted to living in habitats which have been influenced by human activity and an increase in population density has been reported in these habitats. This makes the Sand lizard an important component of man-made landscapes and makes it a model species for determining the status of ecosystems within the study area. The aim of the study was to determine the quantitative indicators and sex structure of the population in the Study area. The study was conducted during the third week of July 2013.

Sand lizards mainly inhabit forest and steppe areas, but are occasionally found in the semi-desert zones on the outskirts of the sands. In the mountains, they are found to a height of 3500 m above sea level. The maximum population density observed in the steppe zone is up to 1000 individuals per hectare. Depending upon local conditions, Sand lizards are active between March/May to September/October, requiring temperatures of above +7.5 °C to remain active. Mating begins shortly after the end of the hibernation period. Eggs are laid in holes, which may be freshly dug by the breeding pair; or are often modified Common mole rat burrows, selected as they have soft soil, are well warmed by the sun and have a comfortable humidity inside, providing optimum conditions for the eggs to develop and hatch. Females lay one or two clutches (4 to 15 eggs per clutch) in late May - early June. The incubation period lasts about two months. The young with a body length of 23 to 34mm appear in July, becoming sexually mature after the second or third winter with a body length of 70 - 80mm. Sand lizards have a lifespan of up to six or seven years. They eat a variety of insects and their larvae, spiders, woodlice, earthworms, molluscs. Occasionally they eat other small lizards and have been recorded as eating their own young.

Sand Lizards are prey species for bird species such as small Falcons, Kites, Harriers and the rare Steppe eagle.

The Sand lizards' preferred range is one of anthropogenic habitats with distinct ecotonal properties (gradual grading of one habitat type into another). In the study area this habitat is provided through

deforestation (including quarterly clearing and buring); wide clearing for power lines, gas and oil pipelines; and roads and associated infrastructure (with the highest preference for slopes and ditches). Roadside verges offer the maximum value of all the natural and anthropogenic habitats, with south facing roadside slopes being preferred due to the warming effect. In addition, human waste (food scraps, grain and other agricultural products) attracts rodents, resulting in there being many old burrows for Sand lizards to occupy. Additionally, waste and farm animal excrement attracts insects, which are the Sand lizard's main food source. The sloping banks of drainage systems (including polder dike systems) also offer favourable habitat.

Visual observations were undertaken in five different 'zones' showing differing degrees of anthropogenic impact: the buffer zone, sanitary protection zones 1 and 2, the industrial zone and the village of Auezov.

- The buffer zone is a hilly territory. The vegetation of grasses and shrubs provides 80 to 90% cover.
- Sanitary zone 1 is approximately 5 km from the industrial zone and sanitary zone 2 is approximately 1.5 to 2 km from industrial zone, in the direction of the prevailing wind. The sanitary zone has vegetation of the meso-xerpohyte type and in depressions it is largely grasses. Vegetative cover is 70 to 80%.
- The industrial zone is characterised by a much greater thinning of the grass cover. Vegetation is mainly wild grasses which provide approximately 55 to 65% cover. The soil is heavily compacted.
- The plots in the village of Auezov were located between domestic buildings and were typified by ruderal plant communities.

The standard block count method (V. Makeyev and AT Bozhanskogo, 1988) was used to estimate the number of Sand lizards in each zone. The surveys were carried out on transects of variable bandwidth, the population density is given by:

$$A = \sum \frac{ni}{2ldi}$$

Where a - population density, *l is the length* route, *di* - detection distance animal, *ni is* the number of animals found in the interval.

The sex of individuals was determined visually using a range of external characteristics such as body colour, the presence of nodules at the base of the tail, etc.

The study showed that Sand lizard populations in the differing zones are only separated by small insulating barriers and therefore can be thought of as a single population. This close arrangement of the population is typical of the optimum habitat zone, which is located mainly in the steppe zone and

partly in neighbouring (semi-desert and steppe) areas. In other landscapes (for example, floodplains and foothills), Sand lizard populations tend to be more mosaic in their distribution.

In late July near the village of Auezov Sand lizards were observed to leave their burrows between 08.00 and 09.00 on sunny days, but not before 11.00 on cloudy days when the temperature exceeds 23°C. They were observed to be active all day only returning to their burrows with the onset of dusk. Young were observed to hatch around mid-July.

During the observation period, the highest population density was observed in the buffer zone.

Table 4.9.7: Population Density and Sex Ration of Sand Lizards in the Five Zones

Survey Area	Population Density (OS/ha)	% male / % female (ratio)	Characteristic Ecosystem
The settlement "Auezov"	3.8	29.3 / 70.7 (1 : 2.4)	Gardens
Industrial Zone	4.6	32.5 / 67.5 (1 : 2.1)	Weedy vegetation
Sanitary zone 1	7.1	43.4 / 56.6 (1 : 1.3)	Shrubby herb-grass steppes
Sanitary zone 2	5.8	49.1 / 50.9 (1 : 1)	Wormwood-fescue-feather grass steppes
Buffer zone	13.7	43.2 /56.8 (1 : 1.3)	Shrubby herb-grass steppes

The study stated that a habitat type and the level of vegetative cover may have led to the greater population in the buffer zone. Within the village of Auezov vegetatin cover and hence shelter for the lizards was sparser; additionally the gardens had been heavily treated with pesticides (against the Colorado potato beetle), which may have impacted the lizard population.

The sex ratio of a population acts as a regulator of a phylogenetic plasticity of the species and population and is therefore an important bioindicator. It is believed that a sex ratio of 1: 1 (male:female) in the sexually mature portion of animal populations is optimal, as it provides the greatest opportunity for finding a mate.

Therefore it can be expected that for natural ecosystems, the ratio of male:female Sand lizards would be approximately equal (without taking into account the age of the individuals).

However, in both the village and the industrial zone the observed sex ratio was close to 1: 2 with a predominance of females. The high mortality rate amongst males may indicate extreme environmental conditions. In the other zones there was still a slight predominance of females, but the ratio was closer to 1:1 (Table 4.9.7).

The survival rate of females maintains the populations' reproductive capacity at a high level and therefore actively increases the resistance of the population.

The study of quantitative indicators and sex structure of the population of the Sand lizard inhabiting the territory of BMV and its surroundings, showed that the anthropogenically transformed ecosystems of the industrial and inhabited zones are characterised by extreme environmental conditions. The population of Sand lizard exhibits decrease in population dynamics resulting in a gender bias towards females, because of this.

The number and species diversity of mammals and reptiles within the Project study area are relatively low, which is typical for this territory.

Based on the results of the monitoring of Sand Lizard populations conducted in July 2013, it has been concluded that the anthropogenic impact of the production activities has had an impact on the population density of fauna within the Project study area.

Bird Surveys

The avifauna around the BMV was studied on three occasions. A preliminary survey was undertaken in autumn 2010. A breeding bird survey was undertaken between the 23rd and 24th June 2011 to coincide with the end of the breeding season for the steppe, bush, water and marsh birds. During this survey, many species of passerines were rearing their chicks and were attached to their nesting areas. Therefore, despite the short survey period, sufficient data were collected to describe the local avifauna in different areas.

An additional survey was undertaken between 28 September and 2 October 2011 to gather data in relation to migratory and non-migratory species. The surveys coincided with the end of the autumn migration period for sandpipers, skylarks and small insectivorous birds; the main migration period of granivorous perching birds (songbirds); and the beginning of duck migration.

The methodology for the 2010 survey is not recorded however the survey locations are shown as green hatching in Drawing 4.9.2, however a photographic log of habitats, some sighted species and survey locations is presented in Appendix 4.9.8

During both 2011 survey visits, visual observations and bird counts were undertaken in the areas identified on Drawing 4.9.2, the transect routes are marked in red. Different transect widths were used for different classes. A 100m wide a stretch for small passerines, a 500m wide stretch for medium sized birds and large birds were counted within the limits of visibility (Novikov, 1953; Bibbi et al., 2000). Observations were carried out using 8-fold field binoculars. The absolute numbers were then divided by the number of kilometres and then re-counted per 1 square kilometre. The ratio of occurrence of species (species occurrence index) was also calculated (percentage of individual counts when certain species were found).

For the breeding season survey (June 2011), four route surveys, totalling 9km, were carried out over the two day survey period. Total survey effort was approximately ten hours. Three of the route surveys

(6km) took place in the region of active or planned BMV facilities (the new tailings dams, old tailings dams and the mine site; Areas 1, 2 and 3, respectively, on Drawing 4.9.2). One route survey (3km) was conducted in the Kyzylsu river valley (Area 4 on Drawing 4.9.2), where business activities are absent, as a control. The nesting period for various orders of birds using the region in general stretches from April until July; and therefore the surveys are considered to have been undertaken at an optimum time (June).

For the migratory survey in September to October 2011, ten route bird counts were undertaken over five days using the same survey areas used in the breeding bird survey. A total transect length of approximately 26km was investigated. Total survey effort was approximately 23 hours. This included six counts (18km) in the region of active or planned BMV facilities (the old and new tailings dam, the proposed mine site); and four counts (8km) in the Kyzylsu river valley area, where no anthropogenic activities are present, except for cattle grazing.

The four reference area counts included a route count in Kyzylsu River valley, a route along the reservoir shore from the dam to Zhanaul village, and two routes within reference areas on Karakuga Lake (around Shalobay village) and along the creek from this lake to the Kyzylsu River.

Compared to the breeding bird survey in June the migratory survey extended the route count within the area of the future tailings pond by another kilometre downstream of the Alaigyr River to the pond. See Figure 4.9.2 below

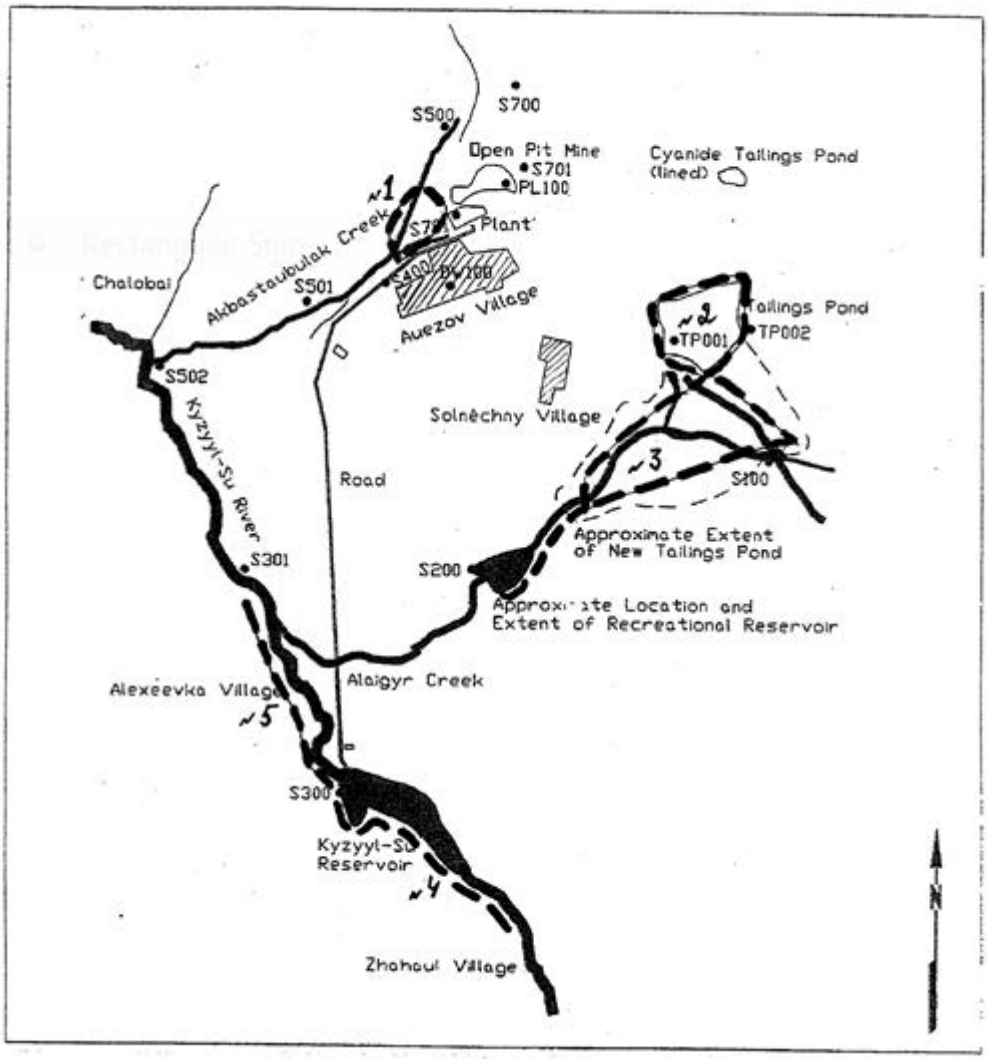


Figure 4.9.2: Route Counts Undertaken in the Migratory Bird Survey (28-09-11 to 02-10-11)

Desk Based Study

A desk based study of the avifauna of the area surrounding BMV was undertaken in autumn 2010. In total according to the literature (Birds of Kazakhstan, 1960-1974; Gavrilov, 1999; Smelyanskiy et al., 2006; Berezovikovet al., 2007), throughout the year during nesting, seasonal migration and wintering, a total of over 206 species of birds can be found in the area around Bakyrchik (Table 1 of Appendix 4.9.4). Out of these, 13 species have been entered in the Red Book of the Republic of Kazakhstan (although two of these species are listed as 'out of danger') and 12 are listed as being of Near Threatened status or greater in the IUCN Red List. A full list of species of conservation concern, and their current status, identified through the desk study is contained in Table 2 of Appendix 4.9.4.

As previously noted, the Project (including Auezov village) is located within the 'Western and northern foothills of the Kalba Range' International Bird Area (IBA), as shown in Figure 4.9.1. The area is therefore considered to be an especially important area for bird habitat (Appendix 4.9.1).

Field Studies

2010 Survey

A survey of the avifauna of the area surrounding BMV was undertaken in autumn 2010. The survey identified 53 species within the Study Area. The territory surrounding BMV was be divided into three zones: (1) flat prairie land; (2) the existing mine, associated industrial facilities / infrastructure and residential areas; and (3) areas of water and swampy ground. The reported data (Table 1 of Appendix 4.9.13) did not make a distinction between areas, although the accompanying report text described the distribution of species as follows.

The area surrounding residential areas and industrial facilities was dominated by passerines, ravens and martins, with birds of prey, such as hawks and falcons, being rarer.

Within wet and swampy areas, wetland birds dominated. As the survey coincided with seasonal migrations eight species of ducks (Anatidae) were recorded. These were Common teal (*Ana screcca*), Garganey Teal (*Ana squerquedula*), Northern pintail (*Anas acuta*), Gadwall (*Anas strepera*), Common shelduck (*Tadorna tadorna*), Ruddy Shelduck (*Tadornaferruginea*), Northern shoveler (*Anas clypeata*), Mallard (*Anas platyrhynnchos*). Common gray heron (Ardea cineriea) and Bald coot (*Fulica atra*) were also found in wetland areas.

Prey birds were represented by single individuals. Black kite (*Milvus migrans*) is a scananger and was found in the areas with waste accumulations, whereas Buzzards (*Buteo buteo*) was recorded in the open landscapes with patches of shrubs. Common kestrel (*Falco tinunculus*) was recorded nesting around industrial facilities and power line poles. Pallid Harrier (*Circus macrourus*) is representative of prey birds occupying wetland territories, whereas the Eurasian Sparrow hawk (*Accipiter nisus*) is a migratory visitor.

Quail (*Coturnix coturnix*) a member of the pheasant family is common in steppe areas, and a species density in the region of 1 or 2 individuals per hectare was recorded.

Migratory wading birds such as Ringed Plover (*Charadrius hiaticula*), Little Ringed Plover (*Charadrius dubius*) and Green Plover (*Vanellus vanellus*) were recorded along banks of reservoirs, ponds and shallow waters. Redshank (*Tringa tetanus*) and Red-necked phalarope (Phalaropus lobatus) were also common along with Oyster catcher (*Haematopus ostralegus*), Green sandpiper (*Tringa ochropus*), Little stint (*Calidris minuta*). During the migration the numbers of sandpipers and migratory waders can increase significantly from 2 to 3 up to 20 to 30 individuals.

Black-headed Gull (*Larus ridibundus*) and Common Terns (*Sterna hirundo*) were also recorded within the study area. Several species were also recorded in and around residential areas, including Hoopoe (*Upupa epops*), Common or European starling (*Sturnus vulgaris*) and Eastern turtle dove (*Streptopelia orientalis*).

The 2010 survey showed that small passerine birds (Passeriformes) were represented by the following species. Short-toed lark (*Calandrella cinerea*) and the White-winged Lark (*Melanocorypha leucoptera*) are typically widely spread, as are Sandmartin (*Ripara riparia*), Barn Swallow (*Hirundo rustica*), Great tit (*Parus major*), House- sparrow (*Passer domesticus*) and Tree sparrow (*Passer montanus*). Common corvid species are Raven (*Corvus corax*), Eurasian Magpie (*Pica pica*), Rook (*Corvus frugilegus*), Jackdaw (Corvus monedula), Hooded crow (*Corvus cornix*).

The study also showed that in areas close to water, passerine species such as Yellow wagtail (*Motacilla flava*) and White Wagtail (*Motacilla alba*) were found at densities in the region of 1 to 15-20 individuals.

In wooded areas / forest plantation the species such as the Ordinary Nightingale (*Luscinia luscinia*), Great tit (*Parus major*), Chaffinch (*Fringilla montifringilla*) and Common bullfinch (*Pyrrhula pyrrhula*) were recorded.

During migration and in winter months, migratory and over-wintering birds typical of the tundra and northern forests are also expected to be present.

A full list of the 53 bird species identified by the 2010 field survey is presented in Table 1 of Appendix 4.9.13

June 2011 – Breeding Season

In total 51 species were recorded during the breeding season surveys in June 2011. Forty-seven species were recorded during the route transect surveys, with an additional four species recorded in Auezov village and the nearby steppe: Demoiselle Crane (Anthropoides virgo), Rock Pigeon (Columba livia), House Sparrow (Passer domesticus) and House Martin (Delichon urbica).

The 51 species belonged to nine orders: Anseriformes (1 species), Falconiformes (5 species), Galliformes (1 species), Gruiformes (1 species), Charadriiformes (9 species), Columbiformes (2 species), Coraciiformes (2 species), Cuculiformes (1 species) and Passeriformes (29 species). Passeriformes (songbirds) were the most represented order, followed by Charadriiformes (waders and gulls) and Falconiformes (birds of prey).

During the breeding season surveys 548 specimens of 39 species were identified within the areas of active or planned BMV facilities (Survey areas 1, 2 and 3 on Drawing 4.9.2). The most common species were the Rosy Starling (Pastor roseus) (57.3% of all recorded sightings), Jackdaw (9.3%) and Common Starling (4.6%). These three species represented 71.6% of all recorded individuals. Survey data can be found in Tables 2 to 4 of Appendix 4.9.13. The area of the future tailing dam turned out to be the most abundant area in terms of both the number of individuals and species (see Table 2 in Appendix 4.9.13).

136 specimens of 23 species (Table 5 in Appendix 4.9.13) were registered in the Kyzylsu river valley (Area 4 on Drawing 4.9.2). The most abundant were: Rosy Starling (27.9%), Nightingale (10.3%), Cetti's Warbler (8.8%), Red-headed Bunting (7.4%) and Hooded Crow (6.6%). These five species represented 61.0% of the birds recorded in this area.

Rosy Starling and Red-headed Bunting were the most commonly observed birds and were presenton all survey routes (Areas 1,2,3 and 4). Hooded Crow, Jackdaw, Tawny Pipit and Wheatears (Common and Isabelline) were also very common (75%) (Table 6 in Appendix 4.9.13).

Fifty of the species recorded during the June 2011 survey breed in the region, while one species (Green Sandpiper) is classed as migratory and does not breed here.

In line with the mainly hummocky steppe landscapes, nesting birds were mostly represented by steppe species adapted to this habitat. The remaining species were recorded as nesting in interzonal biotopes (cliffs, shrubs, floodplains of rivers) and developed areas (residential or industrial). Local birds have adapted to the harsh conditions of the severe continental climate. Those inhabiting open areas tend to occupy mostly humid places - various topographic lows, holes with sparse shrubbery. The nesting period for various orders of birds in general stretches from April until July.

Migratory Surveys September – October 2011

Between 28 September to 2 October 2011, 40 species were recorded during the transect surveys, and an additional two species noted in Auezov village outside the counting period: Rock Dove *(Columba livia)* and House Sparrow *(Passer domesticus)*.

The 42 recorded species belonged to eight Orders: *Pelecaniformes* (1 species), *Ciconiiformes* (1 species), *Anseriformes* (5 species), *Falconiformes* (5 species), *Charadriiformes* (5 species), *Columbiformes* (2 species), *Caprimulgiformes* (1 species) and *Passeriformes* (22 species). Therefore, as in the previous surveys, the most represented Order were the *Passeriformes* (or songbirds).

Results of the autumn migration 2011 bird counts are presented in Tables 8 to 18 of Appendix 4.9.14.

In autumn 2011 a total of 270 birds of 25 species were counted within the areas of active or planned BMV facilities (Areas 1, 2 and 3 on Drawing 4.9.1). Among them are the following common species: tree sparrow (22.2% of all birds counted within the gold mine), linnet (11.8%), mallard (9.6%), hooded crow (8.5%), and magpie (5.2%). These 5 species cover more than a half (57.0%) of all birds counted here. The most frequent birds along the routes are hooded crow (83.3%) and mallard (66.7%).

416 birds of 29 species were counted within the reference areas. The following species dominated here: mallard (19.0%), rook (12.0%), chaffinch (10.8%), tree sparrow (10.1%) and skylark (8.9%). Their abundance totals 60.8% of all birds registered. The most frequent birds seen were mallard and chaffinch (frequency 75.0% each).

Table 4.9.8 describes the most commonly encountered species during the autumn 2011 survey period, all these species were found in both the test areas (1, 2 and 3) and the reference area (area 4).

Table 4.9.8: Most Commonly Observed Bird Species During the Autumn Migration Survey (2011)

Bird Species		Individual Birds, Total	Occurrence,%
English Name	Latin Name		
Mallard	*Anas platyrhynchos*	105	80.0
Chaffinch	*Fringilla coelebs*	78	80.0
Skylark	*Alauda arvensis*	47	70.0
Hooded Crow	*Corvus cornix*	33	70.0
Magpie	*Pica pica*	25	70.0
Tree Sparrow	*Passer montanus*	102	60.0
Linnet	*Acanthis cannabina*	62	40.0

There was a significant difference in both the number of species and abundance of individuals recorded in the areas of the active or planned BMV facilities and in the reference area (the Kyzylsu river valley area). This can be explained by the reference area having a more diverse range habitats, less anthropogenic pressure and richer food resources on the water bodies. The differences are summarised in Table 4.9.9.

Table 4.9.9: Number of Species and Bird Abundance in Different Areas Around Bakyrchik in Autumn 2011.

Areas	Number of counts	Distance, km	Number of Species Per 1 Count				Number of Individual Birds Per 1 Count			
			Min	Max	Average	Total	Min	Max	Average	Total
Test	6	18	6	11	9.2	25	29	73	46.7	270
Reference	4	8	6	16	11.5	29	46	208	104.0	416

Summary of the 2010 and 2011 Surveys

A total of 96 different species representing 14 orders were recorded during the three surveys. A table of the combined survey data is presented in Appendix 4.9.13. The order of representation was as follows: Passeriforms - songirds (42 species), Charadriiformes – waders and gulls (16 species), Falconiformes–birds of prey (13 species), Anseriformes - ducks (11 species), Columbiformes–pigeons (3 species), Coraciiformes (2 species) , Podicepediformes (2 species), Ciconiiformes (1 species), Gruiformes (1 species), Phalacrocoracidea (1 species), Caprimulgiformes (1 species), Calliformes (1 species), Cuculiformes (1 species) and Opodiformes (1 species).

Rare or Endangered Bird Species

Two flocks of Demoiselle Crane, containing between 25 and 50 individuals, were observed on 22 nd and 25th June in Steppe habitat outside of the survey areas, approximately 6km East of Auezov village.

Although this species is listed in the Red Book of Kazakhstan, its status has been reduced to Category V (out of danger) due to increasing population size; and therefore is considered not to be of conservation concern. Demoiselle Crane is also listed as a species of Least Concern in the IUCN Red List.

The Pallid Harrier is was observed during all three surveys and always as a single individual on a hunting or search flight. During the breeding season survey, a single Pallid Harrier flew over the area planned for the future tailings dam (experimental site) on 23rd June 2011. Pallid harrier was also observed twice during the autumn survey on 29th September 2011 in the reference area (near the Kyzylsu Reservoir) and over the future mine site on 1st October 2011. Pallid harrier is non-migratory and can nest in the areas which are less exposed to anthropogenic pressures and disturbance, for example on broad small hill areas of Altai Kalbinski Mountain Range. This species is not listed within the Red Book of Kazakhstan, but is considered to be Near Threatened by the IUCN.

One pair of Eurasian Curlew (Numenius arquata) were observed the left bank of river Kyzylsu (away from the proposed development area) on 24th June 2011. This species is listed as Near Threatened on the IUCN Red List due to declining population trends, although the IUCN note that it is common in many parts of its range, and determining population trends is problematic. It is not listed within the Red Book of Kazakhstan.

Golden eagle (Aquila chrysaetos) is a migratory species through the region and a single individual was observed circling at very high altitude over the area planned for the new tailings facility on 1st October 2011. This species is listed in the Red Book of Kazakhstan as rare (Category III), but is considered a species of Least Concern in the IUCN Red List.

Red-footed falcon (Falco vespertinus), is also a migratory species through the region and a single individual was observed 1st October 2011 in the reference area (near the Kyzylsu Reservoir). This species is not listed within the Red Book of Kazakhstan, but is considered to be Near Threatened by the IUCN.

Invertebrate Surveys

Information on the invertebrate species using the Project study area was obtained through literature searches and field studies. A preliminary survey was undertaken in June 2011 and a more detailed survey was undertaken in June 2013.

In 2011 the main methodological approach was to employ a walk-through route survey (routes as indicated in red on Drawing 4.9.2) and photograph the insects encountered. The photographs were then sent to expert entomologists from the Zoology Institute of the Ministry of Education and Science of the Republic of Kazakhstan for identification and further assessment.

A further, more detailed, invertebrate survey was conducted during the third week of July 2013. The surveys were undertaken in five zones, differing in the degree of anthropogenic impact. Visual observations were undertaken in five different 'zones' showing differing degrees of anthropogenic impact: the buffer zone, sanitary protection zones 1 and 2, the industrial zone and the village of Auezov.

- The buffer zone is a hilly territory. The vegetation of grasses and shrubs provides 80 to 90% cover.
- Sanitary zone 1 is approximately 5 km from the industrial zone and sanitary zone 2 is approximately 1.5 to 2 km from industrial zone, in the direction of the prevailing wind. The sanitary zone has vegetation of the meso-xerpohyte type and in depressions it is largely grasses. Vegetative cover is 70 to 80%.
- The industrial zone is characterised by a much greater thinning of the grass cover. Vegetation is mainly wild grasses which provide approximately 55 to 65% cover. The soil is heavily compacted.
- The plots in the village of Auezov were located between domestic buildings and were typified by ruderal plant communities.

A range of standard entomological techniques were employed (Fasulati, 1971; Zimbalevskaya, 1972; Byzova et al., 1987, Kashcheev et al., 1997-98):

- Collection of single insects from the ground and in flight using a standard entomological net. Visual observation and manual collection of insects was conducted in the areas of human impact and selected areas of the sanitary and buffer zones.
- Vegetation sweeps.
- Light traps. Use 1-2 source.
- Pitfall traps (also known as Barber's soil traps).

Pitfall traps were set directly into the soil in the industrial zone and in selected sites in the sanitary and buffer zones. A line of ten trapping cans set at every ten meters was installed at each sample location (Figure 4.9.3). Fixing liquid (4% formaldehyde) was placed at the bottom of each trap. The traps were put out for 3 days, with a daily sampling. This gave a survey effort of 30 trap-days for each of the five sites, 150 trap-nights in total over the study period. The trap contents were preserved in 70% ethanol and carefully transported to the laboratory for analysis and identification. Each sample was labelled.

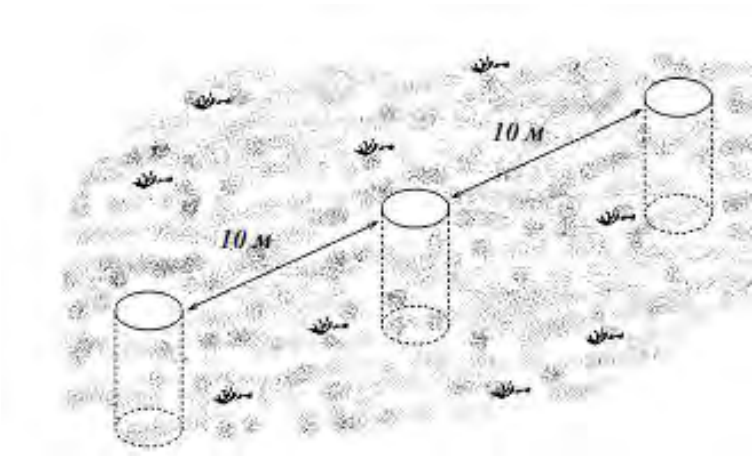


Figure 4.9.3: Schematic Arrangement of Pitfall Traps

Pitfall traps allow the catching efficiency (dynamic density) of soil invertebrates to be calculated using the formula:

$$U = K / n\ t \qquad (1)$$

Where U - catching efficiency; K - the total number of individuals of a species in all samples; n - the number of traps; and t - time for which traps were deployed.

Species were categorised using performance relative abundance (Engelmann, 1978): species with a relative abundance of more than 10% - predominant; from 5% to 10% - the dominant; from 2% to 5% - subdominant; 1 % to 2% - receding and less than 1% - subreceding.

Properties of insects listed in the Red Book of Kazakhstan and the IUCN were established during field studies, as well as through literature review.

4.9.9 Desk Study

2011 Study.

During the field work carried out for the route surveys in 2011, two species of butterflies, four species of dragonflies, two species each of beetles, acridoids, horse flies and ant hills were recorded. An approximate calculation of their population was carried out by the Zoology Institute of the Ministry of Education and Science of the Republic of Kazakhstan.

A list of the observations is given below:

- Dragonfly order - Odonata
- Brown Hawker – Aeschna grandis

- Black-tailed Skimmer – Orthetrum cancellatum
- Common Blue Damselfly – Enallagma cyathigerum
- Broad-bodied Chaser - Libellula depressa
- Отряд Чешуекрылые – Lepidoptera
- Esper's Marbled White – Melanargia russiae
- Gossamer-winged Butterflies – Lycaena sp.
- Beetle order - Odonata
- Seven-spot ladybird – Coccinella septempunctata
- Darkling beetles – Tenebrionidae sp.
- Two-winged order – Diptera
- Deer Fly – Chrysops sp.
- Northern House Mosquito - Culex pipiens
- Hymenopteran order – Hymenoptera
- Harvester ant – Messer sp.

The most commonly occurring orders of invertebrates were butterflies and dragon flies. A single species of butterfly, the Marbled White, was common in all five survey zones with 8 to 20 observed on each walked route. Three types of dragonflies were also commonly found in all zones; Common Blue Damselflies (5 to 19 observed on each walked route), Large Dragonflies (3 to 12 observed on each walked route) and Black-tailed Skimmers (up to 43 observed on each walked route). There were not a lot of the other insects, not counting the abundance of *Acrididae* (grasshoppers) in the Steppe; and Horseflies from the Deerfly species which were particularly abundant in the floodplain of the Kyzylsu river). There were not a lot of mosquitoes, possibly due to the daytime temperatures. Only two ant hills were found - in the area of the old tailings dam and on the future mine site.

2013 Study

Through a combination of desk study and literature review, the 2013 invertebrate study identified eight species of conservation concern (listed in the Red Book of Kazakhstan or included on the IUCN red list) whose known ranges (territories, areas) cross the Study Area. (Table 4.9.10).

Table 4.9.10: Invertebrate Species of Conservation Concern Whose Known Ranges Cross the Study Area (identified through Literature Review, 2013)

Species	Taxomomy	Attributes
Beautiful Demoiselle - *Calopteryx virgo* (Linnaeus, 1758)	Order: Dragonflies - Odonata. Family: Beauties - Calopterygidae.	It lives near slow flowing streams and small rivers, with densly vegetated banks. Active from April to October. The number is quite low and there is a tendency to reduce it further. Larvae - active predators, living in clean running water of streams and small rivers, rarely in stagnant water clean karst lakes. Adults feed on small insects, catching and eating prey on the fly, destroying mosquitoes, black flies and other Diptera. Away from the water of adults do not fly off. Limiting factors: anthropogenic pollution of water bodies
Bolivar brachypterous - *Bolivaria brachyptera* Pall.1773.	Order: Mantis – Mantoptera. Family: Mantis – Mantidae	Found in the steppe zone of Western and Southern Kazakhstan. It is found in grasses and sagebrush, saltwort deserts and semi-desert among sparse xerophytic vegetation. Geobiont predator. The main prey are orthopterans, as well as representatives of the orders Lepidoptera, Diptera and others. In the plains with sagebrush associations the species occurs sporadically, but over large areas. Sharply declining in numbers in areas of overgrazing. An additional threat to the populations near farmland are side effects of broad-spectrum insecticides. The greatest damage to isolated populations is burning of vegetation.
Predatory Bush Cricket - *Saga pedo* Pall. 1771.	Order: Orthoptera - Orthoptera. Family: True Grasshoppers - Tettigoniidae.	In Kazakhstan, in the east it reaches as far as Russia and to Northern and Western Tien Shan. Recently, in the Asian part of its territory, it has become very rare. It inhabits meadow steppe areas with tall meadow and shrub vegetation in the steppe zone. Specialised Photobiont. Predator. Limiting factors: habitat loss due to agricultural land use.
Polish cochineal - *Porphyrophora polonica*.	Order: Hemiptera - Hemiptera. Family: Coccidae	Distributed in the North-West, North, East and South-East of Kazakhstan. It occurs in Western and Eastern Europe and the European part of Russia. It is found on the roots of strawberries and other herbaceous plants.
Delightful beetle - *Carabus imperialis.*	Order: Coleoptera - Coleoptera. Family: Carabidae.	Rare species known only in a few distinct areas of the Altai. Found in the vicinity of Barnaul, Ust-Kamenogorsk, New Bukhtarma, Kalbinskiy ridge in Zyryanovsky and Ulan district of the East Kazakhstan region. Apparently, forest species
Gebler beetle - *Carabus gebleri.*	Order: Coleoptera. Family: Carabidae.	East Kazakhstan: the Ulba, Ust-Kamenogorsk, the Semey valley district. Bukhtarma and Russia, which reliably known only from the surroundings. Zmeinogorsk (type locality). It is found in small-leaved and mixed forests of valleys and foothills, sometimes in bushes. Predator-polyphage.
Steppe Hairy flower Wasp - *Scolia hirta* Schrenk, 1781.	Order Hymenoptera. Family: Scolia – Scoliidae (Wasps).	Arid regions of the Palearctic. In Kazakhstan it is found in the shrubs and grasses of the steppe ravines, river valleys, in the steppe areas. Adults feed on nectar and pollen, larvae - Parasitic entomophagous. Plowing leads to a decrease in the number of species. Not yet assessed for the IUCN redlist. Red book of Kazakhstan.
Large Heath or Common Ringlet Butterfly - *Coenonympha tullia.*	Order: Lepidoptera. Family: Nymphalidae. Subfamily: satyrinae - Satyrida.	Distribution: temperate Eurasia, places to Circumpolar, south to northern forest, in the mountains of the Caucasus, the Urals, Siberia, Mongolia, north of the Far East. In Asia inhabit the tundra and wetlands, valley meadows, caterpillars feed on plants: cotton grass (Eriophorum), sedges (Carex), rhynchospora (Rhynchospora); ovsyannitsa (Festuca), meadow grass (Poa), feather grass (Stipa). Not yet assessed for the IUCN redlist. Large Heath or Common Ringlet Butterfly

Carpenter bee *Xylocopa valga* (Gerstaecker, 1872).	Order Hymenoptera - Hymenoptera. Family Antoforidy - Anthophoridae.	Dweller Palearctic. Common in the Caucasus, Kazakhstan, Central Asia and in the foothills of the Altai. The eastern boundary runs through a vast area of Western Siberia to Mongolia. It dwells on the edges of forest clearings and old-growth forests on the slopes of forested ravines and gullies, in the villages and farmsteads in the cities, in the wood warehouses. Females visit up to 60 different species of flowering plants. In the city the preferred host plant - yellow acacia (karagannik). Listed in the regional Red Data Books of Russia: Tatarstan, Bashkortostan, the city of Moscow, Kirov, Nizhny Novgorod, Leningrad and Moscow regions, the Middle Urals. Carpenter bee is considered a protected species and in some other regions of Russia. However not entered into the Red Book of Kazakhstan at this time

The field study and literature review also identified a further 26 species of insects and other invertebrates whose known ranges (territories, areas) cross the study area; and which are considered to be widespread across and, characteristic of, the Study Area. A total of 13 orders were identified and a full list of all 38 identified species (common and rare) is included as Appendix 4.9.16. The species include examples of agricultural and other pests, as well as species which are considered beneficial.

A detailed breakdown of the data collected in each of the five study zones is presented in Appendix 4.9.16, however a summary of results and comparisons between the study zones is presented below.

The field survey (third week of July 2013) recorded representatives higher insects from three orders Hymenoptera (bees, wasps and ants) (Families: Ichneumonidae, Apidae, Chrysidida, Formicidae, Vespidae, Pompilidae); Orthoptera (grasshoppers and crickets) (Families: Acrididae, Gryllidae) and a Coleoptera (beetles) (Families: Carabidae, Tenebrionida, Scarabaeidae, Elateridae, Curculionidae, Chrysomelidae, Meloidae, Staphylinidae, Dermestidae, Lagriidae, Mordellidae, Histeridae, Silphidae, Anthicidae). From the lower insects, individuals of the order Collembola (Springtails) were abundant; whilst the abundance of individuals from the Order Diptera (True Flies) was small, but showed variety in the composition of families (Asilidae, Scathophagidae, Cecidomyiidae, Drosophilidae, Rhagionidae and Muscidae). Other recorded invertebrates belonged to the orders Aranea (spiders) (Families: Clubionidae, Lycosidae, Linyphiidae, Thomisidae, Pisauridae, Dysderidae); Scutigeromorpha (centipedes) (Family: Scutigeridae and Isopoda (woodlice) (Family: Ligidae).

The main trends in catching efficiency (dynamic density) of Herpetobiont invertebrates (inhabitants of the soil surface) within the five zones of study were investigated. The association gerpetobiont certain habitats defined by their close connection with the vegetation, climate and the degree of ecological plasticity species.

The majority of the invertebrate fauna present within the Study Area comprised arthropods, namely Hymenoptera and Coleoptera. With the greatest number of species belonging to the order Hymenoptera.

Riders (Ichneumonidae – parisatiod wasps) and wasps were especially numerous and were occasionally found within the plots within anthropogenic landscapes. Riders are parasites of other animals, in particular various arthropods and arachnids. Most species of parisatiod insects belong to the family Curculionidae, Chrysomelidae and Nitidulidae, but it can also refer to the family of Staphylinidae, Byrrhidae, Buprestidae, Scolytidae, Cisidae, Endomycidae, Melandryidae and Cerambycidae. Wasps (Scoliidae) were also common in the study Area including Vespidae. Wasp larvae feed on small caterpillars and larvae of other species.

Spider wasps (Pompilidae) prey on spiders, crickets and grasshoppers, caterpillars or butterflies. Cuckoo wasps (Chrysididae) lay their eggs in the nests of unrelated host species (Sphecidae, Eumenidae and Vespidae), where their larvae consume the host egg or larva while it is still young, then the food provided by the host for its own juvenile. These species were found in both the anthropogenic and buffer zones.

Fathead wasp (Ectemnius cavifrons) from the family digger (Sphecidae) feeds on pollen and nectar, prepares for his offspring paralyzed insects and their larvae. It occurs in the buffer zone.

The species composition of ants comprised the carnivorous *Camponotus fedtschenkoi* Maug. and *Camponotus*. *interjectus* Mayr., which are night predators; and the herbivourous *Messor variabilis* and *Messor excursionis* Ruzs., which feed on the stems, fruits and seeds of saltworts, thistles and many shrubs.

Beetles were represented by several families. The family of ground beetles (Carabidae) were the most numerous (from 0.2 to 1.65 for 10 copies trap / day). In more humid conditions, such as the ruderal ecosystems within the village, members of the family were more common.

Anthropogenic zones were characterised by *Amara aenea, Amara sonsularis, Calosoma auropunctatum* and *Harpalus rufipes*. However, the Krasotel steppe (*Calsoma denticolle*) was only found in the buffer zone. This species is very beneficial in the control of agricultural pest such as webworm moth. Along with *Calsoma auropunctatum* this species is included in the regional Red Data Books of a number of regions of Russia, such as the Voronezh region and the Chuvash Republic. They are not included in the Red Book of Kazakhstan.

The second largest family, Carpet beetles (Dermestidae) was represented by two species *Dermestes elegans* (Gebler, 1830) and *Dermestes frischi* [Kugelann, 1792].

Blister beetles (Meloidae) were represented by *Mylabris calida*, which is widespread in Central Asia and is a significant pest of cruciferous plants; and *Mylabris quadnpunctata*, *Mylabris frolovi* and *Mylabris scabjosae* which are known to parasitise Moroccan locust and grasshopper as well as inhabiting Asteraceae species.

Darkling beetles (Tenebrionidae) which are characteristic of dry open spaces were poorly represented during the survey. However psammophile (sand loving) Blaps species, for example *Blaps deplanata* (cockroach) were recorded more often.

The Large Heath or Common Ringlet Butterfly (Coenonympha tullia), (Order: Lepidoptera,Family: Satyridae) was recorded in the natural habitats of sanitary protection zones 1 and 2. This species is described in the literature as occupying a wide variety of grassy habitats, including roadsides, woodland edges and clearings, prairies, bogs, and arctic and alpine taiga and tundra. This species has yet to be assessed for the IUCN red list, but is listed in the Red of Kazakhstan at Category III (rare). The species is also classed as 'Vulnerable' in the "Red Book of European butterflies.

Among insects caught using light traps was The Bedstraw Hawk-Moth or Galium Sphinx (Hyles galii (Rottemburg, 1775) (Family: Sphingidae). Adults have a wing span of between 5 and 8 cm. They feed on fireweed (*Epilobium angustifolium*, *Epilobium montanum*, *Chamaenerion angustifolium*), bedstraw (*Galium verum* and *Galium mollugo*) and various other plants (*Clarkia, Fuchsia, Circaea, Plantago* etc.). The species listed in the regional Red Data Book of Kamchatka (Russia), but is not included in the Red of Kazakhstan.

The traps in the natural cenoses (buffer zone) recorded numerous locusts (Acridida) including *Oedipoda caerulescens* which frequents dry areas with low and open vegetation. It is exclusively a terrestrial insect and does not fly. It is camouflaged to match its substrate and makes little or no sound. The female lays her eggs in bare, dry soil. Its diet consists mainly of grasses and it is sensitive to grazing and recreational use of the territory. The species listed in the Red Book of Moscow region (category 2 - decreasing species), but not within the Red of Kazakhstan.

The Dynamic distribution density of herpetobiont invertebrates is quite varies across the five study zones as shown in Table 4.9.11 and represented in Figure 4.9.4.

Table 4.9.11: Dynamic Distribution Density of Herpetobiont Invertebrates

Zone	Dynamic density (as individuals per 10 traps per day)
Industrial Zone	5.2
Village	11.4
Sanitary Zone 1	7.6
Sanitary Zone 2	2.4
Buffer Zone	5 9

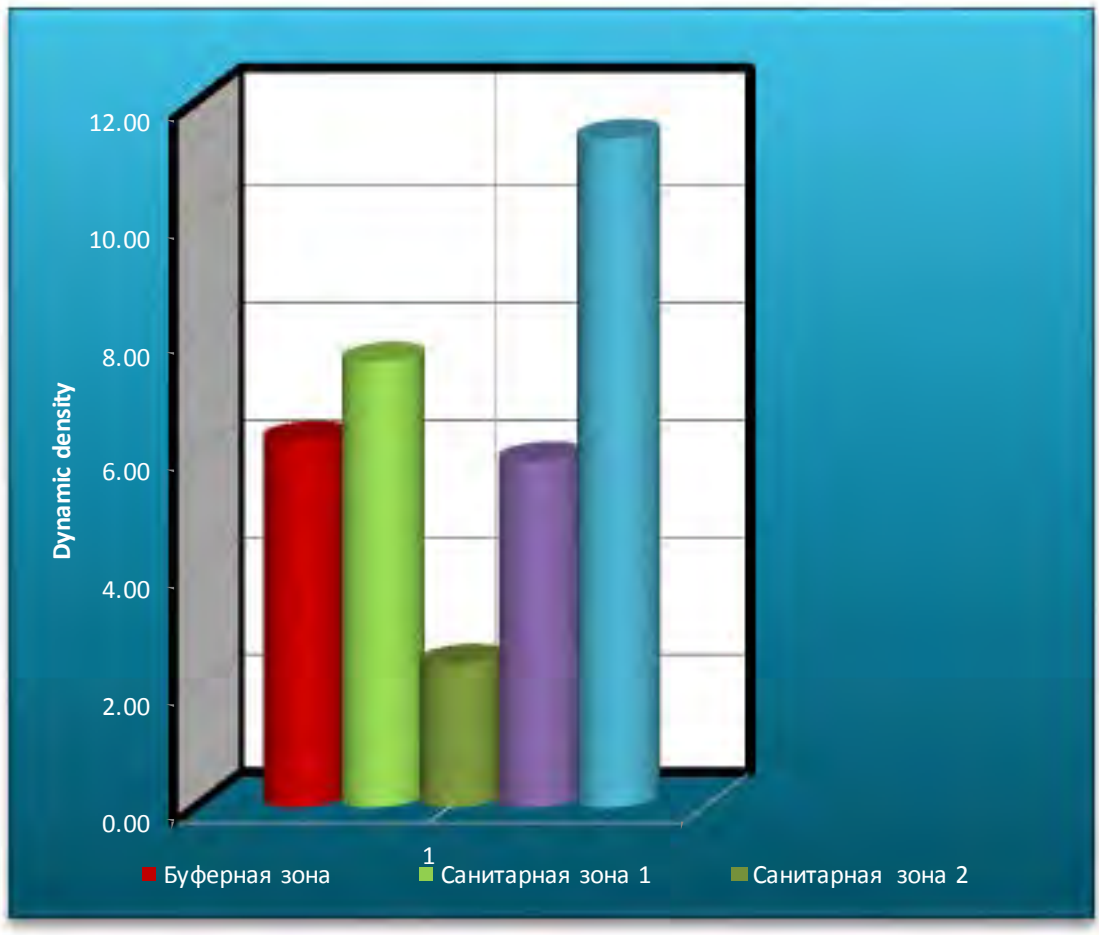


Figure 4.9.4: Dynamic Distribution Density of Herpetobiont Invertebrates

Species diversity (number of recorded families of invertebrates) is grater in the village and the buffer zone (29 and 20 recorded species respectively). Thirteen families were recorded in the industrial zone and Sanitary zone 2; whilst 15 families were recorded in the sanitary zone 1.

The results highlights the abundance of herpetobionts in the village community. The hydrothermal conditions in the built up environment improves living conditions; and the changes of vegetation create a wide variety of microenvironments / niche habitats. This increases both the total number of individuals and the number of recorded families.

For most of the investigated zones, communities of soil invertebrates include 1 or 2 predominant, dominant and subdominant families; and a large number of families, whose share in the total population is less than 2% (Figure 4.9.5). The dominant families in each zone are:

- Industrial area - parasitic mites and saprophagous kozheedy
- Village - predatory ants, ground beetles, spiders, carrion; saprophagous: woodlice and carpet beetle larvae
- Sanitary Zone 2 - predatory spiders and ants;

- Sanitary Zone 1 – saprophagous insects: carpet beetle larvae
- The buffer zone - saprophagous: springtails and ants, and others small families.

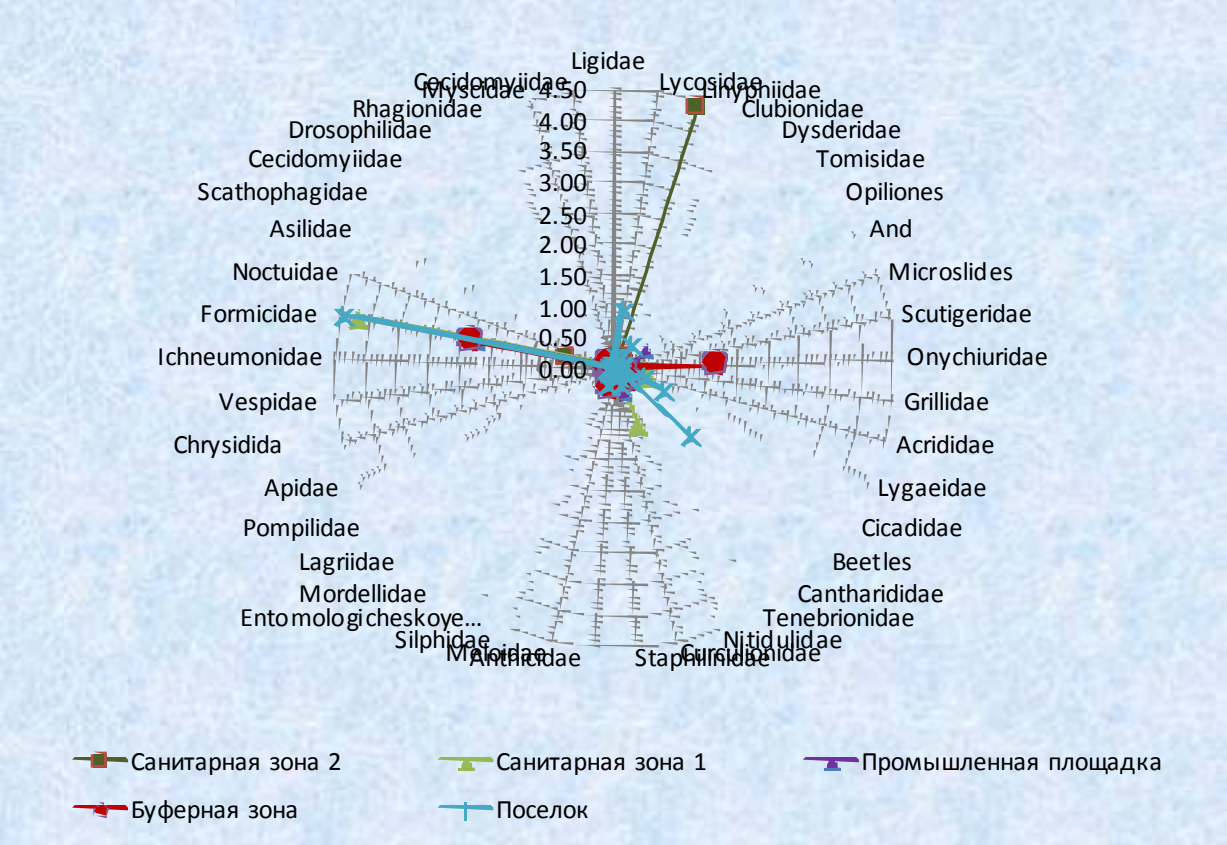


Figure 4.9.5: Value of Dominance Families Herpetobiont Invertebrates in Anthropogenically Transformed and Natural Cenoses

This distribution is characterised by the relative abundance of families in industrial areas, as wellas a buffer zone. In the first case, an abundance of small families is associated with the heterogeneity of soil, grass layer and high mosaic microenvironment. The buffer zone is also characterized by the presence of natural microhabitats. In this regard, there are multiple peaks in the graphs of density dynamic representatives of the families of invertebrate communities listed areas (Figure 4.9.6).

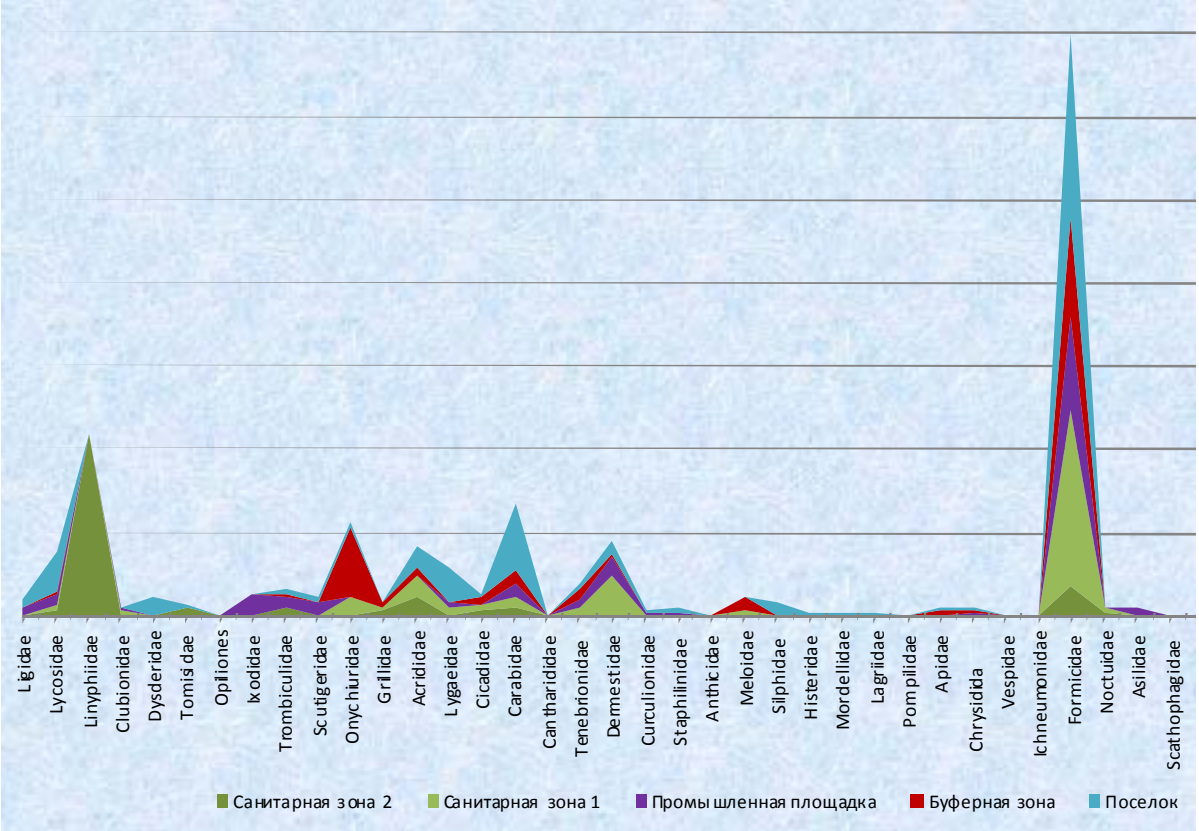


Figure 4.9.6: The Dynamic Density of the Representatives of Families of Invertebrates Herpetobiont Anthropogenically Transformed and Natural Habitats

In general, the majority of species are zoophages from the taxonomic groups spiders, ground beetles, ants, mites, however the ratio or abundance of these species in the different study zones / habitats varies. This is mainly manifested between the two dominant groups: ground beetles and ants. Such a significant increase in the number of predatory groups in the anthropogenic areas indicates significant changes taking place in the structure of ecological communities, even if the total diversity of the families and groups of invertebrates is maintained.

The study revealed a quite diverse fauna of insects and other invertebrates species within the study area. This is in part due to changes in the community structure of invertebrates within the anthropogenically transformed habitats:

- Decrease in the number of individuals and a change (increase or decrease) in the number of families in comparison with the control area (buffer area)
- Changes in the type of dominant families compared to the sanitary and buffer zones. predominant species are predatory Formicidae, saprophagous Dermestidae and Onychiuridae or herbivorous Acrididae
- Increase in the number of receeding and subreceeding families (with a share of total population of less than 2%)
- Delays in the development phase of Coleoptera-predominant

- Increase the proportion of zoophages in the trophic structure of the community Herpetobiont invertebrates
- The local extinction of vulnerable species listed in the Red Book of the IUCN regional Red Books of neighboring countries:
  - *Calosoma auropunctatum* (Herbst, 1784) Krasotel zolotistotochechny. Order Coleoptera. Family Ground beetles, Carabidae.
  - *Calosoma (Campalita) denticolle* Gebler, 1833 - Krasotel steppe. Order Coleoptera. Family Ground beetles, Carabidae.
  - *Coenonympha tullia* - Large Heath or Common Ringlet Butterfly. Order Lepidoptera. Family Satyridae.
  - *Hyles galii* (Rottemburg, 1775). Order Lepidoptera. Family Sphingidae.
  - *Xylocopa valga* (Gerstaecker, 1872) – Carpenter bee. Order Hymenoptera. Family Antoforidae - Anthophoridae.

The used scheme of diagnosing the state of invertebrate fauna is based on the generally accepted definition of soil-zoological indicators

Rare Invertebrate Species

Only one species identified in the field survey is listed in the Red of Kazakhstan. Large Heath or Common Ringlet Butterfly (*Coenonympha tullia*) is classed at Category III (rare) and is also listed as 'Vulnerable' in the "Red Book of European butterflies". As described previously, this species was only recorded in the natural habitats of sanitary protection zones 1 and 2; and is described in the literature as occupying a wide variety of grassy habitats, including roadsides, woodland edges and clearings, prairies, bogs, and arctic and alpine taiga and tundra.

Five species recorded during the 2013 field survey are listed in the regional Red Books of countries neighbouring the RoK, however they are not in the Red of Kazakhstan and are therefore not assessed as being of conservation concern within the RoK. None of the five species have been assessed for the IUCN Red List. Carpenter bee (*Xylocopa valga*) is listed in the regional Red Data Books of Russia: Tatarstan; Bashkortostan; the city of Moscow; Kirov; Nizhny Novgorod; Leningrad and Moscow regions; and the Middle Urals. Ground beetles *Calsoma denticolle* and *Calsoma auropunctatum* are included in the regional Red Data Books of a number of regions of Russia, such as the Voronezh region and the Chuvash Republic. The Bedstraw Hawk-Moth or Galium Sphinx (*Hyles galii*) is listed in the regional Red Data Book of Kamchatka (Russia). *Oedipoda caerulescens* is listed in the Red Book of the Moscow region (category 2 - decreasing species).

Aquatic Ecology Study

Little is known of small rivers and their associated fauna in different regions of RoK, as most research has concentrated on the major river / water systems due to their high commercial value fisheries. This also explains the paucity of data in relation to some non-commercial species. Additionally there is

little data regarding commercially valuable species where they occur at densities too low to make commercial fishing viable (for example in small rivers and waterbodies).

At the same time, these populations of common gene pool species and the study of their biological indicators can be used to evaluate the reaction of species to external pressures. Allowing patterns of dynamic processes in populations to be described.

These water systems are most vulnerable to anthropogenic impacts. Contact with significant amounts of pollutants usually leads to a degradation and disappearance biodiversity in small rivers. This is due to a weak recovery potential with low water content.

The important role played by these small water courses in the life of local communities is often heavily dependent on the state of these ecosystems. Therefore, maintaining a stable condition biodiversity is also of large socio-economic importance.

The aim of the 2013 aquatic ecology study was to investigate the biodiversity of aquatic ecosystems in the Kyzylsu river basin (left tributary of the River Irtysh), in the area of influence of BMV.

The objectives of the study included:

1. Assessment of the species diversity of aquatic and riparian flora;
2. Evaluation of the species diversity of aquatic fauna;
3. Assessment of the status of populations of key fish species in studied reservoirs;
4. Development of recommendations on monitoring and conservation of hydrobiocenoses.

The objects of study were the main reservoirs, which are located on the territory of BMV and its area of influence, these are identified in Drawing 4.9.2 and further described in Appendix 4.9.18.

1. *Distant pond in disused quarry* - Area of 4.4 ha. Waters λ-shaped. The quarry sides have collapsed in some areas allowing thickets of reeds and cattails to develop (Photo 1, Appendix 4.9.17). The pond reaches depths of 3 to 5 m in these areas, however in the open part of the pond depths of 15 m are achieved. Of all the man-made ponds within the study, this pond has some productivity due to the introduction of organic matter by the in-flowing Mayran bastau river (a tributary brook. Cold spring). Coordinates N 49º 44 'E 81º 33'.

2. *Distant pond in disused quarry* -1. Area of 0.6 ha. Waters form an irregular oval. Depth of up to 20 m. Waters ultra-oligotrophic (very low levels of nutrients, little to sustain life). Coordinates N 49º 45 'E 81º 31'.

3. *Pond in pit number 2*. Area of 6.2 ha (Photo 2 of Appendix 4.9.17). Also in the northern part there is an isolated body of water. In the southern part of the quarry as an isolated body of water, fuelled by the release of groundwater. The pond has a curved shape in the form of a

bow. Increasing the depth comes in stages, according to the system of transport rocks from the quarry. Maximum depth of 30 m. Coordinates N 49º 43 'E 81º 36'.

4. *Pond in pit numbers 5 and 6*. Area of 0.7 ha. During the period of work on the pond was evacuated in connection with what studies have been conducted. The area was 0.7 hectares. Coordinates N 49º 43 'E 81º 33'.

5. *Reservoir in former pit (Sorokovaya)*. Area 0.4 hectares. Pond oval shape (Photo 3 of Appendix 4.9.17). The steep banks are almost bare of vegetation. Depth gradually increases towards centre reaching a maximum depth of 12m. Coordinates N 49º 42 'E 81º 31'.

6. *Kyzylsu Reservoir*. The reservoir is approximately 38.6 ha and is established on the river of the same name. The reservoir is a channel type with a fairly deep floods in the western part (Photo 4 of Appendix 4.9.17). The right bank is steep, but the left bank is more gently sloping with thickets of reeds and cattails. Soft underwater vegetation is present at depths of up to 5m. Basic depth is of the order 4 to 5m, in shallows 2 to 3m. The maximum depth of up to 20m. Coordinates N 49º 38 'E 81º 33'.

7. *Alaaygyr Reservoir*. Area 7.6 ha. The pond is formed at the confluence of the River Alaaygyr and an unnamed watercourse (Photo 5 of Appendix 4.9.17). The retaining dam is currently broken. Maximum depth is 3.5m, however average depth is 1.5 to 2.0m and consequently the reservoir is at risk of zamoroopasny (mass mortality of fish resources and other water animals, invoked by breaking of hydrochemical and other regimes), as the entire water column could freeze in winter. This is only prevented by the inflow of water from the streams flowing into it. Thickets scrub surface vegetation do not from a strong border, but the eastern part of the shallow pond margins and the adjacent land is heavily overgrown. Soft podgruzhenny vegetation is distributed throughout the entire pond bed. Coordinates N 49º 41 'E 81º 36'.

8. *River Alaaygyr*. Flows for approximately 7.9km before flowing into the Alaaygyr Reservior and for a further 7.2 km from the exit of the reservoir to the confluence with the River Kyzylsu (Photo 6 of Appendix 4.9.17). Width in the upper reaches rarely exceeds 2m. Below the Alaaygyr Reservior the river widens with an issued flood plain up to 5 to 10 m wide. Confluence with the River Kyzylsu is at the railway bridge. Coordinates: from N 49º 42' E 81º 41' to N 49º 39' E 81º 32'

9. *Unnamed river*. Length 4.7km. Coordinates: from N 49º 43 '23 "E 81º 39' 13" N 49º to 41 '25 "E 81º 37' 17". It is a narrow waterway with a significant flow. Confluence with the River Alaaygyr is near the Alaaygyr Reservoir.

10. *Brook Akbastaubulak*. Approximate length of 12.1km. A tributary of the River Kyzylsu, with the confluence at the Village of Shalabay. The Brook Akbastaubulak provides less flow to the River Kyzylsu than does the River Alaaygyr. Several dams are constructed along the length of the

Brook Akbastaubulak and the water used for agriculture (Photo 7 of Appendix 4.9.17). Coordinates: from N 49º 44' E 81 º 34' to N 49º 42' E 81 º 30 '. It should be noted that the mine drainage water is currently being discharged into the Akbastaubulak Brook instead of the existing tailings dam (see Section 4.8 on Water Resources). The duration of this discharge is unknown, however during the Project all mine water would be directed through treatment facilities preventing the contaminated water into this watercourse. As part of the Project the flow of the Akbastaubulak Brook will be diverted to the north of its confluence with its tributary the Zhumataybastau. Both watercourses will be diverted in to the River Mayranbastau to the west. This will prevent the Akbastaubulak Brook flowing through the area of the proposed Waste Rock Dump. Like the Brook Akbastaubulak, the Mayranbastau is also a tributary of the River Kyzylsu and so the overall flow to the River Kyzylsu will not be depleted as a result of the diversion. The impact of the diversion upon the Brook Akbastaubulak is discussed later within this chapter.

It should be noted that ground and surface waters around the Project Area have been monitored for several years and although there is an excess of sulphate, cadmium, and arsenic, it has been determined that this is due to the natural properties of the water in the area and is not related to the historic mining activities or current discharges of mine water.

The studies provided data on the species diversity of flora and fauna; assessed the state of the populations of a number of major fish species; and made recommendations for monitoring the state of conservation of ecosystems and water bodies.

The survey was conducted in July 2013 and investigated 5 manmade ponds (formed in quarry or mine pits) and 5 natural waterbodies. Samples were assessed for zooplankton, zoobenthos and phytoplankton. Sampling locations are shown in Figure 4.9.7 (below) and Drawing 4.9.1.

Figure 4.9.7: Sampling Points in the Study Area (Black Circles Indicate Sampling Sites)

The selection and analysis of hydro-biological samples was based on the method of Kuznetsova et al. 1995, (Methods of bioindication in aquatic ecosystems - Ecological monitoring. Part 1. Methods of biomonitoring). The collection of hydro-biological material was conducted in accordance with conventional methods as described by Gidrometizdat, 1983. (Manual methods of hydrobiological analysis of surface water and sediments) and Almaty, 2006 (Toolkit at hydrobiological fisheries research reservoirs Kazakhstan).

The following terminology was employed:

- Plankton - Community of passive organisms, both animals and plants that live in the water column;
- Periphyton - Community plant organisms forming biofouling on various subjects in the aquatic environment;
- Benthos - Community of benthic organisms (inhabiting the lowest level of a body of water, including the sediment surface and some sub-surface layers;
- Nektobentos - group of organisms that inhabit and as rule- move freely in benthic zone, and in the water column;
- Morphophysiological indicators - weight indices of internal organs, used to indicate the intensity of physiological processes, depending on the state of the environment;
- GSI - gonadosomatic index (the ratio of weight of gonad to weight of the fish in ppm);

- HSI - hepatosomatic index (ratio of liver weight to the weight of the fish in percentage);
- CSI – Cardiosomatic index (the ratio of heart weight to weight of the fish in percentage);
- Qf - fatness of Fulton (the ratio of body weight and length of the fish);
- Qc - fatness of Clark (weight and length of the fish carcass);
- FI - absolute individual fecundity, thousand. Pieces;
- RFSL - individual relative fecundity (ratio of FI to the length of the female's body, pieces / cm.); and
- RFm - individual relative fecundity (ratio of FI to the weight of the carcass of the female, pc / g.).

Samples of zooplankton were collected by screening 100 litres water through Apstein's network followed by fixation in a 40% formalin solution. In the laboratory, the microscopic identification and calculation of plankton was undertaken. Methods for identifying species composition were taken from Kutikova, (1970); Mordukhai (1987); Tsalolihin (1994); and Tsalolihin (1995).

Zooplankton organisms were counted in a certain part of the sample chamber Bogorov's camera, followed by viewing half its volume or total balance for the detection of large and rare animals. Calculations of individual weight zooplankton applied linear equations - weight dependence. For each type of shellfish the size and weight of all stages of its lifecycle were taken into account. The number of individuals and the weight ratio of all identified species are summarized below for the main groups of organisms and the community at large. The size and weight of the zooplankton were calculated for 1 m^3 of water column.

Benthic samples were collected using a scraper with the seizure of 1.0 m^2, washed through a series of sieves with different mesh sizes. Benthic organisms were placed into 4-10% formalin solution. In the presence of significant amounts of clam in the sample a 10% formalin solution was used, as the water dilutes the mantle cavity of retaining liquid.

The samples were stored in the wide mouth jars of dark glass. To determine the number of organisms samples were placed in a petri dish and identified using a key, allowing the a full taxanomic classification (type, class, or order, followed by a more detailed definition of the systematic position of the animals to the level of genus and species) groups of organisms. Weighing was performed after preliminary Drain into weighing bottle on an analytical balance. Determination of number and biomass was conducted following 'Guidelines for the collection and processing of materials in hydrobiological studies in freshwater'.

Samples of algae were selected by a simple scoop of 0.5 litres of water, fixed with 4% formalin solution. Qualitative and quantitative analyses were then conducted. The concentration of phytoplankton was determined by sedimentation; and species identification was carried out by means of determinants using a microscope "Biola". The number of cells was calculated using a counting chamber camera.

Total biomass was calculated by summing the biomass of individual populations in accordance with Guidelines for the collection and processing of materials in hydrobiological studies in freshwater. Phytoplankton and its products, 1984. Food capacity of the reservoir was determined using the methodology described in Kuibyshev, 1986.

Ichthyological analysis included the determination of linear dimensions; weight; fatness; morphological and physiological indicators of female fertility; age; and, in some cases, regression calculation of growth rates.

Determination of linear weights was conducted according to standard procedures (Pravdin, 1966). Fatness was calculated for two indicators, Fulton (Qf) and Clark (Qc) (Nicholas, 1974). Absolute individual fecundity (AIP) was calculated by the ratio of the standard sample and gonads (Spanovskaya et al., 1976).

Morphophysiological indicators were determined by weighing the individual organs (liver, heart) and presented in the form of indices of carcass weight (Schwartz et al., 1978). Age was determined by the annual rings. For benthos eating fish (except tench) this was done using scales; for representatives of other families (e.g. pike, perch) and tench, the gill lid was used (Nicholas, 1974).

Statistical analysis was carried out on the material following the methodology described in Zhivotovsky (1991) with the use of MS Office Excel 2003 and 2007 MS Office Excel.

Survey Results

Aquatic Flora

Phytoplankton and Periphyton

The special hydrochemical regime of the investigated reservoirs forms unique algocenosis (algal community) which the predominant forms are diatomic, but which also includes rheophile (living in swiftly flowing water) and eurytopic (tolerant of a wide range of habitats or ecological conditions) algae and other groups. Limnophioilic species (prefering lakes, ponds, marshes, pools or other slow moving, still or stagnant water) are also found in bed reeds.

Due to the high water exchange in streams microflora rather poor in species. The reservoirs and ponds were dominated by diatom species of the genera Navicula, Diatoma, Synedra, Zygnaema, Scenedesmus, Pediastrum and Chlorella. From the blue-green the most commonly recorded species were of the genus Oscillatoria, although they were found infrequently. The main concentration of phytoplankton and periphyton were located in the reed beds near the shore.

The highest phytoplankton biomass was found in the eutrophic (nutrient rich) reservoirs Kyzylsu Reservoir and Alaaygyr Reservoir. Plankton biomass was approximately 5.4 to 9.5mg / l. The high

presence of Euglenophyta (Euglena algae) significantly increased the biomass of phytoplankton these reservoirs.

Within the streams (rivers and brooks) phytoplankton biomass ranged from 0.9 to 3.1g / l, which is probably the normal range of these waterbodies; and was predominantly green and Golden algae.

For the anthropogenic ponds in former mine pits and quarries, phytoplankton biomass was within the range 0.2 to 1.5mg / l, and predominantly comprised diatoms.

Higher Aquatic Vegetation

Hard emergent (above water) vegetation was only found in small areas surrounding the anthropogenic ponds in former pits and quarries. However, at the reservoirs and along the banks of streams, it was richer in both numbers and in species. Hydrophilic macroflora was mainly represented by Common reed (*Phragmites communis Trin.*), Narrow-leaved cattail (*Thypha angustifolia L.*) (Photo 8 of Appendix 4.9.18) and Bulrush (*Scirpus lacustris L.*). On the banks and in the shallows clumps of Flowering rush (*Butomus umbellatus* L.), Sedges (Carex spp.) (Photo 9 of Appendix 4.9.17), Water knotweed or Amphibious bistort (*Polygonum amphibium* L.), Water mint (*Mentha aquatica* L.), Branched bur-weed (*Sparganium erectum* L.), Common bladderwort (*Utricularia vulgaris* L.) and European water-plantain (*Alisma plantago-aquatica* L.) were recorded. Willow (Salix sp.) and non-native trees were also found on the banks.

The recorded underwater flora mainly comprised pond weeds (which are semi-submergered), with several species and their hybrids being recorded: Floating pondweed (*Potamogeton natans* L.), Brilliant or shining pondweed (*Potamogeton lucens* L.), Fennel pondweed or Ribbon weed (*Potamogeton pectinalis* L.), curly-leafed pondweed (*Potamogeton crispus* L.) and clasping-leaf pondweed (*Potamogeton perfoliatus* L.). The following species were also noted Eurasian or Spiked watermilfoil (Myriophyllum spicatum L.) (semi-submerged); Rigid hornwort (Ceratophyllum demersum L.) (fully submerged); Soft hornwort (Ceratophyllum submersum L.) (fully submerged); and Straight vallisneria or Tape grass (Vallisneria spiralis L.).

Stoneworts (fresh water green algae) (Charaphyta) were represented by trifoliate duckweed (Lemna trisulca L.), which inhabits the region on or just below the surface of the water.

Sporadic blushes of the non-native invasive species American or Canadian Waterweed (*Elodea canadensis* Michx.) were also recorded on the Kyzylsu Reservoir.

Within the Kyzylsu and Alagaar Reservioirs, the considerable depth of the water column does not create favourable conditions for the mass development of associations of submerged and semi-submerged plants, but the areas occupied by rigid surface vegetation (on the banks and surrounding areas) are quite sufficient for normal functioning of ecosystems of natural reservoirs. However, the

development of full hydrofitocenosis communities on the anthropogenic ponds in former pits and quarries is not possible.

In general, the biological diversity and quantitative characteristics of the recorded micro- and macroflora at each of the sample sites corresponded to the hydrological characteristics of the water bodies and the level of organic matter entering them.

Aquatic Fauna

Plankton Community

The diversity the plankton in the surveyed waters included 35 species belonging to three classes Rotatoria (12), Crustacea (15) and Copepoda (8) as described in Appendix 4.9.18

The main species making up the zooplankton community were: Asplachna priodonta, Keratella cochlearis, Polyarthra remata (Rotatoria), Daphnia longispina, Chydorus ovalis, Ceriodaphnia reticulata (Cladocera), Cyclops abyssorum, Eudiaptomus graciloides (Copepoda).

Zooplankton biomass in the studied waterbodies ranged from 0.583 to 8.551g/m^3 (Table 4.9.12). These data show that the waterbodies belong to the ultraoligotrophic, β-oligotrophic and β-mesotrophic types, depending upon their level of producitvity.

Table 4.9.12: Number (ind / m^3) and Biomass (g/m^3) of Zooplankton in the Investigated Reservoirs

Pond	Number (ind/m^3)	Biomass (g/m^3)	Level of trophicity*
Kyzylsu Reservoir	11.65	5.347	β- mesotrophic
Alaagyr Reservior	9.53	8.551	β- mesotrophic
River Alaagyr	5.19	1.540	β-oligotrophic
Unnamed river	4.11	1.363	β-oligotrophic
Brook Akbastaubulak	5.58	2.315	β-oligotrophic
Distant pond in disused quarry	7.58	3.342	β- mesotrophic
Distant pond in disused quarry -1	3.03	0.583	ultraoligotrophic
Pond in Pit № 2	3.37	1.772	β-oligotrophic
Pond in Pits No. 5 and 6	4.11	2.202	β-oligotrophic

*Following Kuibyshev, 1986. On the relation of some trophic levels and 'trophic scales' of lakes of various natural areas. Abstracts of the V Congress VGBO. - Part 2.

The community of plankton inhabiting the water column in most waterbodies is was predominantly Copepoda. This group is dominated by the size of populations, but because of the low weight of individuals, did not play a significant role in the formation of plankton biomass reservoirs. The only exception is Alaaygyr Reservoir, where the character was planktofauny kladotseridny (dominated by cladocerans, small crustaceans). In part, the same can be said of Kyzylsu reservoir.

The level of food capacity that exists at present in the Kyzylsu and Alaaygyr Reserviors may provide acceptable conditions for fish populations, trophicity-plankton and fry. Accordingly, these reservoirs could be developed as commercial and recreational fisheries.

The trophicity level of the anthropogenic ponds in former mines and quarries is very low. Up to ulta-oligotrophic (very low productivity and nutrient content) in the 'Distant pond in disused quarry -1'. This is explained by the low content of organic matter in their water. The exception is the 'Distant pond in disused quarry' where organic matter is introduced by the in-flowing Mayranbastau river

Benthic Fauna

The benthic fauna of the studied waterbodies was represented by about 50 species belonging to five classes, as listed in Appendix 4.9.18. It should be noted that not all individuals could be classified to the species level. Some photographic examples are shown in Appendix 4.9.17.

The fifty species included 12 molluscs, two arthropods and two annelids.

Approximately 35 species of insects belonging to six orders were found in the benthos of the studied waterbodies. The majority were recorded in the larval stages, but a number of groups, such as Hemiptera and Coleoptera also were found in the imaginal stage (Appendix 4.9.18).

One of the best represented insect groups in the benthos of the studied waterbodies was the Odonata (Dragonflies). These can be of significant importance in the diet of fish, such as Perch, as well as being a predator of other species. A total of ten species of six families were recorded.

The Hemiptera were the most species rich order of insects, with 16 species belonging to five families found in the studied waterbodies.

Despite the presence of suitable habitats on a number of the studied waterbodies, Diptera (true flies) larvae were quite rare in collections at all sample locations. A maggot was caught by a Sandmartin at the Alaaygyr Reservoir (*Ephydridae sp*.) and the Kyzylsu Reservoir a few individuals of the family Chironomidae were recorded, but could not be identified to the species level.

Plecoptera

Stoneflies (Plecoptera) are widespread in natural water bodies in the region, reaching a particular abundance in streams and rivers with a noticeable flow. Only one species (Leuctra fusca) was recorded during the study (Appendix 4.9.18); however it is possible that they do inhabit the study areas, but were not recorded due to the timing of the survey.

The order Trichoptera (caddisflies) usually inhabitants running waters of the investigated region. Species diversity in the study area was limited to four species belonging to two families.

Ichthyofauna (Fish)

Three species of fish were identified in the study area, the Silver or Prussian Carp, the Common carp and the Common dace.

Silver or Prussian Carp (*Carassius gibelio* Bloch, 1782) was mainly recorded in the Brook Akbastaubulak which creates a cascade of small dams with appropriate conditions for the habitat of this limnophilic (preferring slow moving, still or stagnant water) species. With the passage of juvenile carp imposed in the riverbed. Species is also found in the Distant pond in disused quarry and is a prey species of Perch.

Common carp (*Cyprinus carpio* L., 1758). This species is widely used for stocking ponds. In the investigated area it is found in the Reservoir in former pit (Sorokovaya) (Photo 14 in Appendix 4.9.17). There are local legends about "20 kg carp" being caught in other ponds such as the Distant pond in disused quarry 1; however these are considered not to be plausible as such growth requires a food supply of at least mesotrophic level which is not observed in these waterbodies. Distant pond in disused quarry 1 is ultraoligotrophic.

Table 4.9.13 shows the real growth rate of Common carp from the Reservoir in former pit (Sorokovaya), which show that this population is characterised as extremely slow growing and unproductive.

Table 4.9.13: Growth of Common carp in Reservoir in former pit (Sorokovaya).

Age	Linear growth, cm.			
4+	6.3	9.3	12.3	15.5
3+	6.1	8.5	12.4	
2+	6.6	10.8		

Common carp in the in Reservoir in former pit (Sorokovaya) become sexually mature in the fourth year of life with a body length of more than 15 cm. An individual weighing over 100 grams in 5 years of age already had one spawning.

It is possible that the population of Common carp in the Reservoir in former pit (Sorokovaya) is self-perpetuating, although it has a very low rate of reproduction, which is caused by oligotrophic conditions within the pond. The basis of its nourishment they here compose plankton and periphyton with an insignificant portion of air insects.

According to survey data (survey of local fishermen), Common carp are present in the Kyzylsu Reservoir and it is considered that this may be a reproductive population.

The Common or Eurasian dace (Leuciscus leuciscus L., 1758) is a moderately rheophilic (preferring or living in flowing water) species and was recorded in both the River Alaagar and Alaagar Reservior. It is also the main species of fish found at the pond in pit number 2 (see Photo 15 of Appendix 4.9.17).

The hepatosomatic index (HSI - ratio of liver weight to the weight of the fish in percentage) in the Common dace populations studied are sex and age dependent (Table 4.9.14). Large indices are typical for females and larger (older) individuals. The differences between the samples of the Alaagar Reservoir and the Pond in pit number 2 compared to those in the River Alaagar are associated with the dimensional characteristics.

The low Cardiosomatic index (CSI - the ratio of heart weight to weight of the fish in percentage) of Common dace from the Pond in pit number 2 is probably related to the total energy expenditure on considerable movement in the thickness of water. It is possible due to the lack of predators, they compensate for the deficiency of animal food by consumption of fouling on the rocks (detritus).

Table 4.9.14: HIS and CSI of Common Dace Populations in Differing Waterbodies

Pond	HSI			CSI		
	All fish	Females	Males	All fish	Females	Males
Alaagar Reservoir	1.54	1.90	1.18	0.14	0.14	0.14
River Alaagar	1.21 ±0.10	1.23 ±0.17	1.21 ±0.09	0.15 ±0.01	0.15 ±0.01	0.15 ±0.01
Pond in pit number	1.55 ±0.11	1.71 ±0.19	1.41 ±0.11	0.11 ±0.004	0.12 ±0.01	0.11 ±0.005

The degree of maturity of gonadosomatic index of Common dace in the three waterbodies (the ratio of weight of gonad to weight of the fish in ppm) is related to dimensional characteristics and sex (Table 4.9.15). Increased GSI in Common dace from Pond in pit number 2 is due to the increased intensity of reproduction required in order to maintain a stable population in the harsh conditions/trophic deficit.

Table 4.9.15: Gonadosomatic Index of Common Dace from the Three Studied Waterbodies

Pond	Females	Males
Alaagar Reservoir	48.95	4.89
River Alaagar	42.43 ±5.15	3.36 ±0.33
Pond in pit number	51.13 ±3.38	4.95 ±0.64

The sexual structure of the populations studied showed an approximately equal sex ratio (male:female). Fertility is higher in females inhabiting the lenthic reservoirs than those in the fast-flowing River Alaaygyr. However, dimensional characteristic also play a role in fertility in the River Alaaygyr (Table 4.9.16). The fertility of female Common dace from the Pond in pit number 2 is slightly higher, which indicates a relatively low rates of reproduction.

Table 4.9.16: The Fertility of Female Common Dace from the Three Studied Waterbodies

	FI (thousands)		RFSL (FI/cm)		RFm (FI/g)	
	Limits	Average	Limits	Average	Limits	Average
Alaagar Reservoir	-	9.5	-	565	-	111
River Alaagar	2.9 -11.2	5.4	224-744	393	75-208	149
Pond in pit number 2	7.9 -15.6	10.3	445-872	579	78-166	108

FI - absolute individual fecundity
RFSL - individual relative fecundity (ratio of FI to the length of the female's body, pieces / cm);
RFm - individual relative fecundity (ratio of FI to the weight of the carcass of the female, pc / g.)

In the Pond in pit number 2, the Common dace feed on aerial insects and periphyton; in the Alaaygyr Reservoir they feed on aerial insects and macrophytes. Indices of stomach fullness for Pond in pit number 2 are 16.2 ‰; for the Alaaygyr Reservoir they are 12.7 ‰. This indicates that the nutritional status at the Common dace from the Alaaygyr Reservoir is higher than that of individuals from the Pond in pit number 2; and even more so from individuals in the River Alaaygyr. In both cases, it is related to food security. Both the Pond in pit number 2 and the River Alaaygyr are less fat thanthe Alaaygyr Reservoir (Table 4.9.17).

Table 4.9.17: Fatness of Common dace from the three studied waterbodies

Pond	QF			Qc		
	All fish	Females	Males	All fish	Females	Males
Alaagar Reservoir	**2.01**	**2.07**	**1.95**	**1.79**	**1.78**	**1.81**
River Alaagar	1.72 ±0.04	1.71 ±0.05	1.75 ±0.07	1.57 ±0.03	1.52 ±0.03	1.63 ±0.05
Pond in pit number 2	1.92 ±0.02	1.86 ±0.03	1.97 ±0.03	1.70 ±0.02	1.68 ±0.03	1.71 ±0.03
Qf - fatness of Fulton (the ratio of body weight and length of the fish); Qc - fatness of Clark (weight and length of the fish carcass);						

In summary the troubles facing populations of Common Dace are associated with a deficit of food resources. There was no evidence for the impact of pollutants on population-biological indicatorsin the studied species.

Common Roach (Rutilus rutilus L., 1758) was the most abundant species within the investigated waterbodies. It was found in the Distant pond in disused quarry; Pond in pit number 2; Reservoir in former pit (Sorokovaya); Alaaygyr Reservoir; and Kyzylsu Reservoir and also the River Kyzylsu downstream of the Reservoir (Photo 16 of Appendix 4.9.17).

The morphio-physiological indices of Common roach in the studied waterbodies showed variable trends (Table 4.9.18). The only thing you can more or less confidently assert is the increasing CSI in individuals from the River Alaaygyr). Also, there is some tendency for an increase in the number of males, except for at the Distant pond in disused quarry. However, the small sample size did not allow you to make specific findings.

Table 4.9.18: Morphio-Physiological Indices of Common Roach from the Five Studied Waterbodies

Pond	HSI			CSI		
	All fish	Females	Males	All fish	Females	Males
Kyzylsu Reservoir	-	1.54 ±0.29	-	0.13 ±0.003	0.13 ±0.003	0.14 ±0.01
Reservoir in former pit (Sorokovaya)	1.17	1.05	1.42	0.10	0.10	0.10
Pond in pit number 2	-	1.55	-	-	0.12	-
Distant pond in disused quarry	1.20	1.10	1.39	0.12	0.13	0.10
Alaaygyr Reservoir	1.39 ±0.18	1.48 ±0.29	1.31 ±0.25	0.13 ±0.01	0.12 ±0.01	0.14 ±0.01
River Alaaygyr	-	-	-	0.15	0.15	0.14

Hepatosomatic index (HIS) was higher in specimens from natural bodies of water and also from the Pond in pit № 2. Roach from other man-made bodies of water exhibited greatly reduced HSI. This is probably caused the type of food or size and age characteristics of samples.

In the Kyzylsu Reservoir roach generally feed on macrophytes, as there is plankton and benthos. In the River Alaaygyr the species tends to consume higher aquatic vegetation. However in the anthropogenic ponds the maion food source is periphyton, with an insignificant portion of air insects also eaten in the Reservoir in former pit (Sorokovaya). The fatness of Common roach in the six studied water bodies is given in Table 4.9.19.

The Table shows that individuals in the anthropogenic ponds and Alaaygyr Reservoir appeared more well-fed; this was assumed due to the low number of small fry recorded (i.e. fry are larger than in other waterbodies) and the lack of trophic competitors and large predators; and, for Alaaygyr Reservoir, the large availability of food.

Table 4.9.19: Fatness of Common Roach from the Six Studied Waterbodies

Pond	QF			Qc		
	All fish	Females	Males	All fish	Females	Males
Kyzylsu Reservoir	2.05 ±0.02	2.06 ±0.02	2.04 ±0.05	1.84 ±0.02	1.84 ±0.02	1.85 ±0.03
Reservoir in former pit (Sorokovaya)	2.38	2.36	2.43	2.17	2.12	2.28
Pond in pit number 2	-	2.27	-	-	1.96	-
Distant pond in disused quarry	2.14	2.18	2.08	1.92	1.94	1.90
Alaaygyr Reservoir	2.21 ±0.05	2.32 ±0.05	2.11 ±0.04	2.02 ±0.04	2.10 ±0.05	1.93 ±0.03
River Alaaygyr	2.01	2.03	1.99	1.84	1.88	1.80
Qf - fatness of Fulton (the ratio of body weight and length of the fish); Qc - fatness of Clark (weight and length of the fish carcass);						

The level of maturity of the gonads measured at gonadosomatic index (GSI), of Common roach within the six studied water bodies can be divided into three groups: high performance (Alaaygyr Reservoir), medium performance (Kyzylsu Reservoir, Reservoir in former pit (Sorokovaya) and Pond in pit number 2) and lower performance (Distant pond in disused quarry and River Alaaygyr); as shown in Table 4.9.20.

Table 4.9.20: Gonadosomatic Index of Common Roach from the Six Studied Waterbodies

Pond	Females	Males
Kyzylsu Reservoir	15.17 ±0.67	5.30 ±1.40
Reservoir in former pit (Sorokovaya)	16.99	4.80
Pond in pit number 2	16.97	-
Distant pond in disused quarry	11.20	4.05
Alaaygyr Reservoir	19.78 ±2.82	7.40 ±0.31
River Alaaygyr	10.00	3.45

Increase GSI in Common roach from the Alaaygyr Reservoir is due to the need for intensive reproduction due to significant populations of predator species. Low levels of GSI for individuals from

the River Alaaygyr are related to the dimensional characteristics of the sample. Reasons for the low GSI in roach from the distant pond within the disused quarry are unknown.

In the Kyzylsu Reservoir, the sexual structure of the population is characterised by a significant prevalence of females over males (9: 1), which is indicative of low rates of reporduction. An equal sexual structure (1:1 male:female) was only observed in the Alaaygyr. Reservior, an equal ratio indicates a high reproduction rate as there is the greatest chance of males and females meeting.

The populations of roach in both the Kyzylsu and Alaaygyr Reservoirs are both sufficiently numerous to make fishing capacity. Within the man-made ponds, this species is represented by sparse self-sufficient groups. No obvious signs of pollution impact on roach populations were observed.

The Common or Eurasian minnow (Phoxinus phoxinus (L., 1758) (Photo 17 of Appendix 4.9.17) prefers living in flowing water (rheophilic) and was most abundant in reaches in streams. The species was therefore not found in the Kyzylsu or Alaaygyr Reserviors, or the anthropogenic ponds – except the Distant pond in the disused quarry, where individuals can enter from the River Mayranbastau.

The Common freshwater bream or Carp bream (*Abramis brama* L., 1758) was only recorded in Kyzylsu Reservoir. The proportion of species in the catch was small, only seven specimens were caught; four females and three males. Indices of the fatness of individuals were all satisfactory level, as were other morpho-physiological indices (Table 4.9.21).

Table 4.9.21: Morpho-Physiological Indices for Common Bream On Kyzylsu Reservoir

Index	Females	Males
GSI	19.28	4.57
HSI	1.49	1.32
CSI	0.11	0.12
QF	2.18	2.12
Qc	1.99	1.95

Bream feed on the remains of benthic organisms and detritus. The population is considered to be stable, however population size could not be determined although it is likely this species forms small clusters within the Reservoir. Ontogenetic abnormalities and disorders were not noted in the seven individuals captured.

During the 2013 surveys Tench (Tinca tinca L., 1758) was only recorded at the Kyzylsu Reservoir (Photo 19 of Appendix 4.9.17). However the survey of fishermen revealed that in winter 1995, juvenile Tench were also caught just at the exit of one of the dams on the River Akbastaubulak.

The catches of Tench were of large, sexually mature, individuals. In the caught individuals, the sex ratio was 1: 3 in the favour of males. However, the end of July, when the studies were conducted, represents the post-spawning period for this species and it is likely that many females had not yet

begun to actively feed (and were therefore not available for capture). It is therefore very likely the sex ratio in the population is close to equal.

Indices of the fatness of individuals were at a satisfactory level (Table 4.9.22). High rates of GSI wre observed in females as this was the post-spawning period and eggs were therefore not present and any unlain eggs would have been reabsorbed. Sex differences in morphological and physiological traits were observed.

Table 4.9.22: Morpho-Physiological Indices for Tench on Kyzylsu Reservoir

Figure	The	BROWNISH
GSI	29.25	2.47
HSI	1.54	1.53
CSI	0.11	0.11
QF	3.02	3.01
Qc	2.75	2.77

The population of Tench in the Kyzylsu reservoir is sufficient to support a commercial fishery. No developmental abnormalities were noted.

Gudgeon (*Gobio gobio* L., 1758) was only recorded in the flowing water of Brook Akbastaubulak and the River Mayran bastau (and cold spring) (Photo 20 of Appendix 4.9.17). The species cannot migrate to the upper reaches of the River Alaaygyr due to the damming of the River. However its absence in the lower reaches of the River Alaaygyr (below the dam) is difficult to explain as it would be expected that this species would enter River Alaaygyr from the River Kyzylsu. This could perhaps be confirmed through further study.

Unnamed loach species (Cobitis melanoleuca Richardson, 1925) was local to the River Alaaygyr (Photo 21 of Appendix 4.9.17). It does not occur in the Alaaygyr Reservoir, as nutritional prey species are absent. This species only lives in fast flowing waters, which distinguishes it from other loach species that may also inhabit weakly running water.

Siberian Stone Loach (Barbatula toni Dybowski, 1869) prefers living in flowing water (rheophilic) and was therefore only observed in fast glowing waters within the River Alaaygyr, Unnamed River and Brook Akbastaubulak (Photo 22 of Appendix 4.9.17). Due to recent revisions, its taxonomic status not fully described, but it is likely that this species in-flows from and is therefore present in the River Kyzylsu.

The Burbot or Freshwater Ling (Lota lota L., 1758) is the only freshwater gadiform (cod-like) fish and it inhabits cold oxygen rich waters. According to the survey of fishermen it inhabits the Kyzylsu Reservior, however due to the timing of the field sampling and its life cycle / ecological features it was not caught.

The Northern Pike (*Esox lucius* L., 1758) was found in both the Kyzylsu and Alaaygyr Reservoirs (Photo 23 of Appendix 4.9.17). The species also spreads into the Rivers Alaaygyr and Kyzylsu. Catches recorded individuals over eight years old (8+) age (Table 4.9.23). For Pike, in contrast to perch, there is a tendency for some increase in the rate of growth, which is potentially due to an increase in prey species (which is expected in particular for the perch). In Kyzylsu Reservoir males grow somewhat faster than females, however in the Alaaygyr Reservoir male and female growth rates are roughly similar.

Table 4.9.23: Growth of Northern Pike in Kyzylsu and Alaaygyr Reservoirs

Pond	Generation	Linear growth (cm)							
Alaaygyr Reservoir	2004	16.3	22.9	27.2	33.8	38.1	41.4	44.7	47.9
	2005	18.5	25.9	30.8	34.5	39.4	43.1	45.6	
	2006	18.6	26.5	31.4	35.0	38.1	41.3		
	2007	19.2	25.2	31.4	34.7	38.3			
	2008	19.0	26.1	32.1	35.6				
	2009	19.3	24.3	28.7					
	Females	18.8	25.4	30.8	34.7	38.3	41.8	45.1	47.9
	Males	19.0	24.7	30.2	34.7	38.5			
Reservoir Kyzylsu	2007	17.4	22.8	27.4	32.2	37.7			
	2008	17.6	24.0	29.9	33.9				
	2009	18.3	24.9	29.8					
	2010	13.9	21.4						
	Females	17.7	22.7	27.5	30.8	36.4			
	Males	17.2	24.2	29.8	34.3	39.0			

In general, the Northern Pike in the Kyzylsu and Alaaygyr Reservoirs are growing more slowly than has been observed in other water bodies in Kazakhstan foe which data are available. In the study of morphological and physiological parameters it was observed that the Northern Pike has a certain dimensional variation of Cardiosomatic index (CSI) (Table 4.9.24). Juveniles having a carcass weight (body weight without viscera) up to 350 g, have a higher CSI, than adults. This is probably due to the greater mobility of small animals who are forced not only to hunt, but also to evade predators (bigger pike).

Table 4.9.24: CSI of Northern Pike in Kyzylsu and Alaaygyr Reservoirs

Weight of carcass	Alaaygyr Reservoir	Kyzylsu Reservoir
≤ 350 g	0.14 ±0.004	0.15 ±0.019
> 350 g	0.11 ±0.005	0.08 ±0.002
Total:	0.12 ±0.005	0.09 ±0.032

The CSI of Northern pike from the Alaaygyr Reservoir is slightly higher than those from the Kyzylsu Reservoir. It is possible that this phenomenon is caused by the influence of pollution, as the Kyzylsu Reservoir is located in places away from mining. It is thought that this may also explain the increased hepatosomatic index (HSI) of Northern pike in the Alaaygyr Reservoir (Table 4.9.25). However, this has not been investigated or proven.

Table 4.9.25: HSI of Northern Pike in Kyzylsu and Alaaygyr Reservoirs			
Pond	**Total**	**Females**	**Males**
Alaaygyr Reservoir	1.38 ±0.29	1.41 ±0.31	1.33 ±0.26
Reservoir Kyzylsu	0.98 ±0.26	1.01 ±0.25	0.95 ±0.28

The food sources of pike in the investigated reservoirs represented species characteristic of these habitats The stomach content of pike from Alaaygyr Reservoir contained Roach and Perch in roughly equal proportions. The stomach content of pike from Kyzylsu Reservoir contained Roach, Perch and Tench. Fatness of the individuals in both reservoirs is at a good level (Table 4.9.26).

Table 4.9.26: Fatness of Northern Pike in Kyzylsu and Alaaygyr Reservoirs						
Pond	**QF**			**Qc**		
	Total	**Females**	**Males**	**Total**	**Females**	**Males**
Alaaygyr Reservoir	1.02 ±0.11	1.05 ±0.08	0.98 ±0.14	0.92 ±0.07	0.94 ±0.03	0.89 ±0.10
Reservoir Kyzylsu	1.00 ±0.05	1.02 ±0.06	0.99 ±0.04	0.95 ±0.05	0.95 ±0.06	0.94 ±0.04

The European Perch (Perca fluviatilis L., 1758) was recorded in the Distant pond in disused quarry, the Reservoir in former pit (Sorokovaya), the Alaaygyr Reservoir, the middle and lower reaches of the River Alaaygyr and the River and Reservoir Kyzylsu. (Photo 22 of Appendix 4.9.17).

The study recorded individuals up to 11 years of age and back calculation of growth showed a gradual decrease of growth rates from 2003 to 2009 (Table 4.9.27).

Table 4.9.27: Growth of European Perch in Investigated Waters											
Pond	Generation	Linear growth, see for years									
		1	2	3	4	5	6	7	8	9	10
Reservoir Kyzylsu	2003	7.4	11.1	12.6	14.1	17.1	20.0	22.3	24.5	25.2	28.2
	2005	7.1	10.0	12.3	15.6	17.5	19.3	21.2	23.4	-	-
	2006	6.8	9.5	12.0	14.1	16.3	18.0	20.0	-	-	-
	2008	6.6	9.4	12.5	14.5	16.1	-	-	-	-	-
	2009	6.6	8.9	11.4	13.2	-	-	-	-	-	-
Alaaygyr Reservior	2006	6.6	8.9	12.2	14.5	16.5	18.5	21.1	-	-	-
	2008	6.0	8.5	10.7	12.7	14.6	-	-	-	-	-
	2009	6.3	8.8	11.0	13.0	-	-	-	-	-	-
River Alaaygyr	2011	6.0	8.8	-	-	-	-	-	-	-	-
Distant pond in disused quarry	2005	6.8	10.2	14.2	16.9	19.0	21.0	23.0	25.0	-	-
	2006	6.2	9.5	12.5	15.0	17.4	20.0	22.2	-	-	-
	2007	6.2	10.4	12.4	15.2	17.9	20.0	-	-	-	-
	2008	5.4	8.3	13.1	15.4	17.3	-	-	-	-	-
Reservoir in former pit (Sorokovaya)	2007	6.8	10.5	13.2	15.9	18.6	20.3	-	-	-	-

In general, all groups showed reasonable rates of rates of linear increase, even in oligotrophic waters. This is due to the type of food /nutrient availability. Oligotrophic conditions within waterbodies is a limiting factor only in the early stages of development of the species. Basic population is formed during this period. Therefore, in the anthropogenic waterbodies (pits in quarries) perch is represented, by

small but stable populations, for which there are sufficient food resources (smaller fish and benthic invertebrates).

Reduction in the growth rates is most likely explained by an increase of the number of individuals in the waterbodies and therefore depends on the size and productivity of each generation .

Morpho-physiological indicators only show the general conditions of the habitat type. HSI has a primarily dietary dependence. Populations manifest themselves as predators and benthophages (feeding on organic matter on the bottom) have large values HSI, than optional zooplanktofagi (feeding on Zooplankton) (Table 4.9.28).

Table 4.9.28: Variation of Morphological Indices in European Perches

Pond	HSI			CSI		
	Total	Females	Males	Total	Females	Males
Reservoir Kyzylsu	1.23 ±0.09	1.34 ±0.11	0.98 ±,10	0.12 ±0.005	0.12 ±0.01	0.12 ±0.11
Alaaygyr Reservior	0.77 ±0.04	0.78 ±0.05	0.71 ±0.01	0.11 ±0.01	0.: 11 ±0.01	0.13 ±0.02
River Alaaygyr	1.21 ±0.06	1.25 ±0.05	0.97	0.15 ±0.01	0.14 ±0.005	0.18
Distant pond in disused quarry	1.07 ±0.14	1.00 ±0.17	1.32 ±0.14	0.13 ±0.004	0.12 ±0.01	0.14 ±0.01

In the Kyzylsu Reservoir the diet of European perch consists of dragonfly larvae and fish (roach over the age 2+) in the car. On the Distant pond in disused quarry, perch feed on the same dragonfly larvae and the fish (perch of older than 1+ and crucian 0+-1+).

On the Alaaygyr Reservoir perch feed on zooplankton and fish (roach aged 0+). Thus, the perch of the first two bodies of water consume food containing more accumulated pollutants in their tissues, both due to lifestyle and lifespan. This is also true for perch from Reservoir in former pit (Sorokovaya), HSI = 1.32.

The special diet of perch in the Alaaygyr Reservoir comprises less "contaminated" food mainly due to the short period of its existence (zoo plankton)

The River Alaaygyr is of special note due to an apparent natural rise in HSI have mladshevozrastnyh groups (2+). Their diet is dominated nectobenthos (gammarids) and benthos (stoneflies) and zooplankton.

However, the influence of the generation on the variation of morphological parameters cannot be excluded (Table 4.9.29).

Table 4.9.29: Age Variability of Morphological and Physiological Indices in European Perch						
Pond	**Age**					
	4+	**5+**	**6+**	**7+**	**8+**	**10+**
HSI						
Reservoir Kyzylsu	1.18 ±1.07	0.84 ±0.01	-	1.45 ±0.18	1.37	1.04
Alaaygyr Reservior	0.82 ±0.17	0.73 ±0.08	-	0.84 ±0.14	-	-
Distant pond in disused quarry	-	0.69 ±0.14	0.80	1.25 ±0.36	0.99	-
CSI						
Reservoir Kyzylsu	0.10 ±0.01	0.14 ±0.01	-	0.12 ±0.01	0.13	0.11
Alaaygyr Reservior	0.12 ±0.01	0.12 ±0.02	-	0.10 ±0.01	-	-
Distant pond in disused quarry	-	0.13 ±0.01	0.12	0.13 ±0.01	0.11	-

The studied populations have their own unique weight ratio of internal organs. And probably theyare due to not only the habitat types, but also the demographic structure of the population and a number of other factors. Fatness of the individuals in all three reservoirs is at a satisfactory level (Table 4.9.30).

Table 4.9.30: Fatness perch of the Investigated Reservoirs						
Pond	**QF**			**Qc**		
	Total	**Females**	**Males**	**Total**	**Females**	**Males**
Reservoir Kyzylsu	2.15 ±0.05	2.22 ±0.06	1.96 ±0.06	1.98 ±0.04	2.05 ±0.04	1.83 ±0.06
Alaaygyr Reservior	2.02 ±0.04	2.00 ±0.05	2.09 ±0.10	1.90 ±0.04	1.90 ±0.05	1.93 ±0.11
River Alaaygyr	2.16 ±0.06	2.19 ±0.06	2.03	1.99 ±0.04	2.02 ±0.04	1.86
Distant pond in disused quarry	2.25 ±0.07	2.26 ±0.09	2.23 ±0.002	2.07 ±0.06	2.08 ±0.07	2.02 ±0.04

Thus, evaluating the two predators, we can say that the Perch and Pike in the studied waterbodies show good performance for individuals of small reservoirs. In some cases, the formation of morphological parameters may be affected by pollution, but size and age variability also plays a large role.
Populations of these types within the Kyzylsu and Alaaygyr Reservoirs can be used in commercial fishery, whereas individuals from other waterbodies within the study can be used for sports and recreational fishing.

There is a risk that development may lead to an imbalance within the ecosystem of the region and the change of dominants resulting in the uniqueness of the region being be lost. Therefore monitoring of the biological diversity of the region (aquatic flora and fauna) is recommended.

It is necessary to assess the status of species with narrow reaction norm on some important indicators of habitat. These should be easily identified by persons with some training and knowledge, but who may not be experts in the field.

These species include: Caddisflies, Common minnow, Gudgeon, Siberian stone loach and the larvae of Diptera and Tench which are useful indicators with respect to the impact of flow rates and resistance to eutrophication.

The abundance and distribution of these species should be subject to monitoring. Furthermore, for the fish, as simpler and more accessible objects, it is necessary to consider appearances of various morpho-physiological indicators (e.g. changes in HSI, CSI etc. as described above) as an indicationof the disturbance of the development of organism. In this case the basic index will be the type and the frequency of the appearance of these indicators.

Assessing the dynamics of these indicators allows trends in the eutrophication of water bodies, the external appearance of anthropogenic factors and many other causes of the dynamics of populations and ecosystems to be identified.

Diversion of the Brook Akbastaubulak

Brook Akbastaubulak is a tributary of the River Kyzylsu, with the confluence at the Village of Shalabay and has a total length of approximately of 12.1km. Several dams are constructed along the lengthof the Brook Akbastaubulak, predominantly in areas around the settlements of Auezov and Shalabay, and the extracted water used for agriculture (Photo 7 of Appendix 4.9.17). At the current time the only available flow data for the Brook Akbastaubulak are Spring flows (i.e. high flows due to winter snow melt) at the confluence with the River Kyzylsu, which are therefore not representative of conditions along the entire length of the watercourse; there are also no data regarding water levels within the Brook Akbastaubulak. These will require further investigation.

As described previously the Aquatic Survey in July 2013 showed the Brook Akbastaubulak to support populationsofCommon or Eurasianminnow, Silver carp, SiberianStone loach and Gudgeon; and there was also anecdotal evidence from the survey of local fishermen that in 1995 juvenile Tench were also found in the watercourse (although was not substantiated during the 2013 survey). The available survey data did not report where on the Brook the species were encountered, however the varied nature of the Brook with its dammed areas and stretches of faster flowing water makes it suitable habitat for a range of fish species; for example the Silver carp is limnophillic (preferring to live in lakes, ponds, marshes, pools or other slow moving, still or stagnant waters); whereas the Common minnow is rheophilic (preferring to live in flowing water) and both are common within the Brook.

Table 4.9.31 lists the five fish species recorded in the Brook Akbastaubulak; and indicates their distribution in the wider area by showing whether they were recorded in other waterbodies during the 2013 survey.

Table 4.9.31: Fish Populations Recorded In Brook Akbastaubulak (July 2013)									
	Brook Akbastaubulak	Distant pond in disused quarry	Former pit (Sorokovaya	Kyzyl Reservoir	River Alaagar	Alaagar Reservoir	Pond in pit #2	Unnamed river	River Kyzylsu
Silver Carp	Main population								
Common minnow									
Siberian Stone Loach									
Gudgeon									
Tench	1995 local fisherman survey - juveniles only								

None of the fish species recorded in the Brook Akbastaubulak are unique to the watercourse within the local area. The Brook Akbastaubulak supports the main population of Silver carp within the watercourses studies in 2013.

The Aquatic Survey in July 2013 also recorded nine invertebrate species within the Brook Akbastaubulak. As shown in Table 4.9.32 none of the species are unique to the Brook and are found in at least one other waterbody within the local area.

Table 4.9.32: Invertebrate Populations Recorded In Brook Akbastaubulak (July 2013)									
	Brook Akbastaubulak	Distant pond in disused quarry	Former pit (Sorokovaya	Kyzyl Reservoir	River Alaagar	Alaagar Reservoir	Pond in pit #2	Unnamed river	River Kyzylsu
Leech (Erpobdella octoculata)									
Water scorpion (Corixia linnaei)									
Water boatman (Notonecta glauca)									
Riffle bug (Velia affinis)									
Pond skater (Limnoporus rufoscutellatus)									
Pond skater (Gerris costae)									
Stonefly (Leuctra fusca)									
Caddisfly (Potamophylax rotundipennis)									
Caddisfly (Limnephilus decipiens)									

Conclusions

The flora of the Project area is dominated by herbaceous perennials, followed by semi-shrubs and herbaceous annuals. Many plant species identified in the area are of economic importance, for example being used as a food or fodder crop, having medicinal uses, or being used as a raw material.

The Project study area is situated on a spur of Kalba Range and its foothills. The landscape is mainly associated with the lowland dry steppe belt although parts are situated in the foothill draughty steppe belt. The Project lies within the 'Western and northern foothills of the Kalba Range' International Bird Area (IBA), however the 816 hectare BMV site (including the existing industrial areas) only accounts for 0.1% of the 657,000 hectare IBA.

Eight rare and endemic plants have been identified within the Project study area, however, these species are not considered to be unique to the site and are found within the wider region. Large Heath Butterfly, classed as rare in the Red book of Kazakhstan, was recorded in 'natural habitats' 1.5 to 5.0km from the industrial area. No mammals, fish or reptiles listed in the Red book of Kazakhstan or classed as globally threatened in the IUCN Red List have been identified within the project site. However, Pond Bats are listed as Near Threatened by the IUCN and were observed in the within residential areas and technical facilities where disturbance already occurs.

Thirteen species of birds of prey were observed in the study area, all observations were of single individuals. The Golden Eagle is a migratory species, it is common internationally, but has a sporadic distribution in RoK and is listed in the Red Book of Kazakhstan. A single individual was observed at very high altitude above the site in October 2011. The species does not nest in the vicinity of the site and it is likely that the site forms only a very small part of its wide hunting territory. Similarly, lone individuals of the IUCN Red listed bird species (Near Threatened status) Pallid Harrier were also observed at height on hunting flights in 2010 and 2011. Pallid harriers also do not nest in the vicinity of the site.

4.10 Archaeology and Cultural Heritage

The archaeological and cultural heritage baseline was collected through a combination of desk study research and fieldwork undertaken both by WAI and JSC Avalon, an archaeological surveyor commissioned in 2013 by Polymetal to produce an independent historical and cultural heritage survey of the Project mine site and surrounding area (Appendix 4.10.1).

In general, the Project area and surrounding industrial and agricultural zones have undergone strong influence by industrial activity since mining operations began in the 1950s. As a result, the discovery of further sites of archaeological significance within the Project footprint is unlikely.

4.10.1 Oblast-level Archaeological Finds and Context

In the wider region, anecdotal evidence and reports from the oblast-level East Kazakhstan Ministry of Culture suggests there are a number of sites of archaeological importance, and some have already undergone archaeological investigations. This area is reported to have been originally settled from the Mesolithic era through part of the Bronze Age (12,000 – 3,000 years ago), with a vast majority of archaeological sites located in the vicinity of major rivers, including the Irtysh River and its major tributaries.

Bronze Age and pre-Bronze Age carvings can be found on rock faces scattered around the countryside in East Kazakhstan Oblast, though no documented such carvings are located directly in the vicinity of the Project site. It is therefore not thought that the Project will impact the setting of the carvings.

Independent archaeological experts report that this rock art is very common in the region, both because it was made by people previously inhabiting the area but also because the more accessible depictions often get destroyed over time. WAI's reconnaissance trips to a site roughly 30km to the north of the Project area identified carvings dating back to the Bronze Age (ca. 4,000 – 3,000 years ago) depicting horses with riders and curly-horned sheep (Photo 4.10.1). Still older carvings depict horses as prey in hunting scenes, as well as autochs (wild ox) (Photo 4.10.2). Apart from making assumptions based on style and image, further age estimates would be possible with further study on the basis of rates of weathering.

At present, ancient stone carvings are not protected by the state, though the oblast Ministry of Culture is currently preparing a five-year plan for archaeological development and investigation, including mapping and protection of each find, across East Kazakhstan Oblast. New laws will require higher responsibility for destruction of ancient monuments. At the same time, the Ministry of Culture will co-host an international archaeological heritage festival in August 2015, including leading academics and policymakers convening to meet with the oblast Akim and officials. The oblast's archaeological heritage may benefit from such international exposure, in particular through further legislative protection of currently unprotected sites.

Photo 4.10.1: Bronze Age Stone Carvings of Riders and Hunters

Photo 4.10.2: Likely pre-Bronze Age Stone Carving of an Auroch with Modern-era Graffiti

4.10.2 Archaeological Finds in Zharminsky District

According to JSC Avalon's report, the highest concentration of historical and cultural monuments in Zharminsky District is located in the vicinity of settlements, such as Zharma village, Kriushi, Tuma, Karazhal, and near Lake Karakol. In addition, a number of petroglyphs and tin mines from the Bronze Age as well as Turkic stone sculptures were discovered in recent years within the Delbegetey hills, located in the north-western sector of the district.

4.10.3 Project Area Finds and Cultural Context

All the surveys to date indicate that, within the mining license area, there are currently no objects of identified historical and cultural value as defined by Kazakh legislation. However, field reconnaissance relating to archaeology and cultural heritage in the Project area was undertaken by JSC Avalon in August 2013, by Polymetal during January-May 2015, and by WAI in June-July 2015.

JSC Avalon's survey reported that, in the vicinity of Auezov and Shalabay, there are three sites designated by the local Akimats to be of historical and cultural value. These are: 1) a memorial to Bakyrchik Kazhy Mamai Uly, the discoverer of the Kyzyl ore deposit; 2) a memorial dedicated to the Great Patriotic War, erected in 1963, located in Shalabay village; and, 3) a memorial in the valley of the Kyzylsu River, erected in 2003, in honour of Teristanbaly Nyman Kozhageldiuly Zharylgapov.

During the initial surveying process, Polymetal came across a Muslim cemetery roughly 50m^2 in area dating back to the late 19th and early 20th centuries, located around 100m north of the BMV offices and close to Open Pit 4 (Photo 4.10.3). Among these graves was that of the locally notorious discoverer of the Bakyrchik deposit, Bakyrchik Kazkhy Mamai Uly (1815-1901). Polymetal employees reported that although tombstones suggested 8 people were buried at the site, 15 bodies were discovered with no existing documentation regarding the seven additional bodies. After initial discovery of the graves, Polymetal informed the Akimat about the need for a reburial. They then completed procedures with the oblast-level Ministry of Culture, confirming that the graves are not of cultural heritage value. They also obtained a letter confirming epidemiological safety before reaching an agreement with relatives about the location and procedure of relocation. They contracted a third party company to provide exhumation and funeral services. A commemoration ceremony was held, convening village elders, relatives, and members of the community.

Photo 4.10.3: Previous Location of Burial Ground within the Project Area

TSF Facility Burial Site

The second burial site was located in what will become the Project's TSF facility, in the grasslands to the south-east of Auezov town (Photo 4.10.4). The exhumation process was carried out in a similar manner as with the first site, though in this case Polymetal did not need a letter from a cultural authority since this was an ancient grave area, undocumented and discovered by accident. According to the Polymetal, these graves were unregistered and belonged to members of a community living in the area during the 1930-50s, with the last person buried there in the 1950s. The state had ownership of the land in the following years before the land was bought up for the purposes of the Project. The exhumation process was carried out with the consultation of local authorities, local community representatives, relatives, and religious representatives.

The exhumed remains from both burial sites were relocated during August-October 2014 to a newly-built Muslim mausoleum (Photo 4.10.5, Photo 4.10.6, and Photo 4.10.7) located adjacent to the Muslim cemetery serving Auezov and Shalabay and near the Christian cemetery that serves both settlements. The land is officially within Shalabay municipality. The tombstone of Bakyrchik Kazkhy was also relocated to the same mausoleum.

The map in Drawing 4.10.1 shows the location of the original grave sites in relation to Auezov and Shalabay, as well as the newly-constructed mausoleum.

Photo 4.10.4: Previous Location of Burial Ground within the Designated TSF Area

Photo 4.10.5: Newly-constructed Muslim Mausoleum for Relocated Graves

Photo 4.10.6: Detail of Relocated Graves within the Newly-Built Muslim Mausoleum

Photo 4.10.7: Tombstone Commemorating Bakyrchik, the Founder of Auezov, Located Within the Newly-Built Mausoleum

4.10.4 Additional Objects of Historical or Cultural Heritage Value

Stakeholder interviews and site reconnaissance undertaken by WAI, together with the findings from JSC Avalon's survey and report, suggest that no further objects of historical or cultural heritage value exist within the Project area. It should be noted that in 2013 JSC Avalon recommended that the grave of Bakyrchik Kazkhy, now located within the Muslim mausoleum, be placed under state protection as a monument of historical and cultural value. It remains unprotected but WAI's site reconnaissance suggests that, given its location within a newly built mausoleum, it is currently at low risk of being vandalised or destroyed.

4.10.5 Consultation with Local Residents

Local people living in Auezov, Solnyechni, and Shalabay report that they visit the graves at the Muslim and Christian cemeteries (Photo 4.10.8) on a regular basis, particularly on important dates such as 'Parents Day', a Kazakh day that celebrates parents. The location of the mausoleum is convenient for visitors who also go to the two active burial sites, in particular the Muslim cemetery located adjacent to the newly-built site.

Photo 4.10.8: Active Russian Orthodox Cemetery Serving Auezov and Shalabay, Located within Shalabay Municipality

WAI identified that in general, local people were supportive of the Project and were positive about the methods employed by Polymetal during the grave relocations. Even in cases when a small minority of residents reported that they feared local (Kazakh) customs may not have been fully respected, they expressed their understanding about the need to relocate graves as part of the process of reopening the mine. They also reported having been grateful to Polymetal for providing all costs for the operation as well as for commemoration services and meals, attended by any relatives or friends of the deceased.

During WAI's extensive social baseline interviews during the site visit, although most people had heard about the procedure, nobody expressed anger or disappointment about the relocation of the graves. Rather, the majority of respondents confirmed that the relocations were done with dignity and according to Kazakh traditions.

4.11 Traffic and Transportation

The total area of East Kazakhstan Oblast is 283,300km^2. Its administrative capital is Ust-Kamenogorsk, which is located 1,038km from Astana and 1,068km from Almaty (Table 4.11.1). Rail and road traffic account for the highest volume of goods and passenger movement across the region, with the regional Akimat reporting that, between those two forms of transportation, 90% of cargo is transported by car or truck whereas the remaining 10% is transported by train. Similarly, official figures report that only 2.5% of passenger travel occurs by train with the vast majority of trips taking place by car and only a very small minority by plane.

Drawing 1.1 shows major roads and railways across the RoK. Drawing 4.11.1 shows local roads and the rail network around Auezov settlement.

4.11.1 Railway Transportation

East Kazakhstan Oblast has 1,243km of rail tracks as well as 76 railway stations and 31 passenger platforms. According to official Akimat sources, the railway is served by the national rail company "Kazakhstan Temir Zholy JSC" as well as smaller Semey and East Kazakhstan branches. 728.6km of track is owned by the Semey regional services whereas the remaining 514.7km belongs to East Kazakhstan regional services based in Ust-Kamenogorsk.

In 2011, the national railway carrier developed a plan of approval for the construction of administrative buildings and service areas around stations at Ust-Talovka, Tansyk, Zhana-Semey, Novo-Ust-Kamenogorsk. A number of other stations in the oblast are listed by the Akimat to be receiving maintenance, including at Zashita, Charsk, Zhangiz-Tobe, Ayagoz, Shemonaikha, Ermakovka, Ziryan, Serebryanka, Zhlanashkol, Ush-Biik, Zharma, Aul, Irtysh-Zavod, Belagash, Turgusun, Korshunovo, Ognevka, Seleznevka.

On the whole, East Kazakhstan region is served by railway lines connecting Ust-Kamenogorsk to smaller towns, including Semey, Ziryan, Ridder, Ayagoz, and Shemonaikha. The two most important intraregional railway lines are the Zashita-Leninogorsk and Zashita-Serebryansk-Ziryan routes, serviced by Shygys Zholserik Ltd. These lines are subsidised by the regional budget, in accordance with national legislation. In the first 11 months of 2011, 136,400 passengers used these routes. A number of lines also lead out of the region, including main railway branches to Russia and China. These are the Zashita – Almaty, Leninogorsk – Astana (with one carriage continuing to Moscow), Rubzovsk – Zashita (with one carriage continuing to Barnaul, Novosibirsk and Biysk), Semey – Kyzylorda, Semey – Karaganda, and also transit routes between Novokuznetsk – Semey – Bishkek, Novosibirsk – Semey – Almaty, Novosibirsk – Semey – Tashkent, and Pavlodar – Semey – Almaty.

Shalabay train station is served by both slower and faster trains, running to Ust-Kamenogorsk every second day and taking approximately three hours (Photo 4.11.1).

Photo 4.11.1: Train arrives to Shalabay Station

Table 4.11.1: Distance (km) between Major Towns in East Kazakhstan. Source: Regional Akimat

	Abay	Ayaoz	Beskaragay	Borodulikha	Glubokoye	Zharma	Zaisan	Zyryabovsk	Cato-Karagan	Kokpekty	Kurchum	Semey	Tarbagatai	Lancer	Urdzhar	Ust-Kamenogorsk	Shemonaikha	Ridder	Kurchatove
Abay		528	277	262	437	342	688	381	463	432	562	182	580	405	713	390	462	600	319
Ayaoz	528		438	420	338	195	400	483	565	316	434	340	214	287	180	310	427	445	475
Beskaragay	277	438		155	330	243	589	468	550	335	453	75	484	300	613	295	305	443	210
Borodulikha	262	420	155		182	233	579	363	445	330	448	65	478	233	603	200	98	236	210
Glubokoye	437	338	330	182		138	484	196	278	230	225	247	378	46	513	18	84	138	392
Zharma	342	195	243	233	138		346	288	370	92	210	153	240	95	375	115	222	245	288
Zaisan	688	400	589	549	484	346		410	328	254	201	499	233	441	580	460	567	595	634
Zyryabovsk	381	483	468	363	196	288	410		82	380	206	363	528	196	663	177	280	293	498
Cato-Karagan	463	565	550	445	278	370	328	82		202	124	460	350	578	668	254	366	384	595
Kokpekty	432	316	335	330	230	92	254	380	202		118	246	148	187	467	207	314	345	380
Kurchum	462	434	453	448	225	210	204	206	124	118		363	266	227	585	209	316	344	498
Semey	182	340	75	65	247	153	499	363	460	245	363		393	218	528	200	163	301	130
Tarbagatai	580	214	484	478	378	240	233	528	350	148	266	393		335	615	351	458	486	528
Lancer	402	287	300	233	46	95	441	196	247	187	227	218	335		470	18	125	153	353
Urdzhar	713	180	613	603	513	375	580	663	668	467	585	528	615	470		490	597	625	663
Ust-Kamenogorsk	390	310	295	200	18	115	460	177	254	207	209	200	351	15	490		101	120	330
Shemonaikha	462	427	305	98	84	222	567	280	366	314	316	163	458	125	597	101		138	308
Ridder	600	445	443	236	138	245	595	293	384	342	344	301	486	153	625	120	138		446
Kurchatove	317	475	210	210	392	288	634	498	595	380	498	130	528	353	663	330	308	446	

4.11.2 Road Transport

East Kazakhstan has 11,734km of roads, including 3,420km of national motorways (mostly asphalted) and, on the whole, the lengthiest network of roads of any region in Kazakhstan (Figure 4.11.1). Official figures report that 7565.3km (64%) of all roads in the region are asphalted. The region has 30 petrol stations and 5 road service stations.

Official figures report that the region has 329 coach routes, including 21 international, 15 interregional, 153 domestic intercity, 79 intraregional intercity, and 61 inter-district routes. 38.2%of settlements are covered by a regular passenger coach service.

Residents of Auezov are served by coach services to Ust-Kamenogorsk and to Semey, with a one-way ticket costing 800 KZT and 1,000 KZT, respectively. Coaches (Photo 4.11.2) are privately run, driven by private drivers. Residents also reported using taxis for transportation to cities, in particular for health-related journeys; a one-way ticket from Auezov costs 1,500 KZT to Semey and 1,200 KZT to Ust-Kamenogorsk.

The 97km drive from Ust-Kamenogorsk to Auezov can take approximately two hours, due to the nature of the road surface, which has deteriorated due to lack of maintenance (Photo 4.11.3). None of the settlements around Auezov are have a petrol station; residents purchase petrol in Char or Kalbatau, sometimes stocking up on extra supplies in canisters. Residents report that not all the roads are ploughed regularly in winter, which makes it more difficult for them to get to work.

Figure 4.11.1: Major Roads in East Kazakhstan. Source: Regional Akimat

Photo 4.11.2: Residents wait for a Coach at Auezov Bus Station

Photo 4.11.3: Dusty Roads in Auezov

4.11.3 Air Travel

East Kazakhstan has two main airports with 'international' status, located in Semey and Ust-Kamengorosk (Photo 4.11.4). Two carriers serve these airports, carrying passengers and cargo. Airports in Zaisan and Urjar carry 'D'-category status, meaning they serve domestic flights only, and two airports in Katon-Karagai and Kurchum are unlisted. Major carriers in operation within the region are SCAT, Air Astana, and Semeyair. Domestic flight patterns and the status of various airports are currently being overhauled as part of Kazakhstan's most recent transport strategy carried out by the Passenger Transport and Highways Administration, in conjunction with local Akimats and corresponding cities and districts. Development plans for nearly all of the airports in the region include: purchase of smaller airports by private owners; renovation of terminals; renovation of runways and taxiways, including paint and navigation equipment; development of electricity supplies and communication lines leading to airports; restoration of fences and replacement of visual reference points around airports; narrower definition of airport operators.

According to official sources, passengers and cargo are currently transported along four intraregional flight routes, namely: Ust-Kamenogorsk-Zaisan; Ust-Kamenogorsk-Katon-Karagai; Ust-Kamenogorsk-Kurchum, and; Ust-Kamenogorsk-Semey-Urjar. Flight tickets for these routes cost between 3,000-8000 KZT. In 2011, 12,800 passengers used the intraregional air routes within East Kazakhstan. Intraregional flights are deployed by the carrier SCAT, with subsidies from the regional Akimat for both passenger and cargo transport. Some of these intraregional routes are seasonal in nature, for example with the Ust-Kamenogorsk-Kurchum route, which is only active during the winter months. Interregional and international flight routes from Ust-Kamenogorsk and Semey include to Almaty, Astana, Shymkent, Karaganda, Moscow, Novosibirsk, Ulgei (Mongolia), and Almaty-Dubai.

Photo 4.11.4: Domestic Interregional Flight from Astana at Ust-Kamenogorsk Airport

4.11.4 Waterways

The Irtysh River, which runs for 1,698km from the border between Kazakhstan's borders with China and Russia is one of the most heavily trafficked waterways in the country. 1,100km of the Irtysh River is in East Kazakhstan Oblast. The National Programme for State River Transport Modernisation, which started in 2005, has added 15 supporting and cargo units to run on the Irtysh River. In addition, existing vessels were equipped with GPS navigation and other technologies to increase efficiency. East Kazakhstan and Semey waterways enterprises are also working towards deepening the Irtysh River in order to open a navigable high-volume route from Russia to China via Kazakhstan.

According to official sources, there are passenger services and leisure cruises (fishing, hunting) on the Irtysh River, including from Ust-Kamenogorsk, Bukhtarma, the Shulba reservoir, and Zaisan Lake. Barges of a variety of sizes (200, 500, and 1,700 tonnes) carry cargo.

4.12 Governance, Demography and Culture

This social baseline report is derived from primary research conducted in June-July 2015 and complemented by data from a number of official databases and data sources[1] of East Kazakhstan Akimat. The report focuses primarily on Auezov and Shalabay settlements as well as the hamlets of Solnyechni and Zhanaaul, which belong to Auezov and Shalabay municipalities, respectively. The territory of Shalabay municipality surrounds Auezov.

In the socioeconomic context of the Project, the two nearest settlements are markedly different in their reliance on mining operations: in Auezov, a settlement that was built to support mining operations at the Kyzyl deposit, the local community indirectly and directly relies on the mine. The job market in Shalabay is diversified and largely independent of the Project, including by way of important local agricultural employers such as Shalabay LLP farm. The settlements of social interest to the Project, which guide this baseline analysis, are shown in Drawing 4.12.1.

4.12.1 Governance and Crime

National and Oblast Level Governance

Kazakhstan, which gained independence 1991, is officially a presidential republic, combining aspects of parliamentary and presidential systems. Its first and only president to date is Nursultan Nazarbayev, who serves as Commander-in-Chief of the Armed Forces and can establish foreign policy, initiate legislation, and appoint the prime minister.

Kazakhstan has a bicameral parliament, comprising the Senate (Upper House, 47 members) and Mazhilis (Lower House, 107 members). It is the country's supreme legislative body. The Senate comprises elected members – two from each of the 14 regions, cities of republican importance (Almaty), and the capital city (Astana), and 15 members directly appointed by the president with the view to ensuring fair representation of national and cultural components of society. The term of office for members of the Senate is six years. The Mazhilis consists of 107 deputies, 98 of which are elected on the basis of party lists and nine appointed by the Assembly of the People of Kazakhstan, a presidentially appointed national political body which aims to represent the various ethnic groups that make up the country's multi-ethnic population. The term of office for deputies is five years.

Currently, three parties are represented in the Mazhilis: National Democratic Party Nur Otan ["Light of the Fatherland"] 80.99%, 83 seats; Democratic Party of Kazakhstan Ak Zhol ["Bright Path"], 7.47%, 8 seats; Communist People's Party of Kazakhstan, 7.19%, 7 seats.

Local government is divided into the following tiers:

[1] http://www.Akimvko.gov.kz

- oblast (regional) tier, which includes the local executive and representative state administrations across fourteen oblasts and the cities of Almaty and Astana;
- rayon (district) tier, which includes the local executive and representative state administrations across 160 rayons, and seventy-nine cities of rayon status; and
- rural (local) tier, which includes the local executive administrations in the settlements, villages (auls) and rural counties.

The mining industry is now under the supervisory control of the Ministry of Investments and Development of RK, which manages the development of the mining industry and will work closely with the Ministry of Energy – Committee for Environmental Regulation, Control and State Inspection in Oil & Gas Sector. The oblast and rayon tiers of local government are composed of representative and executive bodies. Maslikhats head the representative bodies and represent citizen interests, with due consideration to national interests, and are directly elected by the citizens of their respective administrative units for four-year terms. Akims head the executive bodies and represent the interests of the Republic's president and government. The president appoints oblast Akims who, in turn, appoint rayon Akims, who recruit and manage rural Akims.

The Project is located in East Kazakhstan Oblast, which is headed by the Oblast Akim Mr Akhmetov Danial Kenzhetayevich (Photo 4.12.1). Mr Kenzhetayevich has held his position since 11 November 2014, after serving as Kazakhstan's Minister of Energy and Infrastructure (2012-2014). The oblast administrative capital is Ust-Kamenogorsk (also known as Oskemen), founded in 1720, with a population of 318,800 (2011).

Photo 4.12.1: East Kazakhstan Oblast Akimat in Ust-Kamenogorsk, overseen by Oblast Akim Mr Akhmetov Danial Kenzhetayevich.

Rayon (District) and Local Level Governance

The Project is located adjacent to the settlement of Auezov within Zharminsky District, which is headed by the district Akim Mr Mukhtarkhanov Anuarbek Mukhtarkhanuly, based in the district administrative capital, Kalbatau. Drawing 4.12.2 shows the Project's location within Zharminsky District and in relation to the other districts of East Kazakhstan Oblast. Kalbatau is located approximately 75km from the Kyzyl deposit at Auezov. Zharminsky District is comprised of 22 political subdivisions, 83 settlements including the four larger settlements of Charsk, Kalbatau (formerly Georgievka), Zhangiz-Tobe, and Auezov. The district Chief Economist reports that the 2014 population of Zharminsky District is 43,200, of which just over half are female. In general, the population has dropped over the past decade as a result of immigration (out-migration), though the district Akimat reports a trend reversal over the past three years as a result of a better overall quality of life, an increase in the number of women in the area, and better provision of basic infrastructure, such as clean water.

The Akim of Auezov (Photo 4.12.2) is Mr Bakhytbek Amirgazinovich Amirgazin, who is also in charge of the nearby village of Solnyechni, which is considered an offshoot of Auezov and houses mostly BMV workers and some subsistence livestock farmers. Mr Amirgazin has served as Akim of Auezov since 2007. Shalabay has its own Akimat, headed by the Akim Mrs Zhanar Sakenovna Yesenbayeva. Shalabay is less dependent on the mine and its economy is also reliant on farming due to the presence of

Shalabay LLP, a major local employer responsible for 150 jobs and looking to double its size in the next years. Other Shalabay residents work at the school, the healthcare centre, and the Akimat, as well as in local shops.

Photo 4.12.2: Auezov Settlement with the Kyzyl Mine (the Project) in the Background. The Settlement was Founded and Developed in the 1950s to Support Local Mining Operations. Socioeconomic Success of Residents Remains Dependent on Mining Activity.

The Bakyrchik gold mining project has a long history of operations in the area, having prompted the settlement's founding in 1956. In spite of BMV's recent status of Care & Maintenance, relatively positive conditions in Auezov compared with rural settlements of a similar size in East Kazakhstan, including the community infrastructure provided by BMV, appear to attract rural migrants. In this context, BMV and its operations are a major influence on the economy of Auezov and the living standards of its residents. Apart from BMV, other employers in Auezov include the local hospital, school, Akimat, as well as grocery and consumer goods shops. A small number of Auezov residents are entrepreneurs, such a shop owners, beauty salon operators, bar owners, and taxi operators.

The economy of Zharminsky District is developed in accordance with a five-year district development plan. The current plan expires at the end of 2015 and the next one, which runs from 2016-2020, includes potential changes in Auezov as a result of the Project.

Criminality and Law Enforcement

The general trend in Kazakhstan shows an increase in number of recorded crimes and crimes per 10,000 people from 2011 to 2014, with a peak in 2013 both at the national and East Kazakhstan regional level (Table 4.12.1). While the majority of reported crime in Kazakhstan is non-violent, the country does experience a full range of criminal activity. The East Kazakhstan region has a slightly above average crime rate when compared to the national level. Urban areas, such as the cities of

Semey and Ust-Kamenogorsk, have a much higher crime rate than rural areas. Likewise, Zharminsky District's administrative capital of Kalbatau (2014 pop: 12,535) has a slightly higher crime rate than the average rate across the district as a whole, as well as compared with the small town of Charsk (2014 pop: 9,637). In the vicinity of the Project area, Shalabay has a 2014 higher crime rate compared with Auezov, although the latter had an exceptionally low rate of recorded crimes in 2014 after a peak year in 2013.

Table 4.12.1: Crime Statistics For The National Population In Kazakhstan And Across East Kazakhstan Region

	Crimes per 10,000 population			
	2011	**2012**	**2013**	**2014**
Kazakhstan	124.0	172.5	209.7	197.0
East Kazakhstan	163.3	189.7	235.1	207.6
Ust-Kamenogorsk	144.1	182.2	216.2	228.8
Semey	185.5	215.5	296.1	291.9
Zharminsky District	96.0	126.3		108.8
Kalbatau	156.5	43.4		130.0
Charsk	99.9	50.1	44.4	116.2
Auezov	39.0	14.2	49.9	7.3
Shalabay	62.1	17.7	35.6	26.7

Includes Some Data Gaps.
Crime Rate Shown As Crimes Per 10,000 Population

One police officer serves Auezov and Solnyechni (Photo 4.12.3), enforcing laws determined on a national level. Another police officer serves Shalabay and, together with Charsk's police force, the two local officers report to the regional head in Kalbatau. According to the Akim and the local police officer, most offences in the area are petty crime, in other words incidents of small-scale stealing and almost always non-violent. According to the local police officer, there is no drug dealing in Auezov, although drug users do exist. The most common drug is marijuana, which is brought into the locality from Ust-Kamenogorsk. Everyone that WAI interviewed, including the local police officer and Akimat, report that prostitution does not exist in Auezov or Shalabay, though anecdotal evidence suggests that prostitutes do exist in the larger cities, such as Ust-Kamenogorsk.

The local justice system is operated on the rayon-level and the courts nearest to the Project are in Charsk. According to Auezov's Akim, roughly 2-4 local residents end up in court each year, mostly for fights (assault) or as a result of car accidents. Interviewees report anecdotally that the last serious violent crime occurred long ago. Several respondents, including the local police and the Akim, report that nearly all violence is linked to alcohol use.

The local police officer reports that the reopening of the mine would have an overall positive effect on further reducing crime rates, since residents would be kept busy and entertained were they to be offered jobs at the Project.

Photo 4.12.3: Auezov Police Station, where the Settlement's Lone Police Officer Works

4.12.2 Demography

The Project is located in East Kazakhstan Oblast (region), which occupies an area of 283,226km^2 in the easternmost portion of Kazakhstan. East Kazakhstan Oblast was established in 1932, the result of a merger of the two Soviet-era Vostochno-Kazakhstanskaya and Semipalatinsk oblasts. The region borders Russia to the north and northeast and the People's Republic of China to the south and southeast. The easternmost point of East Kazakhstan is within 50km of the westernmost tip of Mongolia, though the two do not share a common border. The region also borders Pavlodar oblast to the northwest and Almaty oblast to the south. East Kazakhstan Oblast is divided into 15 districts, 10 cities, 30 townships, and 870 villages, together housing a population of 1,394,018 (2014).

Total Population

In 2014, the population of Kazakhstan was estimated to be 17,328,100, with East Kazakhstan Oblast making up roughly 8% of the nation's total population (Table 4.12.2). Ust-Kamenogorsk and Semey are the largest cities in East Kazakhstan, with populations of 325,803 and 337,600, respectively. Both cities have grown in population during 2011-2014. At the same time, the population of Zharminsky District, where the Project is located, is mostly rural and has progressively dropped during 2011-2014, even though the population of its largest towns, Kalbatau and Charsk, has remained steady. Auezov and Shalabay have experienced very slight losses in population during 2011-2014.

Table 4.12.2: Population According to Passport Data 2011-2014				
	Total population			
	2011	2012	2013	2014
Kazakhstan	16,673,000	16,673,077	17,160,800	17,328,100
East Kazakhstan	1,397,889	1,394,710	1,393,619	1,394,018
Ust-Kamenogorsk	318,780	321,166	321,619	325,803
Semey	330,800	331,066	337,633	337,600
Zharminsky District	44,594	44,019	43,176	42,288
Kalbatau	12,588	12,429	12,562	12,535
Charsk	9,805	9,786	10,144	9,637
Auezov	2,823	2,824	2,804	2,742
Shalabay	1,128	1,129	1,124	1,124

Net Migration

Official passport statistics indicate that, although Kazakhstan's population rose during 2011-2014, the country has experienced net emigration (out-migration) during that timeframe (Table 4.12.3). The same trend can be seen at the oblast level for East Kazakhstan, with increasingly more people emigrating from the region during 2012-2014. According to these official data, Ust-Kamenogorsk experienced net immigration (in-migration) each year during 2011-2014, reflecting a wider national trend toward urbanisation. Anecdotal evidence from discussions with local stakeholders suggests that the towns of Auezov and Shalabay are experiencing a trend of out-migration of young adults who are seeking more permanent, salaried positions in cities.

The population of Auezov has experienced only slight net out-migration during 2011-2014, though the surrounding Zharminsky District displays a significant out-migration trend. The passport and census data presented here relate to the de jure (legally registered) population and do not present or distinguish from the de facto (actually resident) population. Within the Zharminsky District, migration is not significant, so discrepancies between these statistics will be small. Nevertheless, the district Akimat confirmed that the district has witnessed a net out-migration in recent years, largely related to younger people leaving for salaried positions elsewhere, but that in the past three years this trend appears to be levelling off as local infrastructure and overall quality life improve.

Table 4.12.3: Net Migration 2011-2014. Green Represents Net In-Migration and Red Represents Net Out-Migration					
	Net migration				
	2011	2012	2013	2014	2011-2014
Kazakhstan	5,096	-1,426	-279	-12,162	-8,771
East Kazakhstan	-4,694	-3,444	-4,264	-6,819	-19,221
Ust-Kamenogorsk	2,404	331	3,268	1,210	7,213
Semey	79	1,359	-608	-1,797	-967
Zharminsky District	-904	-1,178	-1,167	-805	-4,054
Kalbatau	-239	-156	26	38	-331
Charsk	-135	-137	-195	-142	-609
Auezov	-36	5	-45	6	-70
Shalabay	-4	-5	9	9	9

East Kazakhstan Oblast

The total population of East Kazakhstan Oblast is 1,394,018 (2014) inhabiting an area of 283,226km^2, meaning the region's population density is 4.92 inhabitants per km^2.

The region is divided into 15 districts as well as the territories of the cities Ust-Kamenogorsk, Ayagoz, Kurchatov, Ridder, Semey, and Zyryanovsk. Table 4.12.4 shows that the broader territory of Semey city has the highest population (329,000) in the oblast, whereas the city of Ust-Kamenogorsk has the highest population density (637.6 inhabitants per km^2). Urzhar, the southernmost district in the oblast, is the most populous district in East Kazakhstan (82,200 inhabitants), whereas the most densely populated district is Shemonaiha (12.05 inhabitants per km^2). Zharminsky District, which houses the Project, has the fifth lowest population density in the oblast, at 1.91 inhabitants per km^2, significantly lower than the national average of 6.0 inhabitants per km^2 as well as that of the oblast as a whole.

Table 4.12.4: Districts and Cities of East Kazakhstan Oblast, by Population Size.

Name	Area (km^2)	Pop. 2011	Density
Ust-Kamenogorsk*	500	318,800	637.6
Ridder*	3,400	58,100	17.1
Shemonaiha	4,000	48,200	12.1
Semey	27,800	329,100	11.8
Glubokoe	7,300	63,600	8.7
Ziryan	10600	75200	7.1
Boroduliha	7000	39100	5.6
Ulan	9,600	40,400	4.2
Zaysan	10,400	36,800	3.5
Urzhar	23,400	82,200	3.5
Kokpekti	14,600	33,400	2.3
Katonkaragay	13200	29200	2.2
Tarbagatay	23,700	46,100	1.9
Zharma	23400	44600	1.9
Beskaragay	11,400	21,700	1.9
Ayagoz	49,600	74,400	1.5
Kurchum	23,200	30,800	1.3
Abay	20100	15400	0.8
Kurchatov*	0.01	11,000	n/a
Not all Towns (*) are Represented			

The main ethnic groups in Kazakhstan are Russian (35.9%), Kazakh (40.7%), followed by with the remaining population composed of a mix of Ukrainian (11.8%), German (3.8%) and other groups, which comprise the remaining 8 %. In many rural areas the proportion of people of Kazakh ethnicity tends to be much higher.

Table 4.12.5 shows the ethnic breakdown of districts and territories within East Kazakhstan Oblast, most of which are predominantly Kazakh. Five districts comprise over 90% Kazakhs, whereas none are

over 90% Russian. Predominantly Russian districts or territories, such as the city of Ust-Kamenogorsk, Ridder, Shemonaiha, or Glubokoe, are located in the northernmost part of the oblast, which shares borders with Russia. Boroduliha is the only district with a population containing over 10% 'other' ethnicities (17.2%), which can for the most part be attributed to its 11.3% German, 2% Tartar, and 1.4% Ukrainian populations.

According to the regional Akimat's website, Zharminsky District is predominantly Kazakh (89.2%), with 8% Russians, 0.5% Ukrainians, 0.5% Tartars, 0.1% Byelorussians, 0.1% Uzbeks, 0.8% Germans, and 0.8% other nationalities. Passport data collected by Polymetal (Table 4.12.6) suggest the proportion of Kazaks within Zharminsky District has remained around 90% throughout the period 2011-2014.

Table 4.12.5: Ethnic Breakdown by District and Cities of East Kazakhstan Oblast

	Ethnic breakdown		
Name	Kazakhs	Russians	Other
Tarbagatay	98.7	1.1	0.2
Abay	98.5	0.8	0.7
Ayagoz	94.3	3.7	2
Zaysan	94.2	4.2	1.6
Kurchum	90.2	8.8	1
Urzhar	89.7	8.4	1.9
Zharma	89.2	8	2.8
Katonkaragay	79.3	18.9	1.8
Kokpekti	74.8	20.3	4.9
Ulan	68.5	27.8	3.7
Beskaragay	64.7	27.2	8.1
Semey	62.4	30.7	6.9
Kurchatov*	39.1	53.7	7.2
Ust-Kamenogorsk*	26.5	68.1	5.4
Boroduliha	26	56.8	17.2
Glubokoe	22.8	71.5	5.7
Ziryan	17.5	77.7	4.8
Shemonaiha	10.8	81.3	7.9
Ridder*	9.6	85.5	4.9
Not all Towns (*) are Represented			

Table 4.12.6: Zharminsky District Proportion (%) of Ethnicities by Year, According to Passport Data

Year	Kazakhs	Russians	Other
2011	91	6.7	2.3
2012	91.2	6.6	2.2
2013	92.2	6.3	1.5
2014	90.1	7.6	2.9

Table 4.12.7 illustrates the gender breakdown at the national, oblast, and district, and city level, as obtained from passport data. During the period 2012-2014, these data show Kazakhstan has a stable

and slightly higher proportion (just under 52%) of females compared to males. This trend is mirrored within East Kazakhstan Oblast, which has been just over 52% female during that same time period.

The cities of Ust-Kamenogorsk and Semey tend to have an even higher proportion of females, relatively stable at around 54.8% and 53.7%, respectively. In contrast, passport data suggest Zharminsky District has a slightly higher proportion of males, averaging 50.2% male during the years 2012-2014. However, data provided in person by the district Akim are commensurate with the national trend, suggesting the district's population is 53.5% female.

District-level officials report that 82,000 KZT is a good monthly salary, but that this sum can be substantially lower (around 65,000 KZT) in rural areas. In comparison with the rest of Zharminsky District, officials report that Auezov salaries are higher than average.

Table 4.12.7: Gender Breakdown (%) by Year, According to Passport Data.

	2011		2012		2013		2014	
Name	Male	Female	Male	Female	Male	Female	Male	Female
Kazakhstan			48.2	51.8	48.2	51.8	48.3	51.7
East Kazakhstan	47.5	52.5	47.5	52.5	47.5	52.5	47.6	52.4
Ust-Kamenogorsk	45.2	54.8	45.3	54.7	45.2	54.8		
Semey	46.3	53.7	46.4	53.6	46.4	53.6		
Zharminsky District	50.2	49.8	50.3	49.7	50.4	49.6	46.5	53.5

Gaps Indicate Missing Data.

Auezov

Auezov's Akim reported that the town's population underwent significant changes when the Project fell into Care & Maintenance in 1998, dropping from a peak population of 7-8,000 to just under 3,000. Village elders report that the settlement had a population of 11,000 in 1969, then 3,000 in 1994, and now 2,800.

On the basis of the household survey findings, there is a relatively low dependency ratio for the community as a whole in Auezov, with around one working age resident for every dependency age resident. The Auezov Akim reports that, out of a population of roughly 3,000, almost 700 are children, 600 are retired, and 100-150 are students and away most of the time. It should be noted that from the working age population, many residents rely on seasonal incomes, so the household income during the winter months (from October until March) may be quite limited.

Polymetal surveyed 52 households, including 141 residents, in the settlement of Auezov (in addition to those surveyed separately in Solnyechni, see 4.12.2.5), located adjacent to the Kyzyl deposit within the broader Auezov municipality. The residents interviewed were 50% male and 50% female. The survey found that, on average, 2.7 people inhabit each house from typically one or two generations. 6 of the surveyed households were inhabited by three generations. The average age of surveyed residents was 40. All houses were privately owned by their residents and 25% of households reported owning a second house elsewhere, mostly in a location outside Auezov.

Housing in Auezov is of varying quality, with residents living either in individual houses or in apartment buildings (Photo 4.12.4).

Photo 4.12.4: Housing in Auezov, House (top) and Apartment Building (bottom)

Interviews revealed that the majority (73%) of households in Auezov were ethnically Kazakh, with the rest reporting themselves to be either Russian or Kazakh-German (1 household). Linguistically, most households (79%) were bilingual Kazakh-Russian, with 19% speaking only Russian and no Kazakh and 2% speaking only Kazakh and no Russian.

Residents of Auezov not born in the settlement reported that they had moved to the village mainly as a move with their parents, had returned there after attending higher education, or had moved there

as a result of marriage. Overall, residents of Auezov reported having inhabited the village for an average of 37 years. The most common travel destinations reported by respondents was Ust-Kamenogorsk, with households traveling there on average 11 times per year, and Semey, with households traveling there on average 6 times per year. Other reported travel destinations were Shalabay, Char, and Kalbatau.

According to the Akim of Auezov, the average salary in each household is 60,000 KZT. According to the household survey, each household reported earning on average 105,461 KZT, with 27% of households responding having no income. Not taking the size of households into account, 40% of households earned combined incomes of over 100,000 KZT. A quarter of households responded that their only source of income was through state pensions for the elderly, with monthly pensions of 64,909 KZT. No households reported any income from livestock.

23% of households reported owning livestock, which they used mostly for food but also to sell. They owned sheep (9%), cows (17%), horses (4%), and chickens (7.6%).

Table 4.12.8 shows reported average monthly expenditure by item and relative percentage of total expenditure. The four largest expenditures relative to the total monthly expenses were food, debt, mortgage, and transportation payments. Residents of Auezov reported to have paid a combined 10% of their expenses on utilities. 16% of households reported that they were currently repaying debt, often to local shops where they had previously bought items on credit.

Table 4.12.8: Breakdown of Average Monthly Household Expenditure for Auezov and Relative Percentage for Each Item Compared to Total Expenditure

Item	Monthly (T)	%
Food	38846	17
Debt	36,610	16
Mortgage	30400	13
Transport	30400	13
Education	21388	9
Coal or wood	17870	8
Clothing	16057	7
Livestock	10729	5
Healthcare	8215	4
Electricity	3800	2
Mobile phone	3636	2
Herder costs	3000	1
Phone and Internet	2450	1
Gas	1848	1

Figure 4.12.1 illustrates the possession rates of various household items by relative percentage of the 52 households surveyed in Auezov. All households surveyed had TV and appliances, whereas 98% of households had central electricity. 90% of households reported having satellite TV. All the households

surveyed reported being in possession of appliances, including washing machines, vacuum cleaners, and microwaves. Just over half of households reported owning cars.

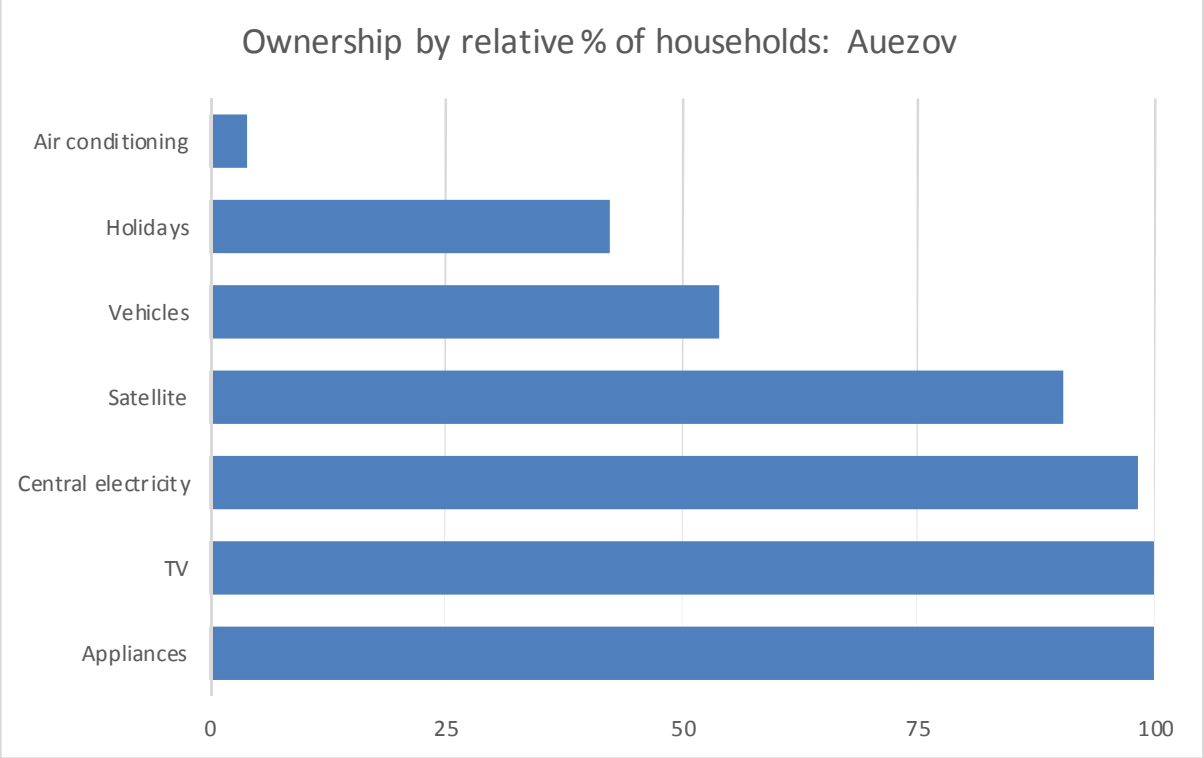


Figure 4.12.1: Ownership of Various Household Items in Auezov by Relative % of the 52 Households Surveyed

As in Shalabay, Auezov residents reported that they thought they had a future in the settlement but especially if it changes for the better as a result of the Project. They identified an improving job market and building of better infrastructure as priorities for the future.

Solnyechni

Nearly all (9) households were surveyed in the hamlet of Solnyechni, which is located in Auezov municipality and is widely considered to be an offshoot of Auezov settlement.

The total number of residents in these households was 33, of which 45% was male and 55% female. Our survey found that on average 3.67 people inhabit each house, belonging to mostly two generations. One household was inhabited by three generations and two households housed just one generation. Married couples formed the basis of six of the households. All houses were privately owned by their residents and no households reported owning any land or houses external to their property in Solnyechni. The average age of the residents surveyed was 36.3.

All residents surveyed spoke both Kazakh and Russian but no other languages. Children from Solnyechni attend school in Auezov, either taking a school bus or walking along the road, which residents reported to be dangerous in winter due to a lack of street lighting.

Residents of Solnyechni reported that they had moved to the village mainly for three reasons: the closure of a farm elsewhere (Murtas) and subsequent job loss, in order to start a new job, or as a result of marriage. They have lived in Solnyechni for an average of 9.75 years. On average, household members reported not traveling further afield than Charsk, Ust-Kamenogorsk, or Semey, where they went by taxi or bus in order to visit relatives or a larger healthcare facility.

Household income varies seasonally for three of the nine households, with two households also receiving external income from family members living elsewhere. The average monthly income per person of those reporting to have jobs or earnings from elsewhere across all the households surveyed was 48,850 KZT, with a maximum salary of 160,000 KZT. Four households had two or more residents earning salaries whereas two households reported having no monthly income at all. Two residents were on disability benefits, earning 20,000 KZT per month. State unemployment benefits are reported to be between 20-25,000 KZT per month.

Six of the nine households surveyed owned animals, supplying them with extra food and income from meat and associated products. Households reported owning sheep (4 households), cows (6), horses (1), and chickens (3). Most meat, eggs, and milk was used by the households themselves. However, cows, if sold, were reported to fetch around 100,000 KZT each, and eggs from chickens an additional 250 KZT per 10 eggs. Seven households also grew their own vegetables for their own consumption. Hunting was not reported to be common, with only one household reporting that they hunted foxes and hares for their pelt.

In Solnyechni, average monthly expenditure per household was 188,349T. The items making up the largest proportion of overall household expenditure each month are food (17.1%), clothing (17.8%), and debt repayment (21.5%). In addition, residents paid 9.7% of their total expenditure on utilities, including electricity, gas, coal, and wood. They also paid 8.3% of their expenditure on hay for their animals. Five of nine households reported making regular debt payments, including two of over 100,000 KZT per month.

A survey of household expenditure also revealed that seven of nine households had access to a telephone landline with internet, and six of nine owned at least one mobile phone. Only one household did not report having central heading and all households reported using coal as heating fuel in winter, purchasing coal by way of regular deliveries by truck. Five households also topped up their heating requirements with wood fuel. The households surveyed also owned televisions (all), satellite TV (4), and cars (4).

Residents of Solnyechni for the large part do not believe they have a future in the village, although two households were optimistic that things would change for the better if the mine reopens, in

particular because their children might be able to get jobs and therefore not have to move further away from their parents.

Five of the nine households surveyed reported having heard about the reopening of the mine but, although they had heard about Polymetal's public consultation meetings at Auezov Akimat, nobody had attended, citing either a lack of time or transportation means. As a result of the interviews carried out for this survey, these households may now be somewhat better informed about the Project, although it is recommended that they attend future consultation meetings in order to keep up with future developments around the mine.

Shalabay

In 2003, a survey of 65 households was conducted in the village of Shalabay, located to the west of the Project site in Auezov municipality. The hamlet of Zhanaaul, located 10km away and housing 55 residents, is also part of Shalabay municipality; however, given its distance to the Project area, only informal interviews were conducted there.

The total number of residents surveyed in Shalabay was 247, of which 51% was male and 49% female. Our survey found that, on average, 3.8 people inhabit each house, from typically 2 generations (parents and children). However, 16 of the surveyed households were inhabited by three generations. The average age of all the residents surveyed was 37.

All houses were privately owned by their residents with the exception of one, which was provided to the family by the local farm Shalabay LLP, and no households reported owning any land or houses external to the house in which they live. Three households owned land in nearby villages.

On the basis of the household survey findings, there is a relatively low dependency ratio for the community as a whole, with around one working age resident for every dependency age resident (52% dependents in each household). It should be noted though that, from the working age population, many residents rely on seasonal incomes, so the household income during the winter months (from October until March) may be quite limited.

Interviews revealed that the majority (76.9%) of households in Shalabay were ethnically Kazakh. Households also reported themselves to be either Russian (12.3%), Mongolian (4.6%), or 'other' (6.2%). Linguistically, most households (70.8%) were bilingual Kazakh-Russian, with only 15.4% of surveyed households speaking only Kazakh and 13.8% speaking only Russian.

Residents of Shalabay reported that they had moved to the village mainly for three reasons: as a result of marriage, for a new job, or had been transferred by their employer. Two families were 'oralmen', ethnic Kazakhs from China, part of a broader government scheme to return to their homeland.

Overall, residents of Shalabay reported that they have inhabited the settlement for an average of 30.2 years, occasionally traveling to Auezov, Charsk, Kalbatau, Ust-Kamenogorsk, Almaty, and Astana. Longer journeys, such as to Almaty and Astana, were usually taken by train, whereas residents reported using private cars or taxi for shorter journeys, such as those within Zharminsky District.

Of the 65 households surveyed, the average monthly household income was 97,854 KZT, or 45,618 KZT per person. Not taking the size of households into account, 38% of households earned combined incomes of over 100,000 KZT. A majority (82%) of households had at least one member holding a salaried position. Just under half of households (49%) had one member with a paid position, whereas a quarter had two members with paid jobs. Just under 8% of the households surveyed had three members working in paid positions. At the same time, 17% of households were occupied by one or more retirees and no salaried workers. Our survey found that these households had an average monthly pension income of 69,000 KZT, or 40,677T per person per month. For several families, salaries and/or pensions were complemented by income generated by the sale of livestock – around 10,000 KZT per month for 15% of households – and also by state-funded disability allowances of roughly 15,000 KZT per month. Shalabay Akimat reports that only 2 residents are officially unemployed, largely because the largest demographic work-related category is 'self-employed', referring to subsistence agriculture.

85% of the households surveyed owned at least one animal, which they used for food or to sell. They owned horses (14% of households), cows (80%), sheep (62%), goats (5%), chickens (38%), and other (3%) animals, such as geese. Residents reported that their horses, cows, and sheep were looked after by herders, who grazed the animals mostly in the Shalabay area and were paid a monthly fee of 600-1000 KZT per head. Only 8% of households reported selling their animal products, as opposed to consuming them themselves.

Table 4.12.9 shows reported average monthly expenditure by item and relative percentage of total expenditure. It should be noted that the questionnaire did not include expenditure on fixed telephone lines, household internet, or mobile phones. The four largest expenditures relative to total monthly expenses were debt, food, clothing, and mortgage payments. Residents of Shalabay reported to have paid a combined 7% of their expenses on utilities. 20% of households were repaying debt, often to local shops where they had previously bought items on credit.

Table 4.12.9: Breakdown of Average Monthly Household Expenditure for Shalabay and Relative Percentage for Each Item Compared to total Expenditure		
Item	**Monthly (T)**	**%**
Debt	32,808	20
Food	32,228	20
Clothing	25,192	16
Mortgage	23,500	15
Education	13,322	8
Livestock	8,997	6
Transport	8,101	5
Healthcare	6,431	4
Coal or wood	5,760	4
Power	2,793	2
Gas	1,908	1

Figure 4.12.2 shows possession rates of various household items by relative percentage of the 65 households surveyed in Shalabay. All the households WAI surveyed had central electricity and nearly all had both a television and appliances, such as washing machines, vacuum cleaners, or microwaves. More than half of the households had satellite television access and just over a quarter had cars. No households had air conditioning and very few travelled on what they described as holidays.

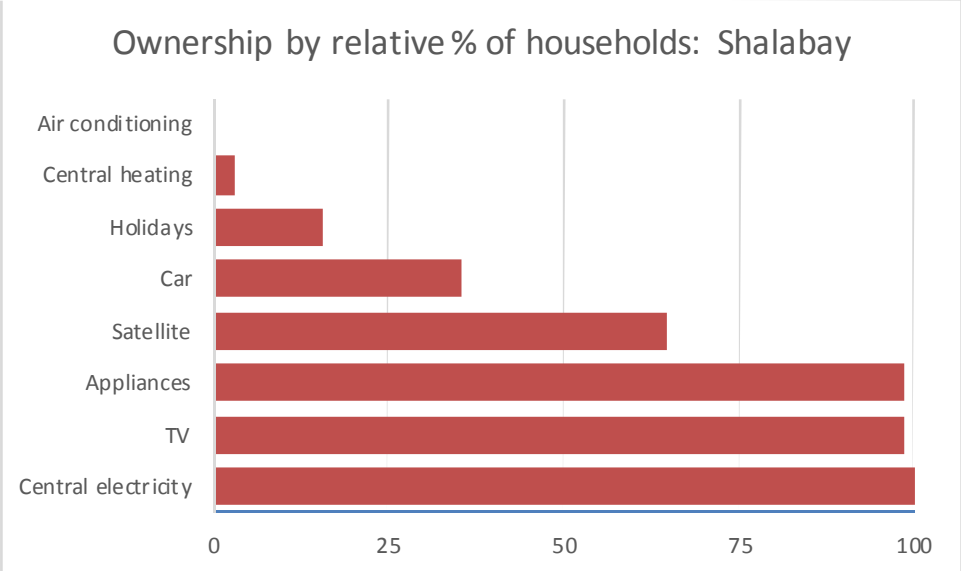


Figure 4.12.2: Ownership of Various Household Items in Shalabay by Relative % of the 65 Households Surveyed

Almost all Shalabay residents reported that they thought they had a future in the settlement, but that certain infrastructure could be improved, including asphalt for roads, the building of a mosque and kindergarten, a bigger hospital, more playgrounds, and better street lighting. Overall, residents rated their quality of life to be good, especially since water pipes were installed in the settlement over the past three years.

The hamlet of Zhanaaul, located within Shalabay's administrative territory, is located approximately 10km to the south of the Project site and houses 55 residents. Residents of Zhanaaul are all subsistence farmers, surviving by keeping animals and growing vegetables. In contrast with residents of Shalabay, locals in Zhanaaul do not rely on herders but, rather, look after their own animals. They sometimes also sell the meat from their animals in Ust-Kamenogorsk, Semey, or Auezov. They report that they are looking for jobs with fixed salaries but at present very few residents of Zhanaaul are employed. They also report that the distance between the village and Auezov makes it difficult for them to travel, especially when roads are covered in snow in winter (Photo 4.12.5). Zhanaaul has no central water supply and residents instead draw water from wells and from local springs. Their close proximity to Kyzyl Su reservoir enables residents of Zhanaaul to go fishing and swimming there. In addition, a number of Zhanaaul residents report that they hunt for food and pelt, including wolves, foxes, and rabbits.

Photo 4.12.5: Road in Auezov Settlement During Winter

4.12.3 Culture

History and Heritage

Kazakhstan has been inhabited since the Neolithic Age, with the region's climate and terrain best suited for pastoral nomads. Kazakh culture has thus been historically nomadic, with the population split into 'steppe clans', the most populous of which include the Great (Older), Middle, and Junior Jüz. The Senior Jüz inhabited northern lands of the former Chagatai Ulus of the Mongol Empire, in today's south-eastern Kazakhstan and China's Ili Kazakh Autonomous Prefecture of northern Xinjiang. The Middle Jüz inhabited lands in Central, Northern, and Eastern Kazakhstan. Finally, the Junior Jüz inhabited lands in Western Kazakhstan. There are differing theories about their formation, including that Jüz are geographical zones separated by natural boundaries and that Jüz were based on tribal

origins or military alliances emerging after the disintegration of the Kazakh Khanate. Nevertheless, each jüz contains a number of clans, which share a presumed genealogy of forefathers going back to their presumed ancestor. Each clan is divided into smaller groups down to the smallest lineage.

Tribalism remains a part of modern life for Kazakhs, who often ask what clan they belong to as part of their greeting rituals. As Kazakhs practice exogamy, each individual is expected to know his ancestors up to the seventh forefather (the 'zhety ata'). Marriage within the zhety aha was considered to be incest taboo.

Traditionally, Kazakh holidays include Nauryz, which is celebrated on 22 March on the day of the spring equinox. Kazakh people also celebrate 'Sogym', an ancient custom held during wintertime, where meat is shared between friends and neighbours. Elderly local people often perceive that younger people no longer follow many of the Kazakh traditions.

Modern-day Kazakh family structures are diverse; however, many still follow the traditional structure whereby elderly parents will often live in the households of one of their sons. Kazakh tradition determines that the youngest son normally stays living with his parents. This often applies to Russian, Kazakh and families of other ethnicities in the local area. The overall family structure normally sees the man as the head of the family unit, although most people, including the women consulted, suggest that in modern-day families there is normally an equal balance of power.

In Shalabay, surveyed household sizes ranged from 1 to 12, including multigenerational families. Households reported that they contained 1 (32.3%), 2 (40%), 3 (24.6%), and 4 (3.1%) generations. The average number of generations per household was 1.98. The mean number of children per couple is 1.3.

Ethnicity and Language

According to the 2009 national census, the main ethnic groups in Kazakhstan are Kazakh (63.1%), Russian (23.7%), Uzbek (2.8%), Ukrainians (2.1%), and Germans (1.1%). The majority (76.9%) of surveyed households in Shalabay were ethnically Kazakh, with a minority of Russian (12.3%), Mongolian (4.6%), and 'other' (6.2%) ethnicities reported. There are no known identified indigenous communities[2] present around Auezov or Shalabay, as reported by officials, historians, and residents. Respondents of the household survey in Auezov reported being either of Kazakh (73%) or Russian (27%) ethnicity.

Although Kazakh is the official state language spoken in Kazakhstan, ethnicity is the main factor determining whether Kazakh or Russian is the first language. In addition, whilst the majority of people who are ethnically Kazakh also speak Russian, most people who speak Russian as their first language do not speak or understand the Kazakh language to any great degree. In Shalabay, the majority (76.9%) of households were ethnically Kazakh, whereas a minority of households were ethnically Russian

[2] As defined by IFC PS7 on Indigenous Peoples

(12.3%), Mongolian (4.6%), or 'other' (6.2%). As in Auezov (79%), most households in Shalabay (70.8%) reported that they speak both Kazakh and Russian.

In many rural areas, the proportion of people of Kazakh ethnicity tends to be much higher. For example, in Zharminsky District, the population is 89.2% Kazakh, 8% Russian, 0.5% Ukrainian, 0.5% Tatar, 0.1% Byelorussian, 0.1% Uzbek, 0.8% German, and 0.8% other ethnicities. According to official sources, the district is home to residents of 23 nationalities, 90.1% of which are Kazakhs, 7% Russians, and 2.9% are others. Most inter-ethnic marriages in Kazakhstan have been between various Slavic or Germanic groups (Russians with Ukrainians, Germans with Ukrainians, Russians with Polish, or German with Russian). Marriages between Turkic and European ethnic groups remain rare, but are increasing.

A number of 'oralman' families inhabit the area around the Project. Oralmen – or 'returnees' – are ethnic Kazakhs who immigrated to Kazakhstan from abroad since its independence in 1991. The ancestors of oralman often originally left Kazakhstan in the 1930s, escaping difficult conditions during the Soviet period of 'collectivisation'. Oralman usually come from neighbouring countries, including China, Mongolia, Uzbekistan, Russian, or Kyrgyzstan. The Akim of Auezov reports that 20-25 oralman families live in Auezov, including around 15 that moved to the settlement 20 years ago and have since been entirely assimilated. The remaining 5-10 families came here in the past 7 years, mostly from Mongolia, and are also for the most part fully integrated into society. All of the oralman households surveyed reported that they felt at home and comfortable in the settlement and that they had no grievances about their assimilation process. All of the families in the survey had been offered financial aid to move back to Kazakhstan. For example, one family reported having been offered 35,000 KZT in order to purchase a house and land in the area. Overall, the oralman families appeared to be better educated than the average population and often overqualified for jobs, reporting having to work in fields outside their area of expertise. They were also notably more active in the community compared with others interviewed, with all families reporting that they regularly attend the Project's public consultation meetings. Reports suggest that there are no oralman-only meetings, societies, or any other organisational structures that may distinguish them from the rest of the population.

Cultural Infrastructure, Libraries, and Social Clubs

According to official sources from 2012, East Kazakhstan houses 626 public cultural centres, including 261 social clubs, 303 libraries, 12 cinemas, 10 museums, 9 smaller film halls, 7 mobile cinemas, 4 concert halls, 2 theatres, 1 recreation park, 1 zoo, plus a number of funds relating to film and culture. The region's cultural budget for 2012 was 2.72 billion KZT.

The region has made significant efforts to improve mobility of cultural experiences, in order to reach remote communities. Such strategies involve using mobile cinemas and libraries, as well as enabling disco or concert facilities for younger people.

The region's libraries contain 8.1 million books, with 324,200 new books added in 2012. In addition, libraries host exhibitions, including for example those devoted to better understanding of cultural

heritage. Since 2003, the region has also benefitted from an increased Internet connectivity, in particular to central district libraries, which in 2012 housed 341 computers and printers. In 2012, official figures report that 30 libraries had Internet connections and email facilities, with 18,100 registered e-users. Libraries with Internet include those in Shemonaikha, Glubokoe, Tarbagatai, Kurchum, Beskargai, Katon-Karagai, Ulan, and Ziryan districts.

Auezov has a library (Photo 4.12.6), located in the Akimat building. The head librarian reported loan volumes of 30-40 books per day, including Russian and Kazakh literature and some children's books in English. The library, which contains 12,000 books (majority in Russian), is funded by the district Akimat in Kalbatau Culture Department and, apart from books, houses a five-year archive of local and national newspapers as well as magazines. Books are free to borrow for a maximum of 10 days at a time. Members of staff report that any additional funding would best be allocated to replacing ageing computers and to renovate window frames.

The region also houses 10 museums, responsible in 2012 for leading 2,650 excursions, 405 lectures, and putting on 140 exhibitions. 1.2 million visitors attended museum events in East Kazakhstan in 2012. Although there are no museums around the Project area, both Auezov and Shalabay School (Photo 4.12.) as well as Shalabay LLP farm have their own small museums, where historical artefacts and documentation is on display.

In 2012, East Kazakhstan's theatres performed 509 plays in front of 128,700 spectators, bringing in 38.8 million KZT. That same year, 585 concerts were put on in front of 167,000 spectators, bringing in 30.1 million KZT.

Residents of Auezov and Shalabay reported feeling nostalgic about some of the aspects associated with the way of life during the Soviet era. On the whole, they reported that spiritual, cultural, and social life was better and more fulfilling before 1991, whereas material life, in other words the quality and quantity of their possessions, is better now.

A map of selected locations of social interest, particularly important during the survey of Auezov, can be found in Drawing 4.12.3.

Photo 4.12.6: Auezov Public Library, Part of the Public Services Offered at the Settlement's Akimat

Photo 4.12.7: Shalabay School Museum Presenting People and Historical Events of Significance

Religion

Although secularism is enshrined in its constitution, according to the 2009 national census 70% of Kazakhstan's population is Muslim, 26% Christian, 0.1% Buddhist, 0.2% others (mostly Jewish), and 3% non-religious. Kazakh ethnics are predominantly Muslim whereas Russian or Russian-Kazakhs are mostly Russian Orthodox. In rural areas, Kazakh people tend to maintain stronger Islamic faith and practices compared to those in urban areas.

In the Project area, WAI's scoping study[3] indicated that people are predominantly Kazakh Muslim, with a small minority of ethnically Russian Orthodox Christians also present. The main religious centre is a mosque in Auezov (Photo 4.12.), headed by an imam who moved to the area in 2007. The imam is an 'oralman', from a family of ethnic Kazakhs previously living in Mongolia. The imam estimated that 25-30 people visit the mosque each day, though they get more visitors on Fridays for the special prayer. The mosque itself can fit 150 people, including a small separated area for women. According to the imam, a minority of visitors are 'zhaneit' – true believers – visiting the mosque on a regular basis, whereas others show up from time to time. He also estimated that most visitors are relatively young, below 40 years of age. In addition, the mosque in Auezov and its associated buildings are used as a social centre, in particular for gatherings and meals of up to 220 people to commemorate the dead. The mosque also houses a small classroom, where children receive religious education, as well as a shop selling items relating to the Muslim faith. The mosque also obtains an income through donations, which are usually around 200 KZT per visitor. According to the imam, the mosque in Auezov has a constructive relationship with BMV, with the company often paying for the mosque's heating, water, and other utilities. For additional requests, the imam writes a formal letter to the company and, he claims, the often help. For example, in 2014 BMV paid 410,000 KZT to cover the heating bills.

[3] WAI report ZT520141 R002 (September 2013)

Photo 4.12.8: Mosque in Auezov

Sports and Exercise

Official figures from 2012 report that 18.2% of the population of East Kazakhstan practice a sport at one of the 2,874 officially designated sports centres, which include gyms, swimming pools, general sports complexes, skiing lodges, and shooting galleries. Sportsmen from the region participated in 190 domestic and international sports competitions during 2012, winning a number of medals. 6 athletes from East Kazakhstan participated at the 2012 London Olympics, where Kazakhastan finished 12th on the medal table with 13 medals (7 gold, 1 silver, and 5 bronze). Olga Rypakova from East Kazakhstan won the gold medal in the triple jump at the London Olympics as well as in the 2012 Diamond League competition. Ice hockey is a particularly important sport in East Kazakhstan, with a number of the nation's most prominent players having originated there. There are 24 hockey rinks in the region, including one in Auezov, sponsored by Polymetal (Photo 4.12.). In addition, there are 32 football fields in the region. Auezov also has a children's playground, which was partly funded by Polymetal (Photo 4.12.10).

Photo 4.12.9: Ice Rink in Auezov, Sponsored by Polymetal. It is Also Used for Football in the summer and Serves as an Important Leisure Point within the Settlement

Photo 4.12.10: Playground in Auezov During Winter, Partly Funded by Polymetal.

Tourism

In 2012, East Kazakhstan officials report having spent 35.6 million KZT on tourism. In the first half of that same year, 158,900 tourists are reported to have visited the region, an increase of 11.6% from the previous year. During that same time period, the general volume of tourist services increased by 24.5%. A regional Tourist Information Centre was launched in 2012, aiming to coordinate tourist activities in East Kazakhstan. The region's tourism action plan aims to expand the tourism industry in the region by way of attracting domestic and foreign investment in ecological, medical, and other kinds of tourism including ski and beach centres. The region is supported by 219 million KZT of national-level funding.

Development programmes within the tourism sector involve the training of tourism-related staff, for example by organising seminars around hotel management and educating guides or guest house owners. East Kazakhstan also has an ecotourism sphere, opened in 2012 through a meeting in Katon-Karagai district in conjunction with the Berel Museum and the youth organisation called the Ecological Tourism Centre, which promotes practical ecological activities for students and teachers and aims to develop ecotourism and environmental improvement in the region.

Other region-wide programmes include multimedia visualisation virtual travel activities, a hiking championship called 'Indian Summer', ski races for anti-drugs charities, as well as a number of strategies to improve the region's entertainment industry.

Reviewing cultural implications of the fall of the Soviet Union in 1991, the general view portrayed by stakeholders consulted suggests that people were left facing very challenging times for quite a number of years. It also saw significant relapses in the maintenance of infrastructure. Many rural villages like Solnyechni and Zhanaaul, and even settlements like Auezov and Shalabay, experienced subsequent depopulation and infrastructure to rural communities fell into a poor state of repair. Many local people have a lot of optimism at present that things are changing for the better, despite rural infrastructure often being in a poor state of repair. People from the rural district comes across as having a sense of pride in their lives.

4.13 Social Infrastructure, Health and Education

4.13.1 Social Infrastructure

District-level officials report that 5.5 million KZT have been spent on general infrastructure across the district since 2014, though this figure varies on an annual basis and comprises roughly 60% allocation to education and the rest on construction and other larger-scale projects.

Electricity

Electricity for Auezov (including Solnyechni) and Shalabay, including for the Project, is centralised and generated at the hydroelectric power plant in Ust-Kamenogorsk, roughly 90km north-east of the deposit, owned and operated by AES Corporation. The plant draws energy from the Irtysh River using 4 individual turbines with a nominal output of 82.8 MW with a generating capacity of 339.4 MW, generating 1.58 billion kilowatt-hours of electricity per year. High voltage lines feed power stations in rural settlements across East Kazakhstan. In Auezov, electricity for households passes through the Project's infrastructure before distribution across the settlement, whereas this is not the case in Shalabay.

Waste Collection and Disposal

Officials at Auezov and Shalabay Akimats and residents report that the collection and disposal of household waste is an important gap in the social infrastructure of Auezov and Shalabay municipalities. There is currently no official waste collection or landfill strategy and the Akim of Auezov is pessimistic that the state will ever fund a waste removal facility. Instead, he proposes that waste collection and disposal should be arranged by a reliable private company. At present in Auezov, a company runs collection and disposal activities but, according to the Akim, they are unreliable, collecting waste irregularly and with vehicles that often break down. Residents report paying 100 KZT per person per month for this private waste collection service, which usually takes place once every three weeks. As a result, residents frequently have to dispose of their own waste individually in the countryside near the road to the northwest of settlement.

In Shalabay, the Shalabay LLP farm helps with the collection of municipal waste by providing trucks on a semi-regular basis, with members of the population paying a small sum per head for the service. According to Shalabay Akimat, officials are currently preparing to cost and devise a collection strategy between all nearby villages. Land has already been allocated for the creation of a landfill site, to be constructed in 2016 or 2017. The operation, which will be run through the district Akimat in Kalbatau, will likely involve using private vehicles for collecting waste from households across the district.

Water Provision and Quality

The source of all process and potable water for the Project is the Kyzyltu underground water intake with the yearly average yield of 1,000-1,3000m^3/day. The process water for the processing plant will be supplied from the tailings facilities.

In Auezov, prices for water, as well as electricity and heating, are announced to the local population at meetings held at the Akimat every six months. Extra meetings are arranged in case additional charges are necessary. Roughly 250 people attend these meetings, which are held at the local school. Smaller meetings of maximum 150 can be held at the Akimat itself.

Some residents of Auezov obtain their water from aquifers, drilled by geologists in the 1970s and 1980s, whereas others rely on taps in the street ('kolonka'), which supply piped water (Photo 4.13.1). Both are free.

An increasing number of Auezov residents receive piped water to their homes, which they pay for through a metering system set up by Polymetal. Prices are reported to be roughly 50 KZT/m3. Residents report mixed feelings about the new system, ranging from satisfaction that they receive potable water to their homes to dissatisfaction about having to pay for water for their flower gardens, which previously was free of charge. Village elders report that most of the pipes are 30-40 years old, with the newest piping having been installed 25 years ago.

The head of Auezov healthcare centre confirms that the water in the settlement is of good quality and certainly potable, though slightly inferior to the water provision from the newly installed pipes in Shalabay. The doctor reported that problems arise in local water quality as a result of degrading older pipes, in particular if water is left to sit in the pipes for longer periods of time.

In 2014, Shalabay Akimat commissioned a central water pipeline, which currently serves approximately 140 households. The pipeline is the property of the Akimat and is serviced by the communal utility enterprise, which is government-owned and located in Charsk. The enterprise, paid for through taxes, services the pipeline at all times, including sending technicians at short notice for emergency works. The Akimat reports that it aims to extend the service to serve every household in the municipality, serving primarily as human drinking water. Prior to the centralised water supply, the population relied on boreholes to extract drinking water as well as water for vegetable gardens and animals; although in principle potable, Shalabay's head doctor reports that this water was salty and not of the best quality. Shalabay LLP farm, a major local water user, draws its water from the Kyzyl Su river.

Kalbatau has a central water pipeline supplying domestic water to its residents. The water is sourced from the Shar River and filtered to make it safe for human consumption.

Photo 4.13.1: Public Water Tap ('Kolonka') by the Side of a Road in Auezov

Emergency Services and Military Installations

Although officials and residents report that household fires are rare, fires in the surrounding countryside are relatively common in the peak summer months. These fires are mostly natural and are kept under control by local residents using private bulldozers and tractors to dig up dirt which is subsequently used to smother the fires. The local Akimat reports that there are no major military installations in the area.

Transportation and Postal Service

Shalabay railway station and maintenance centre was opened in 2008, employing 30 workers to carry out customer service duties as well as to maintain the tracks. Railway employees work for the state and are generally better off socioeconomically relative to the settlement's broader population; many of them live in newly built housing adjacent to the station, which several residents report to be the best available housing in the settlement. Trains stopping at Shalabay run between Ust-Kamenogorsk and Almaty as well as from Ust-Kamenogorsk to Astana, and include 'high-speed' trains and the slower models.

A postal service serves Shalabay and Auezov Akimats, where mailboxes are located. Each Akimat also has a dedicated postal worker, who prepares the mail before it gets collected by car 2-3 times per week and taken to Kalbatau for wider distribution. After collection, letters are reported to generally take 2-3 days to get to Astana and other major domestic cities.

Ecosystem Services and Leisure

Residents of Auezov and Shalabay spend a lot of their free time outdoors, especially during the summer, where barbeques and social visits are particularly popular. Leisure activities relying on ecosystem services include fishing, picking mushrooms or berries, and hunting. A particularly popular area for outdoor activities is around the Kyzyl Su reservoir, located to the south of Auezov settlement and near the hamlet of Zhanaaul. The Kyzyl Zu is protected by a security guard and an unofficially demarcated boundary divides the reservoir into waters that residents can use for swimming and fishing and those that are to be kept clear, as they are near the inlet which provides the drinking water supply to Auezov.

Fishing and hunting often require licenses or permission. For example, district-level officials report that fishing licenses ('tickets') cost 500 KZT for a day and sometimes have to be complemented by an additional 700 KZT for permission to fish on a privately owned lake. Local fishermen report paying in total between 1,000-5,000 KZT for a fishing session on a private lake. In addition, fishermen pay a one-off 5,000 KZT annual membership fee to be able to fish. Fishing locations include most accessible water bodies, including the Kyzyl Su reservoir, Lake Alakol, and rivers running through Shalabay. Veteran fishermen report that the Kyzyl Su has been nearly emptied of fish by illegal fishing, using nets earlier in the season than they are legally allowed to. Some residents also go ice fishing on the Kyzyl Su in winter.

Hunting also requires a license but hunters are also charged a tax on each kill, which in Zharminsky District include for the most part ducks, rabbits, and marmots. Hunters have to settle for a fee with landowners if they wish to hunt on private property, typically 500 KZT and around 200 KZT per kill. An official hunting license fee must be paid annually, currently priced at 25,000 KZT. This license is not necessary for ducks and rabbits. Kills are consumed for their meat and fur. Reported hunting locations include the rural habitats to the south of the Project area, including around Zhanaaul and as far south as Kalbatau.

Anecdotal evidence and observations suggest that local residents pick berries in many of the countryside areas surrounding Auezov and Shalabay, including to the north of the proposed Project site as well as within the proposed TSF facility area.

In Shalabay, sports facilities are located at the local school. A cultural centre was planned and construction started, but its development was halted as a result of the global financial crisis of 2008. The local Akimat reports that the centre is now ruined and an additional 350 million KZT would be required to rebuild it. Shalabay also has a World War II memorial built by the Soviets to commemorate and honour war veterans. One veteran still resides in Shalabay, although he is poorly and frail.

The local Akimats report that relatively few people go away for holidays, and almost nobody travels outside the oblast or abroad. This was confirmed in household surveys. Most local residents report

that they attend the larger events and festivals put on by Polymetal, in particular Metallurgy Day, which occurs annually in July.

Auezov has two restaurants, serving traditional Kazakh meals. Staff at the cheaper of the two restaurants, whose owner lives in Semey, report they get around 50 customers per day, mostly at lunchtime. Over the past five years, they report that the number of visitors has decreased steadily, from 200 per day in 2008 when construction workers from the mine used the restaurant as their designated canteen. Today, customers are residents of Auezov or visitors to the mine. Auezov also has two cafés, which also serve as bars in the evening. Café staff, 3 in total, working at the more family friendly of the two cafés, report that their shifts run from 10am to 6pm and then again from 8pm until 1am. They reportedly serve around 40 customers each day, mostly over-25s, with the majority coming in after 8pm. The other café, Akmaral, is also Auezov's only nightclub. Café owners report that local residents may consume alcohol until they are drunk and incidents of violence do occur, though rarely, yet they rarely see any evidence of drug taking.

Shalabay School representatives report that students at their school have a comprehensive ecotourism strategy for the local area, which involves welcoming tourists to walk along a defined path around local hills, down to a river, and into a cave. So far around 120 'tourists' attend the project each year, most of them children from other schools across the oblast.

The local settlements have no movie theatre and a number of residents report going to nearby cities to see a film. Kalbatau has a library and cultural centre, where disco parties are held for younger residents.

Since 2014, Polymetal have organised a number of social events as well as funding contributions to local services. These initiatives are listed in Table 4.13.1 below.

Table 4.13.1: Polymetal's Social Initiatives in Auezov and Shalabay during 2014-15	
Event/Initiative	**Details**
Ambulance	Purchase of ambulance for Auezov healthcare centre
Auezov healthcare centre	Child's electronic scales were purchased. BMV helps with petrol for ambulance well as with the finance and materials for the repair of premises.
Central Park, Auezov	Central Park of Auezov village contains a playground and ice hockey rink, as well as trees and a war memorial. Polymetal contributed to the reconstruction and development of the park.
Hockey rink	Auezov sponsored the equipment and reconstruction of an ice hockey rink within the Central Park, including dressing rooms (mobile). The site doubles as a football pitch in the summer.
Scholarships for local school children to study at university	BMV grants will be provided for exceptional school students continuing at university in the following fields: Mining; Geology; Metallurgy; Processing; Engineering and Construction; Power and Electrical Engineering.
Lekotek Programme	Programme for children with disabilities based at the local school
Presents for New Year's	In 2014, Polymetal purchased presents for 1,000 children from Auezov and Shalabay villages. The same operation is planned in 2015.
Newspaper subscriptions	Polymetal paid for newspaper subscriptions for veterans, low-income pensioners, and their families.
Household chemicals for low-income families	In October 2014 and 2015, 22 low-income families with children received a set of products and household chemical in the framework of "Month of Mercy".
Stationery for BMV employees' children	In 2014, more than 100 children whose parents are BMV employees received stationery as part of programme "Way to School". In 2015 all children whose parents are BMV employees will receive stationery for school, extended also to Shalabay children from low-income families.
Auezov School	2014: Purchased a projector and school for interactive classrooms, as well as a greenhouse and school bus (with petrol) for Auezov School.
Aid to orphanages in the region	Nov 2014: Polymetal provided aid to orphanages in Ust-Kamenogorsk.
Special holidays and events	Polymetal put on special celebrations for Metallurgist Day and Miner's Day. Annually. Also Children's Protection Day was celebrated in Auezov village.
School athletics tournament sponsorship	Sponsored athletes' trip to tournaments in boxing and karate.
Singing competition for children	Sponsored trip to Almaty for local children to compete in a singing competition.
Extra financial assistance	Provided school, ambulance, fire brigade, mosques and other institutions with financial assistance.
Kindergarten in Auezov	In 2015, Polymetal plans to sponsor the reconstruction of the local kindergarten.
Victory Day 70th anniversary WWII celebrations	In May 2015, Polymetal sponsored celebrations in Auezov.
Shalabay School	Sponsored the development of bee colonies at Shalabay School, which subsequently served as a model for Shalabay LLP's bee hives.

4.13.2 Health

Although Kazakhstan provides free public access healthcare, the best public health facilities are generally located in larger urban areas and health service provision has increasingly been privatised

and decentralised after the Soviet era. As a result, while basic public health services are freely available to most citizens, specialist health care, including certain cancer treatments, is often only available privately and at certain facilities. In general, certain types of medicine are also free of charge, while others have to be paid for privately.

According to the World Health Organization, Kazakhstan's total expenditure on health as % of GDP rose slightly from 4.1 to 4.3% during the period 2009-2013. At the same time, the country's per capita total expenditure on health (at the average exchange rate) increased from USD $302 to 580 during that same time period. In 2013, an estimated 25.8% of the total population of Kazakhstan were under the age of 15. Table 4.13.2 and Table 4.13.3 show general health infrastructure and population statistics for Kazakhstan.

In 2013, life expectancy in Kazakhstan was 63 for men and 72 for women (for those born in 2012). The WHO reported an overall life expectancy of 68.6 in 2010. There is very little published health data for East Kazakhstan Oblast and Zharminsky District. General health trends show that the overall 2012 life expectancy in Auezov (72) and Shalabay (74) was higher than the national average of 70.45.

Recreational drug use has been identified by the UN as rising in Kazakhstan. Certain sexually transmitted infections, including HIV, are understood to be increasing in Kazakhstan, although rates are still comparatively low on global standards (as reported by the World Health Organisation. In 2014, the rate of HIV infection in the age group 15-49 years old was 0.234%. For the same period in 2013, the figure was 0.217%.

Table 4.13.2: General Health Infrastructure Statistics for Kazakhstan

	2006	2007	2008	2009	2010	2011	2012
Hospitals / 100 000	7.1	6.8	6.6	6.4	6.1	5.7	5.5
Acute (short-stay) hospitals / 100 000	5.1	5.0	4.9	4.7	4.5	4.2	4.1
Primary health care units / 100 000	53.0	52.8		49.3			
Hospital beds / 100 000	777.6	772.1	771.0	761.4	729.2	710.5	700.7
Acute care hospital beds / 100 000	526.0	527.7	528.5	559.4	503.1	493.6	455.7
Psychiatric hospital beds / 100 000	63.5	62.8	61.5	60.3	57.8	56.1	54.9
Physicians / 100 000	333.8	336.9	334.8	342.5	350.3	354.7	349.5
% of physicians working in hospitals	28.7	28.9	29.5	29.3	28.2	28.4	29.0
General practitioners (PP) / 100 000	21.6	24.2	27.9	26.1	31.3	31.1	31.2
Dentists (PP) / 100 000	36.7	36.9	36.0	35.7	40.8	39.5	41.2
Pharmacists (PP) / 100 000	91.8	81.7	82.1	76.8	69.0	79.8	80.6
Nurses (PP) / 100 000	738.8	748.8	718.6	768.9	768.8	788.8	804.5

Source – World Health Organization Regional Office For Europe

Table 4.13.3: General health statistics for Kazakhstan for 2010	
Life expectancy at birth (years)	68.60
Estimated infant mortality / 1000 live births (WHO)	19.59
Maternal deaths / 100 000 live births	22.85
Diseases of circulatory system, all ages, / 100 000	621.10
Ischaemic heart disease, all ages, / 100 000	181.33
Cerebrovascular diseases, all ages, / 100 000	185.84
Malignant neoplasms, all ages, / 100 000	157.03
Trachea/bronchus/lung cancer, all ages, / 100 000	27.45
Cancer of the cervix uteri, all ages, / 100 000	8.79
Malignant neoplasm female breast, all ages, / 100 000	20.13
External causes of injury and poisoning, all ages, / 100 000	116.44
Suicide and self-inflicted injury, all ages, / 100 000	22.75
Homicide and intentional injury, 0–64, / 100 000	9.32
Transport accidents, all ages, / 100 000	21.29
Source – World Health Organization Regional Office For Europe	

East Kazakhstan Oblast has 725 family ambulant clinics, including first aid centres and hospitals. Zharminsky District has 11 ambulant clinics, 3 rural health posts, and 30 medical stations. Table 4.13.4 to Table 4.13.7 show local level health statistics.

Table 4.13.4: Doctors per 1,000 Population				
	2007	2009	2011	2013
East Kazakhstan	246	243	241	240
Ust-Kamenogorsk	291	302	194	177
Zharminsky District	2	2	2	2
Kalbatau	2	2	2	2
Charsk			377	405
Shalabay	2	2	2	2
Auezov	1	1	1	1
Blanks denote missing data.				

Table 4.13.5: Infant Mortality Per 1,000 Live Births				
	2006	2008	2010	2012
Kazakhstan	13.91	20.76	16.58	13.48
Zharminsky District	23	22.1	25	11.9
Charsk	2	2	3	3
Shalabay	0	0	0	0
Auezov	0	0	0	0

Table 4.13.6: Total Tuberculosis Cases				
	2006	2008	2010	2012
Kazakhstan				262,787
East Kazakhstan		1,826	1,734	1,410
Zharminsky District	131	121	98	94
Shalabay	2	1	5	6
Auezov	1	4	8	8
Blanks denote missing data.				

Table 4.13.7: Total Cancer Cases		
	2010	2012
East Kazakhstan	3,807	3,851
Zharminsky District		75
Charsk	91	89
Shalabay	1	2
Auezov	3	5
Blanks denote missing data.		

District and Local Level Healthcare

In Kalbatau, the administrative centre for Zharminsky District, the budget for the hospital covers each of the settlement's citizens but they occasionally also treat patients from outside the countryside. The most common illnesses are heart disease, respiratory problems, and complications resulting from car accidents. The district-level healthcare system and hospital has no formal agreements with BMV, though there was previously one in place.

Few if any citizens of Auezov and Shalabay have private health insurance. Head doctors at both healthcare centres in the vicinity of the Project area (Auezov and Shalabay) consider the general health of the local population to be good.

Auezov healthcare centre (Photo 4.13.2, Photo 4.13.3, and Photo 4.13.4) has three doctors, including a general practitioner (head doctor), a paediatrician, and a gynaecologist. The centre also houses ten nurses and a safety worker. The head doctor at Auezov grew up locally after her family moved to the area to work as teachers at the local school. As with the two other doctors at the centre as well as Shalabay's doctor, she completed her medical studies at Semey Medical Institute (now University). Doctors work 8-hour shifts from 9am to 5pm on weekdays. On weekends, one doctor is always on call. The centre collectively gets around 10,000 patients per year, though the doctor estimates she personally gets around 20 patients per day (which comes to around 5,000 patients per year). Auezov medical centre serves the whole municipality, including the village of Solnyechni. Only on rare occasions do residents of other municipalities or foreigners visit the centre and, if so, mostly in emergency situations. The head doctor reports that high blood pressure, heart problems, as well as colds and flus are the most frequently reported illnesses. Serious emergency cases are transferred to Charsk hospital as soon as possible.

Shalabay Akimat representatives report that the healthcare centre is old and in need of maintenance. It is mostly funded by the state but has at times received one-off donations from the BMV Project, in particular in the form of fuel. The head doctor of the healthcare centre in Shalabay (Photo 4.13.5) is the centre's only doctor, working alongside a dentist, a technician, and six nurses. She works 9am to 5pm on weekdays and also from 9-12:30 on Saturdays, in addition to being on call throughout the rest of the weekend. The healthcare centre covers Shalabay village as well as the hamlet of Zhanaaul and four smaller rural settlements of 2-3 households each. Shalabay's doctor reports seeing 10-15 patients per day, though sometimes she may see as many as 30 during exceptionally severe outbreaks of colds or flu. Patients do not need to book but, rather, just show up and are subsequently ordered by a nurse

according to the severity of their symptoms. Patients are mostly from Shalabay village and rarely come from outside the immediate area, though sometimes (1-2 patients per month) non-residents working shifts at the railway station need medical attention. Common illnesses in Shalabay are reported to be arthritis and arthroses, as well as diet-related problems such as heart disease, gastritis, and pancreatic problems.

Auezov healthcare centre has an annual agreement with BMV, with the Project contributing a large part of the money required to develop and maintain the hospital's infrastructure, which now includes laundry facilities. In 2014, BMV donated 6.2 million KZT, which was used to construct an additional wing of the hospital, to buy an ambulance, as well as to fund special medical bags, injections, medicines, and stretchers. There is currently no such memorandum in place for Shalabay healthcare centre, though such an agreement with BMV has been in place in the past.

The heads of Kalbatau, Auezov, and Shalabay hospitals report that health seeking behaviour in the area varies greatly from person to person. At the district level, a programme has recently been put in place to ensure that people come into the hospital more often, and this is said to be working. Patients at Kalbatau hospital are approximately 52% female. Similarly, head doctors in Auezov and Shalabay report that patients at both clinics are 60% female. The pool of younger (under-18s) patients is overrepresented by children under 5.

Sexually transmitted diseases/infections (STDs/STIs) are not frequently reported across Zharminsky District, though serious cases are transferred to the gynaecology department at Charsk hospital. The heads of Kalbatau and Auezov hospitals report that no STDs were diagnosed in the first half of 2015 and that residents either do not have them or are too shy or embarrassed to speak about them. They both report that it would be very difficult to hide them, as every patient at the hospital undergoes a comprehensive check-up and blood test. Shalabay's head doctor reports having diagnosed two cases in the past year, of which one was confirmed to be gonorrhoea by further tests carried out in Charsk.

Although cancer rates are relatively low, reported as 2-5 cases in Auezov annually, diabetes and obesity are seen by local doctors as an emerging health issue in the local population. There are no known cases of HIV in the area, as confirmed by all the healthcare workers WAI interviewed.

According to the head of the healthcare centre, based on her experience during the mine's active years, Auezov hospital will likely get more staff should the mine reopen. In addition, they would likely be given additional equipment, such as a stomach scanner, which they had at the hospital during the mine's operating years before it was transferred to Charsk and Kalbatau hospitals due to a lack of patients when the mine closed. Shalabay's head doctor confirms that, although the centre is currently operating at sub-maximal volumes, the main barrier to better health care is the availability of equipment and medication; the local health centre currently relies on Charsk for supplies of medicines and emergency transfers. Medicines are currently also dispensed at Auezov pharmacy (Photo 4.13.6).

To date, no formal health baseline has been undertaken around the deposit.

Photo 4.13.2: Auezov Healthcare Centre, Which Serves as the Primary Destination for Health Seeking Behaviour in the Settlement, Including for Project Workers

Photo 4.13.3: Auezov Healthcare Centre Waiting Room

Photo 4.13.4: The Newly Built Auezov Healthcare Centre Paediatrics Room, Sponsored by Polymetal

Photo 4.13.5: Shalabay Healthcare Centre

Photo 4.13.6: Auezov Pharmacy

4.13.3 Education

In Kazakhstan, the state fully funds public education whilst students are at school, with education sometimes subsidised up to further and higher education levels. In general, literacy rates across Kazakhstan are very high, at 99.7%. While development of information technology remains a key component of Kazakhstan's State Programme for Educational Development, expenditure on educational content, including staffing and facilities, has significantly increased in general in the past decade.

Official figures show that in 2012 East Kazakhstan had 148 kindergartens, 718 comprehensive schools, 58 colleges, 43 professional Lyceums, 68 non-school institutions, 14 orphanages, 14 organisations for children with disabilities, 7 psychological consultations, 11 corrections cabinets, 2 Nazarbayev Intellectual Schools, and the Nur Orda International School. With the exception of a drop in comprehensive school numbers, the number of all other institutions rose or stayed the same. Across East Kazakhstan, 2012 figures report that 72 settlements do not have primary schools and 118 settlements lack secondary schools. The region's schools were served by 192 buses, of which 166 are the property of the schools themselves. 95% of pupils received hot meals in 2012.

Zharminsky District has 2 kindergartens with 280 places, though several other tiers of pre-school services exist across the broader region. Of the 718 comprehensive schools across East Kazakhstan region, just over half are in Kazakh and a quarter in Russian, with the other half comprising mixed-language schools. In 2012, 175,781 children were registered in schools across the region, a decrease of 2.9% from the previous year.

Schools near the Project Area

The settlements near the Project have two schools, one in Auezov and one in Shalabay. The school in Auezov has 415 registered students, taught by 54 teachers and supported by an additional 30 staff. School children are generally aged 7-18, attending 11 years of education. Education is free for all children, funded by the Kazakh state. At present, there is no kindergarten in Auezov, but the school runs a caregiving centre for children aged 3-5 (45 enrolled). Apart from the classrooms, the school comprises a library, football field, boxing and judo gym, wireless Internet, and around 40 computers. The student body is 52% female and 48% male, which differs from Shalabay, where a slight majority of students are male. Attendance at both schools is generally high and the head teachers report that truancy levels are low, with students able to miss up to 20 days annually due to illness before having to redo the year.

The head teachers of both schools report that failure rates amongst students are relatively low. Last year, 14 of 26 students from Auezov School passed national exams and continued on to university. The remaining 12 students passed another exam, which allowed them to go on to college. Over the past years, most students from both schools are reported to have progressed into technical fields related to mining, including metallurgy and geology.

At present, Auezov School offers parallel classes in each year in Russian and Kazakh, though the head teacher reports that Kazakhstan's President has recently signed a proposal for all children to learn English starting in the 2nd grade. At the same time, Kazakh students would be required to learn Russian from the 2nd grade.

180 pupils are enrolled at the school in Shalabay, divided across 11 years taught in Russian or Kazakh. The school employs 33 teachers. Shalabay School also has a kindergarten, with 36-56 children enrolled each year. An additional 30 children are enrolled in a preschool facility. The head teacher reports that the number of enrolled students has gone up by 40 in the past five years, which is beneficial for the school because they are now able to deliver classes in both Russian and Kazakh separately from the first grade, which ultimately facilitates learning.

The school in Shalabay has the largest gym in the area, which was renovated as part of a state-funded 'education roadmap' scheme alongside six other building projects, including roof repairs. In total, 37 million KZT were spent on the gym and roof, with an additional 46 million KZT allocated to future renovation of the main entrance and windows. The head teacher at Shalabay School reports being grateful for the Project's contribution to the school over the years, which started with a memorandum in the 1990s and has led to more recent donations from Polymetal, including refurbishment of toilets and heating systems (2 million KZT) and the addition of a washing machine (70,000 KZT). The school head teacher has identified future school infrastructure projects, including to construct a greenhouse which he estimates will cost 200,000 KZT.

Shalabay School also houses seven bee hives, which they have owned for the past five years (Photo 4.13.7). The head teacher and bee keeper report that the hives collapsed during a severe winter two years ago and that Polymetal spent 115,000 KZT to rescue and revive them. They also report that the bees forage for nectar on a 5km radius from the school and that the programme has attracted attention from across the oblast, including from Shalabay LLP, which is in the process of launching a 50-hive operation to enhance pollination of their sunflowers and to start a honey selling operation.

Although the maximum capacity of Auezov School (Photo 4.13.8) is 500, it can run in double shifts (7am to 1pm, 13pm to 19pm) if the settlement's population were to increase as a result of the Project's further development. This configuration was the norm when the mine was in operation during the 1990s and the school had over 1,200 enrolled students. Similarly, the head teacher of Shalabay School reports that the maximum capacity of the school is around 255 students per shift and that the school could also revert to a shift system, should enrolment numbers rise as a result of the Project's development.

Both head teachers report that family problems are occasional barriers to educational attainment, including unhelpful or abusive parents. In addition, the head of Auezov School is hopeful that a kindergarten will be built and opened by next year, offering children aged 2-5 the chance to attend and freeing up their mothers to enter the job market. The head of Shalabay School is particularly proud of the school's academic and extracurricular accomplishments, which include victories in national competitions for projects related to ecotourism as well as for their bee hives.

Photo 4.13.7: Hives and Beekeeper at Shalabay School. The Hives Were Sponsored by Polymetal and, Apart From their Educational Value, Served as a Model for Shalabay LLP Farm's Investment in Bees and Honey Production

Photo 4.13.8: Auezov School Interactive Classroom, Recently Funded by the State of Kazakhstan

4.14 Economy, Livelihoods, Incomes and Vulnerable Groups

Since independence, Kazakhstan has carried out a wide range of economic reforms that, together with liberal trade policies, have attracted international investment and encouraged rapid growth in recent years. As a result, Kazakhstan now has the largest economy in Central Asia. Its workforce is estimated to be 8.7 million people and over half of these (51%) are employed in the services and tourism sector; 32% work in agriculture, 18% work in industry. In the years since independence, Kazakhstan has attracted USD $150 billion of foreign investments, equating to around 70% of the total amount of all investments attracted to Central Asia.

Kazakhstan has proven hydrocarbon reserves of between 9-29 billion barrels, while natural gas reserves are estimated at 2 trillion cubic metres. It also has the world's largest reserves of barite, lead, tungsten, and uranium; second largest reserves of chromite, silver, and zinc; third largest of manganese; and significant deposits of copper, gold, iron ore, and rare-earth metals. Kazakhstan is rich in mineral resources, with 30% of world reserves of chrome, 25% of manganese, and 10% of iron ore, according to official estimates. Kazakhstan is now the world's leading producer of uranium and third largest producer of chrome[4]. Reserves of copper and lead zinc are respectively 10 and 13% of global reserves. Kazakhstan is also richly endowed with bauxite, coal, phosphate, titanium, and tungsten.

The service sector, including tourism, represents the national economy's largest sector (55% of GDP), followed by the extractive industry (35% of GDP). Agriculture (7%) is the economy's third largest sector and is based on increasingly mechanised livestock breeding across more than 165 million ha of pastures, although the sector also produces wheat, barley, corn, millet, cotton, vegetables, sunflowers, and mustard.

The leading industry in East Kazakhstan is mining. Other leading industrial areas in the region are mechanical engineering, metalwork, forestry, the food industry, electric power, and agriculture. Gross regional product has grown from 615.1 to 1,070 billion KZT during 2006 to 2010 (Table 4.14.1).

[4] Austrade http://www.austrade.gov.au/Mining-to-Kazakhstan

Table 4.14.1: East Kazakhstan Industrial Statistics, from Regional Passport							
Index	**Units**	**2006**	**2007**	**2008**	**2009**	**2010**	**% Kaz**
Gross regional product	bKZT	615.1	800.5	890	983.7	*1070*	5,9
Industrial output	bKZT	410.1	481.1	469.5	492.1	*624.2*	5,3
Gross volume of agriculture	bKZT	80.3	98.5	110.2	165	*151.2*	10,5
Foreign trade turnover	$ mill	2535.9	3385	3140	2700	*2988.1*	3,9
Capital investment	bKZT	116.1	126.5	161.4	133.4	*150.9*	3,3
Small businesses registered	units	10668	11232	11786	12006	*12096*	5,9
Small businesses active	units	7662	7891	6998	7482	*7308*	5,8
Volume of own yield income	bKZT	34.2	43.4	42.5	42.2	*45.4*	1,5
Average monthly wages	KZT	33101	42138	48293	53496	*61433*	79
General unemployment rate	%	6.9	6.6	6.4	6.4	*5.4*	-0,1
Consumer price index	%	107.5	116.1	110.5	105.7	*108.1*	0,3
Italicised are Figures Predicted for 2010 Passport Data.							

Project Care & Maintenance (1998-present)

In 1998, the Project took on Care & Maintenance status, providing employment for roughly half of the 1,000 workers it employed during its active years. During the past 17 years, in Auezov the local population dropped from 7-8,000 inhabitants to the present-day figure of just under 2,800. The current Akim reports that the Project has always been a vital employer in the settlement, providing employment for builders, miners, geologists, and administrators. Many of these workers left when the mine closed, although some decided to stay in the settlement whilst taking on shift work elsewhere, meaning they would be away for several weeks before coming back for their subsequent weeks off. The elderly, teachers, and shift workers have made up the majority of residents during the Project's Care & Maintenance period.

Although this change had important social consequences in Auezov, in Shalabay the consequences were reduced by the simultaneous opening of Shalabay LLP, a cattle breeding farm which currently employs 140 workers. Some Shalabay residents worked in the mine and were subsequently made redundant, though Shalabay Akimat reports they were for the most part able to find employment elsewhere and thus the size of the local population remained relatively stable.

Likewise, the head of the school in Shalabay reports that the Project entering Care & Maintenance did not have much of an impact on Shalabay because of the local population's skill type, which is focused on supporting the Project's operations in the form of security or maintenance of electricity and other utilities. When the Project's staff numbers were diminished, these workers were deployed at Shalabay train station instead.

Employment Opportunities and Taxes

Shalabay Akimat officials report that the municipality houses a variety of employment opportunities, including 16 farms, the healthcare centre, school, Akimat, railway station, shops, and a meteorological station. The largest local employer is Shalabay LLP farm.

The Akimats of both settlements report that Kazakh income tax is 20%, of which half feeds into the government pension fund and the other half is reserved for government services, including for maintenance of roads and other social infrastructure. Tax rates rise according to salary. Pensions, provided from the age of 55-65, are roughly equivalent to the monthly salary earned by each individual.

Unemployment rates across the district are very low, largely because most people who do not work are subsistence farmers and are not officially registered as unemployed. According to district-level officials, around 13,000 of Zharminsky District's roughly 44,000 population is of working age and, of these, fewer than 200 are registered as unemployed and subsequently receiving state benefits.

Entrepreneurship and Local Shops

Auezov and Shalabay have a number of shops, owned by local and city-based entrepreneurs and run on a daily basis by hired shopkeepers. District-level officials report that being a shopkeeper has a number of incentives, including low taxes and frequent sales.

A structured survey of a representative sample of shopkeepers in Auezov and Shalabay was conducted (Photo 4.14.1). All the shopkeepers that were interviewed did not own the shops but, rather, worked there in shifts, often alongside one or two other shopkeepers. Typical shifts are either short-term, such as two-days-on-two-days-off, or longer-term, such as thirty-days-on-twenty-days-off. Typical working hours were reported to be 9am to 9pm.

Shopkeepers report a variety of shopping habits amongst the local population, although consistently busier times are in the evening (after work) and at the end of the month, when residents receive their salaries and pensions. Summers are busier than winters. A majority (>90%) of customers purchase goods on a credit basis, where their purchases are recorded and paid for collectively at the end of the month. Very few customers fail to pay their debts and several shops have a policy of not offering credit purchases to unemployed residents, though anecdotal evidence suggests that in practice this rule is overlooked.

All the shopkeepers interviewed reported that their stocks come from either Semey or Ust-Kamenogorsk by car, taxi, or privately hired vehicles. Privately run pickup services are economically beneficial to owners, who are often given a discount by wholesale companies if they arrange transportation of goods themselves. Wholesale market 'Myzy' in Ust-Kamenogorsk supplies all but

two of the shops we surveyed; to that end, shopkeepers report that most of the variation in prices at their shops over time depends on fluctuations of Myzy's wholesale prices.

Observed prices for grocery products in June-July 2015 were: bread (50-55T); milk 1L (300 KZT); sugar 1kg (190 KZT); toilet paper roll (30 KZT); coffee – medium box (280 KZT); coffee – Nescafe (650 KZT); tea – medium box (230-270 KZT); fruit juice 1L (160-300 KZT); mixed meat for soup (280 KZT); chicken – small but best quality (620 KZT); chicken – large but worse quality (510 KZT); manti dumplings (500 KZT); toothpaste (374T); bar of soap (185T); fermented horse milk 1.5L (600 KZT); bottle of vodka 0.75L (945T). Prices at the local toyshop were: action figure (1,450 KZT); Barbie-type doll (2,250 KZT); toy cars – small to large (600 – 3,000 KZT); bicycle – small to large (12,500-38,000 KZT). Prices at the Auezov clothes shops were: women's shirt (3,000-3,500 KZT); outfit for young girl (1,600 KZT); dress (2,500-3,000 KZT); pair of shoes (2,800 KZT). Prices were similar across the shops we surveyed, though the same products were slightly more expensive in Auezov.

Bread destined for the Auezov market is manufactured by a local bakery, which shopkeepers report is on the brink of closure because the owners want to move to Ust-Kamenogorsk. One more local bakery operates in Shalabay and could supply Auezov if need be.

Apart from supermarkets and food shops, Auezov also has a toy shop and a small 'mall' with stalls selling articles of clothing. The toy shop is relatively new and was set up to sell toys that were previously sold in a supermarket belonging to the same owner. It also sells a selection of toiletries (~20% of their products). The shopkeeper at the toyshop reports that sales of items relating to outdoor activities are often seasonal, such as bike sales peaking in the summer and ice skates in winter. To that end, Polymetal's sponsorship of the local ice rink has drastically increased the market for skates and the shopkeeper reports that she is hopeful the company may build a roller skating rink to create a parallel summer market for skates. The shopkeeper at the toyshop report that the price of goods has always gone up in recent years, especially for 'luxury items' such as toys, which she reports have risen in price by 20% over the past three years. Shopkeepers in the clothing 'mall' similarly report that prices have gone up for their products and that, at the same time, sales have dropped over the past three years.

Photo 4.14.1: Typical Shops in Auezov, including a Supermarket (top) and Toy Shop (bottom)

Shalabay LLP farm

In Shalabay, the largest employers are Shalabay LLP farm and the railway station. Shalabay LLP, as it is today, was founded in 2005, even though the original farm existed until bankruptcy in 1996, and is the largest land owner in the area, owning 35,000ha around Shalabay settlement. In addition, the farm recently bought another farm around 150km away, to be restored and launched as an additional branch of the Shalabay LLP operation, with the potential to hire another 15-150 people.

The current Financial Director of the company was the Akim of Shalabay before she secured an investment from a wealthy Shalabay-born business man now living elsewhere. In 2005, the farm employed 6 people whereas now there are 150 employees (90% male). The farm specialises in breeding cattle of the Kazakh white variety, currently owning 3,000 head of cattle after starting with 150 cows and 5 bulls. The farm also keeps sheep (2,000) and horses (500). In addition, the farm has opened a second branch in the Almaty region, which today houses 1,500 head of cattle.

Kazakh white cattle are of important regional significance, sold alive to local farms for breeding but also to other regions within Kazakhstan. Its meat stands out, according to farm workers, because it is particularly tasty and marbled. One-year-old bulls or cows are sold for 300-350,000 KZT each.

Shalabay LLP farm also grows crops, in particular grains and sunflower, as well as grass for the livestock to graze upon. Shalabay LLP has no formal agreement with Polymetal but it has an agreement with Shalabay Akimat about the development of social programmes; for example, the farm pays for additional snow ploughing services on the streets of Shalabay and Auezov, provides the local population with hay for livestock, as well as jointly financing the construction of a local ice hockey rink.

In 2014, in order to increase the harvest of sunflowers, Shalabay LLP bought 50 bee hives, which today have a 6km pollination radius. The hives are relocated regularly according to which crops need pollinating around the farm. In addition, the bees produced 30L of honey in their first year, which is being sold in the local shops and which WAI was told is very popular. Shalabay LLP leadership is hopeful that the honey business will grow quickly in future years. Shalabay LLP management reports concerns that its staff might be tempted to join the mine if jobs become available at the Project. However, they also express optimism that the Project would grow the local economy and thus also create a larger local market for the farm's products.

In Shalabay, local farm Shalabay LLP owns its own supermarket, which it uses to advertise and sell its products to the local market. Shopkeepers there report that their business is largely unaffected by changes at the Project, including recently when Polymetal arrived. They report selling between 100-120 loaves of bread (50-55T) each day but almost never meat, although anecdotal evidence and observations suggests a number of clients purchase sausages. The availability of some basic foodstuffs, such as eggs, fluctuates depending on deliveries.

Supermarket shopkeepers in Auezov report that their prices are considered relatively expensive for the district and even the oblast, estimated at around 10-20% higher than in Ust-Kamenogorsk, which is why residents tend to purchase only essentials from them. They also report that price differences between shops are often exaggerated and that they all mostly have the same prices, since items are sourced from the same wholesale market.

Overall, shopkeepers reported that they expect business to increase if the Kyzyl mine reopens. Some have already noticed an increased number of foreign visitors in the settlement to meet with Polymetal; these visitors purchase juice, tea, and chocolate as souvenirs but, unlike the local population, rarely alcohol.

Vulnerable Groups

In the context of extreme climatic conditions in the project study area, coupled with the predominantly low income generating profile of the population in Zharminsky District, much of the local population could be classified to a greater or lesser extent as vulnerable. The socio-economic profile of Auezov remains under-developed and the settlement, which was built to support the mine, relies on mining operations for much of its direct and indirect employment. At the same time, it is these factors that have increased the resilience and coping strategies of the rural communities. Coping strategies have contributed to the development of a cohesive community culture. In general, this tends to manifest in: a collegial approach to tasks; a more communal attitude towards material possessions; a relative absence of anti-social behaviour and criminal activity; a respect for the elderly; and, a sense of collective responsibility for the infirm and for child welfare.

Notwithstanding these coping strategies, the residents of the Zharminsky District remain particularly vulnerable for a number of reasons; due to the settlement's relative geographic isolation from a significant urban centre, its comparatively poorer social infrastructure, and its relatively limited range of livelihood opportunities at the current time. It may also be the case that due to the distance from Kalbatau, local people have reduced access to social welfare reflecting the fact that people do no travel to Kalbatau to officially report themselves as unemployed. The official unemployment rate in Kazakhstan measures the number of people actively looking for a job as a percentage of the overall labour force.

Project impacts associated with physical and economic displacements at Auezov have created a small group of people that is particularly vulnerable, especially where people have experienced impacts on their livelihoods. Women, children, seniors and disabled people can in general be identified as the most prevalent vulnerable groups in Auezov and Shalabay. Employment opportunities for women are historically limited in the Project area and broader Zharminsky District. District-level officials report that women largely work in the educational and cultural realms whereas men work in industry. Anecdotal evidence suggests that earnings are similar between the genders.

Auezov's Women's Union (WU) reported that it invites members from what are perceived as 'good families' to join its ranks, bringing them together to solve problems and come up with solutions for younger people with relationship issues. The WU does a lot of work helping divorcing couples to reconcile their relationship; as a result, divorce rates in Auezov are relatively low, including only one instance of divorce over the past year.

The WU and other residents in Auezov and Shalabay report that the lives of women may sometimes be very difficult, especially as a result of physical and mental abuse from husbands under the influence of alcohol. Elders and WU representatives report that only extremely violent cases get reported to the police and are taken further to the district court, and female residents report having nowhere to go aside from the police should they need physical protection.

Shalabay Akimat reports that women are well represented in local society. Currently, Shalabay's Akim is female, as is the head doctor at the hospital, several teachers at the school, the head of Shalabay LLP, as well as several other shop owners.

Impact of Mine Reopening

On a district level, the reopening of the mine is welcomed by officials, who report that the Project would have only positive impacts, including: the creation of new jobs, higher and more stable salaries, increased income for the municipality in the form of taxes, higher production volumes for local and regional companies, a more developed social sphere with improved social infrastructure and opportunities, higher outside investment in the region, and a generally more positive outlook for residents of the area.

District-level officials also predict an employment shift from agricultural to industrial sectors. This is confirmed by the founder and CEO of Shalabay LLP, the largest employer in Shalabay, who reports being worried that the mine reopening might entice farm workers to leave their jobs and move over to work for the Project. In the broader village of Shalabay, the Akimat reports hopes for further job creation should the Project mine reopen. As a result, the Akimat predicts that the local population might grow, in particular if BMV workers would wish to build houses in Shalabay to get further away from the noise from the mine. Officials and residents report a general worry about dust and noise from the open pit and from trucks associated with the mine.

Shalabay and Auezov Akimats report attending and hosting all the hearings relating to the reopening of the mine, and that these meetings have generally been helpful during the pre-construction phase of the project. In Shalabay, 50-60 residents generally attend the meetings, including the village elders who speak on behalf of citizens that are unable to attend. In Auezov, 150-180 residents attend each meeting.

In terms of the health of citizens, the head doctor of Auezov healthcare centre, based on her experience working at the centre throughout 13 years when the mine was in operation and 17 years

of it in Care & Maintenance, is unsure whether the 'professional illnesses' – illnesses she thinks were caused by mining activity, she witnessed during the mine's operating years would reappear, were the mine to reopen. According to her, these illnesses, including bronchitis and other breathing problems, may be reduced or avoided altogether as a result of the advanced technologies used by mining operations today. Likewise, the head doctor at Shalabay hospital reports to have attended all the public consultations and is hopeful that Polymetal's promises to minimise public health risks from the Project are carried out.

Shopkeepers report that sales would increase if the mine reopens. In addition, they express hope that an increased number of permanent positions at the mine would mean that people would permanently move to Auezov and nearby settlements rather than coming there just for shift work.

Overall, members of the Auezov and Shalabay populations report a feeling of apprehensiveness around the reopening of the mine, since so many companies have owned the Project in recent years. They report that they expect a better life from any development of the Project, though many are aware the processes leading to positive change are slow.

4.15 Land Use, Tenure, Acquisition, Physical Displacement and Economic Displacement

4.15.1 Land Use

The total land area in East Kazakhstan is 283,300 km^2 (10.2% of total Kazakhstan area) and in Zharminsky District is 23,400km^2. The region comprises steppe grassland, deserts, as well as mountain and taiga biomes. The northern and eastern boundaries of the region contain the foothills of the Western, Central, and Southern Altai mountains, which are notoriously high in content of nonferrous, precious, and rare earth metals content. The Arid Zaisan hollow is located to the south of the Altay Mountains, which borders on the Saur-Tarbagatai ridge to the south. The south-western and western borders of the region comprise small hills, whereas hilly plains (Kalbin Mountains) dominate the region's central portion. 11.9% of the region is forested, often dark coniferous forest located along the Altay Mountains. The region also contains deciduous and mixed forests as well as pine towards the north-western borders.

According to official statistics, East Kazakhstan's gross agricultural production was 229.8 billion KZT. The region's agricultural production can be divided into the breeding of livestock and the growing of crops. In 2012, the region's farms produced 224,100 tonnes of meat, an increase of 4.5% over 2011 figures. Similarly, production of milk (739,000 tonnes, +2.2%) and eggs (135.5 million units, +77.2%) was also up from 2011 figures. Total livestock counts also increased from 2011 to 2012, including for cows (+6.9%), horses (+2.9%), and poultry (+10%). Major farms in East Kazakhstan are the Kamyshenskoe, Agrofirm Prirechnoe, Begration, Plemzavod Kalbatau JSC, Antropov BI, Belovodye, Glubochanka, E. Zaytenov, Katan-Karagai deer park, Vydrikhinskoe Ltd, SN Dudkin, Gemma, Yakb, and Zhas Kanat farms.

According to official 2012 figures, East Kazakhstan contains 1,218ha of land used for agriculture, up 3.4% from the previous year. Of this area, 543,400ha are designated for cereal and leguminous crops, 360,300ha for olive cultures, 23,600ha for potatoes, and 8,800ha for other vegetables. An additional 262,600ha of land is designated for livestock feed, up 25% from 2011 to 2012, with the production of 2,041,000 tonnes of hay. Agricultural crops were chemically treated against weeds on 264,000ha and on 168,800ha against plant pests. The region's gross grain output was reported to be 580,000 tonnes.

Drawing 4.12.4 shows land use around the Project area in terms of social activities such as fishing, hunting, and foraging.

Acquisition

Polymetal's legal team reports that all the necessary land for the project has been secured on a long- or short-term rental basis, and that all necessary paperwork and agreements between the local Akimat administration and Polymetal have been completed.

In 2014, Polymetal acquired 25 houses and a disused petrol station, all located along one road partly within the Project's designated SPZ area. A total of 68 registered residents were affected by the process, which Polymetal reports was carried out fairly and commensurate with Kazakhstan's law. During the July 2015 survey, 12 households still lived in the acquired houses, with permission from Polymetal, whereas the remaining 13 have already moved out.

WAI have not been involved in the relocation process; however relocations were carried out in accordance with Polymetal's Household Relocation Plan.

WAI found during interviews that residents' overall satisfaction around the compensation process varies greatly. Of the nine households surveyed (including a shopkeeper interviewed separately), three were overall satisfied with the process and outcome. The remaining six expressed concerns around the process, or the practical aspects of their forthcoming move.

The interviews suggest that the displacement may affect the livelihood of some residents, e.g. moving from a house with a garden to an apartment without a garden, or shifting from subsistence living to seeking employment in an urban setting.

Local Area Land Use and Herding

The predominant land use within the licence area is steppe grassland used for summer grazing, typical of the wider East Kazakhstan region. The soils are generally shallow, nutrient poor and the vegetation is subject to a relatively short growing season. They are black earth and chestnut soils that have been cultivated since the Soviet times.

In Auezov or Shalabay, purchasing land requires a formal application to the municipal Akimat, which lists the desired purpose for the land. Upon submission, the application is passed on to the district level Akimat in Kalbatau, where it is reviewed. If permission is granted, a land allotment is granted, environmental checks are carried out, and the plot is initially leased out for 2 years before it may be subsequently purchased.

Adult cows, sheep, and horses are generally assigned to herders, who care for and oversee the animals during the day as they graze on fields in the local countryside. Cows are picked up from their owners at 5am by herders and spend the day grazing near the settlements of Shalabay and Auezov, before being brought back each evening at 7pm (Photo 4.15.1). Sheep are taken to Zhanaaul for the entire grazing season. Calves roam freely in both Auezov and Shalabay. Each spring, both municipality Akimats hold a meeting where stakeholders are assembled, including Akimat representatives, herders and animal owners. These hearings determine the price per animal for the upcoming season, responsibilities and liabilities, as well as assigning a herder to each animal and a territory for each herder. Like other residents, herders live in houses in Auezov, Shalabay, or Solnyechni.

Shalabay has 3 official herders, responsible for 200-300 animals and earning monthly wages of 600 KZT per head of cattle and 350 KZT per head of sheep. In Auezov, interviews and official administrators report that monthly herder prices are 1,000 KZT per head for 4 official herders. Fees are paid by animal owners directly to the herder, without the Akimat taking any commission. The Auezov Akimat reports that unofficial herders, in other words those who are not registered at the annual meeting, do not exist.

Herders report a strong connection to the animals they are responsible for as well as to the land they use. However, the herders interviewed in June-July 2015 were mostly relatively new to the profession, with one having only become a herder in the past year after a long career as a driller.

Herders also report that their job is physically very demanding both on them and on their horses, with one herder reporting that his only horse has to work every day of the summer. In addition, interviewed herders all reported earning less than needed to properly feed their families and animals.

Auezov residents frequently report using state-owned land surrounding the settlement for growing vegetables or as grazing territory for animals (Photo 4.15.3). The existence of these 'unwritten rules' on a social level, which are not commensurate with Kazakh national legislation, is confirmed by the Akim, who reports that residents may use public land for agriculture even if they do not own it, especially if it is near their house. If they need even more land, they can request permission to use state owned land from the Akimat, often without paying a fee.

In Shalabay, most agricultural land is owned by Shalabay LLP, which the local Akimat reports has seeded 3,000ha of land, mostly with sunflowers and wheat to feed the animals as well as wheat used for human consumption. Shalabay residents also grow potatoes and hay to feed livestock.

The district Akimat reports that around 65% of Zharminsky District's population owns and 'ogorod' (Photo 4.15.1), or vegetable garden, where they grow vegetables for their own consumption and also to sell to neighbours and at local markets.

Photo 4.15.1: Local Residents Collect their Animals from the Herder at the End of a Day

Photo 4.15.2: A Vegetable Farm 'Ogorod' in Auezov. Ogorods Represent a Major Source of Subsistence for Local Residents

Photo 4.15.3: State-owned Grassland in and Around Auezov Covered by Snow During Winter

4.15.2 Public Attitudes and Perceptions of the Project

The general perception from stakeholders indicates that people are very positive of the project and feel that, if it is developed appropriately, it will have major economic benefits. Local elders report that only older and disabled residents of Auezov tend to stay in the settlement to start their families, whereas younger people move to bigger cities in search of educational and regular employment opportunities.

A sizeable number of household survey respondents were not aware of any of the details about the proposed Kyzyl mine. In particular, residents and local herders were not aware of which areas, including those currently sometimes used for herding, are due to be fenced off when the Project develops further. Public consultation undertaken to date has shown that local residents, especially those from Auezov, are very interested in knowing how the Project develops.

Residents of Auezov and Shalabay, including Solnyechni and Zhanaaul, have quite high expectations of the Project in creating direct and indirect employment opportunities for local people. Some local residents perceive that there will be environmental and social risks associated with the Project, including how the development might affect their water quality, the air quality, and through noise pollution. Concerns were also raised regarding the resettlement process and compensation provided for impacts associated with physical and economic displacements.

From the perspective of employment, local people have aspirations that if the Project develops it will provide a more stable source of employment. Consultation during June-July 2015 highlighted the expectations of local people that the development would improve local facilities in Auezov, including through additional water pipelines and the improvement of local roads and their maintenance regime. During interviews, the district-level Akimat and Akims of Auezov and Shalabay were all supportive of the Project, inferring that the employment opportunities would be highly beneficial for the local area. The Akim and other officials, as well as local residents, stated that the main concerns people in Auezov had related to creation of dust and noise from activities on site.

Whilst Polymetal are actively engaging with local people regarding the overall development, there is a clear need to increase the current level of engagement: many stakeholders interviewed during surveys were not aware of important project details.

Polymetal established a grievance mechanism (Photo 4.15.,Photo 4.15., and 4.15.6) in 2015 that currently operates from the office of the Auezov Akimat and the Project site and in the Akimat's office in Shalabay. The mechanism is commensurate with recommendations found within IFC PS1 (articles 2, 25, 34-35), PS2 (20, 26), PS4 (12), and PS5 (11). In addition, Polymetal continues to organise and attend grievance meetings at Auezov Akimat, in the presence of the Akim, where company representatives answer questions and propose mitigation strategies in front of local residents.

WAI observed a grievance meeting in July 2015, aimed at dealing with grievances regarding new payment systems for water for public gardens and private 'ogorod' vegetable gardens. The meeting featured two administrators from the Akimat, the Akim, Polymetal's General Manager, and 12 citizens (3 men, 9 women), and lasted approximately 2 hours.

Village elders report that, compared with previous companies, Polymetal has been more communicative and transparent with the local population but that, in the end, most residents of Auezov and Shalabay are indifferent about which company takes over the Project and are mostly concerned with the creation of jobs and development of the local economy. Polymetal continues to conduct its community relations according to a Stakeholder Engagement Plan, which identifies key stakeholders and actions as the Project develops.

Photo 4.15.4: Polymetal Bulletin Board Displaying Relevant Information and News about the Project, Located Outside Auezov Akimat

Photo 4.15.5: Polymetal Grievance Box, Located at the Main Entrance of Auezov Akimat

Photo 4.15.6: Polymetal Grievance Box, Located at the Main Entrance of the Project Site

Appendix 4.8.1: SW Stage Data

Table xx Surface Water Monitoring Locations

No	Corresponding Stream	Description of Location	Easting and Northing		Elevation	Date of Measurements										
			x	y	z	10/06/15	17/06/15	24/06/15	26/06/15	27/06/15	01/07/2015	08/07/15	17/07/15	22/07/15	29/07/15	05/08/15
						Stream Stage (mASL)										
1	Mayranbastau	Mayranbastau brook, the mouth;	539,587	511,893	389			388.74	388.73		388.73	388.71	The residents built a dam upstream of the gauging location, which has modified the stream stage artificially			
2	Mayranbastau	Holodniy Klyuch brook, the mouth;	537,060	507,946	346.9			346.38	346.38		346.38	346.36	346.36	346.35	346.35	346.34
3	Akbastaybulak	Akbastau brook, upstream section line, the sources;	541,406	512,659	418			417.59	417.41		417.59	417.59	417.59	417.59	417.57	417.57
3a	Akbastaybulak	Akbastau brook, downstream section line, the mouth;	541,355	511,105	398			397.41	397.41		397.41	397.4	397.4	397.4	397.4	397.38
4	Zhumataybastau	Kyzyltu brook, upstream section line, the sources;	543,079	513,394	436			435.11	435.65		435.64	435.65	435.65	435.63	435.63	435.63
4a	Kyzyltu	Kyzyltu brook, downstream section line, the mouth;	541,544	511,108	390			349.65	389.14		389.13	389.08	389.06	389.05	389.05	389.04
5	Akbastaubulak	Akbastaubulak brook upstream of the road Auezov-Shalabai and discharge from wastewater treatment facility;	540,269	508,859	371			370.27	370.21		370.24	370.32	370.25	370.22	370.2	370.19
6	Akbastaubulak	Akbastaubulak brook, downstream of the discharge from wastewater treatment plants;	537,092	507,665	344	343.63	343.59	343.6	343.58		343.57	343.5	343.46	343.44	343.44	343.46
7	small brook near Auezov	brook №1 with no name in Auezov village, the mouth;	540,711	508,397	382				381.35		381.33	381.32	381.32	381.33	381.31	381.3
8	Alaaygyr	Alaaygyr brook, upstream section line;	547,327	505,988	428	427.5	427.47	427.49		427.52	427.51	427.46	427.47	427.49	427.48	427.48
9	Brook No 2	brook №2 with no name left-bank tributary of Alaaygyr brook, the mouth;	547,327	505,688	429			428.44		428.43	428.42	428.41	428.4	428.39	428.37	428.36
10	Brook No 3	brook №3 with no name right-bank tributary of Alaaygyr brook, the sources;	545,514	508,282	434.375			433.925		433.905	433.915	433.915	433.912	433.911	433.908	433.906
11	Brook No 3	brook №3 with no name right-bank tributary of Alaaygyr brook, the mouth;	544,945	506,768	406			405.58		405.58	405.58	405.56	405.56	405.54	405.54	405.52
12	Alaaygyr	Alaaygyr brook, upstream of the reservoir;	545,305	506,490	408			407.42		407.43	407.42	407.4	407.38	407.35	407.35	407.34
13	Alaaygyr	Alaaygyr brook, the mouth;	538,831	503,624	353			352.62		352.72	352.59	352.58	352.61	352.57	352.59	352.57
14	Kysylsu	Kyzylsu river near Shalabai village	536,971	507,794	345.2			344.94	344.91		344.89	344.9	344.86	344.82	344.79	344.76

Appendix 4.8.2: Water Quality

Appendix 4.8.2 – Bakyrchyk Groundwater Quality Data - July 2015.

The parameter, mg/dm3	MPC	The value of the parameter at the point control (mg/l)								
		1H	**2N.**	**3H**	**4H**	**5H**	**6N.**	**7N.**	**9N.**	**10h**
The level, m		2.88	2.73	5.03	1.98	1.16	3.36	15.93	3.03	0.99
The PH		7.37	7.40	7.65	7.50	7.72	7.53	7.54	7.22	7.36
BOD5		3.50	3.42	3.39	2.63	2.30	1.93	1.95	2.83	2.78
GVA total, mg-equiv/dm3										
TDS (Dry balance)		1575,0	1563,0	1247,0	1097,0	361.0	989.0	247.0	1427,0	1107,0
bicarbonate		305.1	207.47	213.57	231.88	207.47	170.86	207.47	457.65	445.45
Carbonates		0	0	0	0	0	0	0	0	0
Sulphates	500	**770.9**	**803.8**	**610.8**	490.6	97.9	162.6	35.0	508.3	374.1
Chlorides	350	46.67	51.53	41.51	32.64	8.59	32.64	4.58	86.46	54.97
Nitrates	45	11.00	12.00	8.40	2.50	2.45	**220.0**	3.80	1.25	3.00
nitrite	3.3	0.125	0.425	0.012	0.015	<0.002	<0.002	<0.002	<0.002	<0.002
Ammonia and ammonium ions	2.6	0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05
Synthetic surfactants		0.067	0.036	<0.025	0.049	0.054	0.063	0.040	0.036	0.062
Petroleum products		<0.02	<0.02	<0.02	0.03	0.03	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.0533	0.0138	0.0201	0.0091	0.0239	0.0730	0.0028	0.0085	0.0146
Cadmium	0.001	0.0005	0.0008	0.0004	0.0005	0.0005	0.0007	0.0009	0.0005	0.0007
Manganese	0.1	0.0137	**0.3192**	0.0282	0.0135	0.0025	0.0133	0.0005	**0.5305**	0.0033
Copper	1.0	0.0019	0.0047	0.0029	0.0024	0.0008	0.0007	0.0002	0.0004	0.0008
Arsenic	0.05	0.0067	**0.0654**	0.0043	0.0077	0.0076	0.0102	0.0330	0.0057	<0.001
Selenium	0.01	0.0023	<0.001	<0.001	0.006	0.0035	0.0032	<0.001	<0.001	<0.001
Lead	0.03	0.0010	0.0007	0.0008	0.0014	0.0021	0.0003	0.0017	0.0028	0.0026
Strontium	7	2.4068	2.1934	1.8603	2.2616	0.7006	1.2965	0.4193	2.1664	1.4153
Fluoride	1.5	0.10	0.14	0.16	0.20	0.39	0.22	0.40	0.62	0.82
Zinc.	1.0	0.0001	0.0032	0.0054	0.0099	0.0027	0.0045	0.0032	0.0027	0.0047
Potassium		7.0	7.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		273.5	258.0	236.5	209.5	89.5	177.5	60.5	240.0	157.0
Magnesium		75.5	71.5	42.0	43.0	16.5	25.5	16.0	57.0	60.5
Sodium		129.5	128.5	110.5	85.0	23.5	46.5	18.5	163.0	148.0
Sukhoi Design Bureau (100 ml)		16.6	16.6	10.0	6.6	3.3	16.0	8.0	10.3	2.3

Note: MPC : Maximum Permissible Concentration

The parameter	MPC	The value of the parameter at the point control (mg/l)								
		11h	**12h**	**13h**	**14h**	**15h**	**16h**	**17h**	**18h**	**19h**
The level, m		16.21	6.89	4.88	13.19	3.52	8.32	5.56	2.07	20.38
The PH		7.60	7.06	7.82	7.76	7.62	7.63	7.38	7.32	8.05
BOD5		1.02	0.32	0.34	1.93	1.98	1.02	1.04	0.31	0.32
GVA total, mg-equiv/dm3										
Airborne substances		6.0	<3.0	26.0	220.0	31.5	74.0	77.5	18.0	11.0
Dry balance		270.0	259.0	277.0	338.0	412.0	571.0	1084,0	1068,0	267.0
bicarbonate		122.04	195.26	189.16	170.01	164.75	183.06	189.16	195.26	170.86
Carbonates		0	0	0	0	0	0	0	0	0
Sulphates	500	88.1	52.3	72.2	102.4	140.3	493.1	482.0	450.3	457.3
Chlorides	350	4.29	2.58	3.72	5.20	16.60	4.87	57.26	88.70	5.28
Nitrates	45	6.20	1.00	2.00	7.0	9.50	21.6	16.00	8.60	8.50
nitrite	3.3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ammonia and ammonium ions	2.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Synthetic surfactants		<0.025	0.032	0.027	0.028	0.034	0.069	<0.025	<0.025	<0.025
Petroleum products		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.0036	0.0021	0.0091	0.0138	0.0143	0.0298	0.0111	0.0049	0.0077
Cadmium	0.001	0.0007	0.0005	**0.0011**	0.0007	0.0006	0.0006	0.0009	0.0009	0.0008
Manganese	0.1	0.0006	0.0005	0.0194	0.0030	0.0012	0.0014	0.0007	0.0031	0.0018
Copper	1.0	0.0011	0.0009	0.0001	0.0040	0.0009	0.0004	0.0002	0.0003	0.0032
Arsenic	0.05	0.0101	0.0066	0.0173	0.0042	0.0019	0.0075	0.049	0.0440	0.0051
Selenium	0.01	0.0025	<0.001	0.0078	<0.001	0.0033	0.0024	<0.001	<0.001	0.0013
Lead	0.03	0.0019	0.0020	0.0028	0.0082	0.0032	0.0030	0.0028	0.0034	0.0027
Strontium	7	0.4795	0.4116	0.5899	0.7270	0.6224	1.0138	1.5266	1.6887	0.5168
Fluoride	1.5	0.65	0.36	0.80	0.42	0.26	0.45	0.12	0.10	0.60
Zinc.	1.0	0.0063	0.0018	0.0014	0.0075	0.0017	0.0024	0.0048	0.0031	0.0098
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		59.0	71.0	71.0	80.0	80.0	130.0	222.5	215.0	63.0
Magnesium		8.5	9.5	10.5	12.0	17.0	18.0	41.5	35.0	8.5
Sodium	200	26.0	21.05	29.0	30.5	40.5	45.0	64.5	78.5	27.5
Sukhoi Design Bureau, some in 100 ml		7.6	15.0	21.0	2.0	6.3	7.3	7.0	11.0	6.0

Note: MPC : Maximum Permissible Concentration

The parameter	MPC	The value of the parameter in the control point (mg/l)										
		7p.	**8p.**	**9p.**	**10P.**	**11P.**	**15P.**	**16P.**	**17P.**	**18P.**	**19P.**	**20P.**
The level, m		4.74	5.98	1.58	1.66	13.15	12.59	3.71	8.40	5.68	4.86	0.86
The PH		7.57	7.50	7.48	7.46	7.74	7.56	7.60	7.65	7.15	7.80	7.52
BOD5		0.34	0.36	0.42	0.43	0.38	0.61	0.82	0.98	0.34	0.33	0.40
GVA total, mg-equiv/dm3												
Airborne substances		<3.0	<3.0	248.0	250.0	123.0	224.0	11.0	114.0	8.0	3.0	5.0
Dry balance		316.0	310.0	560.0	550.0	222.0	342.0	198.0	622.0	260.0	295.0	230.0
bicarbonate		250.18	242.04	384.43	370.95	146.45	173.91	79.33	183.06	207.47	189.16	158.65
Carbonates		0	0	0	0	0	0	0	0	0	0	0
Sulphates	500	54.3	52.3	116.1	110.0	44.9	105.8	59.3	244.9	51.0	70.0	49.4
Chlorides	350	4.93	6.80	23.94	22.05	3.87	4.93	13.38	7.39	3.17	4.93	3.52
Nitrates	45	2.0	1.50	3.50	3.95	5.0	7.40	5.50	29.50	1.00	2.90	4.45
nitrite	3.3	<0.002	<0.002	0.041	0.038	0.097	0.187	0.062	0.015	<0.002	<0.002	<0.002
Ammonia and ammonium ions	2.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Synthetic surfactants		<0.025	<0.025	0.049	0.048	0.052	0.028	<0.025	<0.025	0.052	0.058	0.053
Petroleum products		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.0047	0.0046	0.0076	0.008	0.0305	0.0136	0.0323	0.0308	0.0036	0.005	0.0009
Cadmium	0.01	0.0007	0.0007	0.0009	0.0009	0.0006	0.0008	**0.0013**	0.0008	0.0008	0.0009	0.0005
Manganese	0.1	0.0011	0.0010	0.0019	0.0017	0.0017	0.0034	0.0030	0.0081	0.0019	0.0032	0.0019
Copper	1.0	0.0034	0.0032	0.0026	0.0024	0.0058	0.0043	0.0134	0.0033	0.0023	0.0034	0.0058
Arsenic	0.05	<0.001	<0.001	0.0077	0.0070	<0.001	0.0045	0.0080	0.0016	<0.001	<0.001	0.007
Selenium	0.01	0.0073	0.0071	<0.001	<0.001	<0.001	<0.001	0.0017	<0.001	0.006	<0.001	<0.001
Lead	0.03	0.0041	0.0040	0.0028	0.0026	0.0035	0.0084	0.0037	0.0045	0.0023	0.0052	0.0035
Strontium	7	0.6994	0.7000	1.1614	1.1611	0.4508	0.7269	0.3524	1.3968	1.1700	0.6814	0.4513
Fluoride	1.5	0.22	0.25	0.58	0.60	0.14	0.40	0.17	0.46	0.38	0.64	0.55
Zinc.	1.0	0.0043	0.0040	0.0030	0.0028	0.0038	0.0078	0.0122	0.0041	0.0042	0.0025	0.0077
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		104.0	102.0	113.0	110.0	66.0	82.0	38.0	137.5	83.0	81.0	77.0
Magnesium		11.0	10.0	42.0	43.0	5.0	12.0	8.0	21.0	10.5	10.5	8.0
Sodium	200	20.0	20.0	41.0	40.0	11.0	31.5	18.0	51.5	19.5	28.5	14.0
Sukhoi Design Bureau (100 ml)		n/a		8.3	n/a	n/a	2.0	6.6	6.0	11.6	19.3	9.3

Note: MPC : Maximum Permissible Concentration

The parameter	MPC	The value of the parameter in the control point (mg/l)										
		4H	**5H**	**6N.**	**7N.**	**8N.**	**9N.**	**10h**	**11h**	**12h**	**13h**	**14h**
The level, m		0.84	3.02	0	0	0.94	3.71	0.16	16.76	4.92	1.94	4.24
The PH		7.82	7.82	7.99	7.77	7.72	7.44	7.85	8.18	7.72	7.70	7.68
BOD5		0.22	0.21	0.33	0.26	0.42	0.44	0.23	0.22	0.25	0.21	0.30
GVA total, mg-equiv/dm3												
Airborne substances		10.2	5.2	<3.0	<3.0	*	*	6.2	7.5	<3.0	<3.0	206.0
Dry balance		262.0	228.0	219.0	313.0	319.0	444.0	280,0,0	338.0	354.0	281.0	299.0
bicarbonate		213.57	137.29	146.45	204.42	189.16	350.86	208.25	271.54	231.88	201.67	216.62
Carbonates		0	0	0	0	0	0	0	0	0	0	0
Sulphates	500	47.68	44.45	42.80	76.56	89.32	98.37	49.50	46.5	74.5	49.8	51.9
Chlorides	350	4.01	4.01	4.58	4.58	4.58	3.4	10.25	3.87	8.80	3.17	14.78
Nitrates	45	1.90	2.80	4.90	2.50	3.70	1.85	2.75	5.60	1.36	3.56	<0.10
nitrite	3.3	0.02	<0.002	<0.002	<0.002	0.015	<0.002	<0.002	0.065	<0.002	<0.002	<0.002
Ammonia and ammonium ions	2.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Synthetic surfactants		0.038	<0.025	<0.025	<0.025	<0.025	0.053	<0.025	<0.025	<0.025	0.052	<0.025
Petroleum products		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.0451	0.0057	0.0034	0.008	0.005	0.007	0.0257	0.0207	0.0023	0.0031	0.071
Cadmium	0.001	0.0005	0.0006	0.0009	0.0008	0.0007	0.0008	0.0007	**0.0012**	0.0008	0.0008	**0.0011**
Manganese	0.1	0.0011	0.0017	0.0019	0.0034	0.0016	0.0021	0.0030	0.0054	0.0019	0.0021	0.0034
Copper	1.0	0.0027	0.0043	0.0023	0.0031	0.0023	0.0021	0.0122	0.0032	0.0034	0.0031	0.0021
Arsenic	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Selenium	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Lead	0.03	0.0041	0.0040	0.0028	0.0026	0.0035	0.0084	0.0037	0.0045	0.0023	0.0052	0.0035
Strontium	7	0.6994	0.7000	1.1614	1.1611	0.4508	0.7269	0.3524	1.3968	1.1700	0.6814	0.4513
Fluoride	1.5	0.80	0.56	0.50	0.56	0.50	0.90	0.62	0.66	0.46	0.40	0.94
Zinc.	1.0	0.0031	0.0022	0.0034	0.0022	0.0018	0.0018	0.0122	0.0032	0.0021	0.0032	0.0065
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		65.5	59.5	55.5	82.5	72.5	94.5	68.0	72.5	82.5	77.0	67.5
Magnesium		9.5	8.0	7.0	10.5	11.5	17.0	15.8	25.0	14.5	9.0	16.0
Sodium	200	31.0	26.0	24.0	29.5	28.5	39.5	25.0	21.0	32.5	19.0	27.0
Sukhoi Design Bureau (100 ml)		6.6	14.3	16.0	5.3	15.6	n/a	12.0	6.6	5.0	2.3	24.0

Note: MPC : Maximum Permissible Concentration

The parameter	MPC	The value of the parameter at the point control (mg/l)								
		1Rae	**2Rae**	**3Rae**	**15Rae**	**16Rae**	**17Rae**	**18Rae**	**19Rae**	**20Rae**
The level, m		0	0.62	0	0.9	0	0.94	0.71	0	0.79
The PH		7.95	7.78	8.10	7.92	7.74	8.25	8.33	8.40	8.37
BOD5		0.10	0.13	0.14	0.11	0.13	0.94	0.10	0.34	0.31
GVA total, mg-equiv/dm3										
Airborne substances		5.0	10.0	<3.0	81.0	6.0	*	60.0	5.0	10.0
Dry balance		259.0	214.0	218.0	273.0	384.0	229.0	205.0	280.0	205.0
bicarbonate		158.65	170.86	140.35	210.52	228.82	189.16	128.14	201.51	210.25
Carbonates		0	0	0	0	0	0	0	0	0
Sulphates	500	68.32	45.69	44.45	51.9	101.7	44.86	53.9	72.0	49.50
Chlorides	350	4.58	4.29	4.01	5.63	16.54	3.4	1.78	4.55	4.10
Nitrates	45	4.90	2.80	4.25	<0.10	3.44	1.25	<0.10	2.35	2.0
nitrite	3.3	<0.002	0.208	<0.002	<0.002	0.018	<0.05	0.39	<0.002	<0.002
Ammonia and ammonium ions	2.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Synthetic surfactants		<0.025	<0.025	0.026	0.05	0.034	0.033	<0.025	<0.025	<0.025
Petroleum products		<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02
Iron	0.3	0.003	0.0021	0.0012	0.0031	0.0023	0.0032	0.0022	0.0041	0.0026
Cadmium	0.001	0.0001	0.0001	0.0002	0.0001	0.0002	0.0002	0.0002	0.0001	0.0001
Manganese	0.1	0.0021	0.0011	0.0013	0.0022	0.0011	0.001	0.001	0.0024	0.0012
Copper	1.0	0.0032	0.0021	0.0021	0.0024	0.0017	0.0019	0.0013	0.0024	0.0014
Arsenic	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sodium	200									
Selenium	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Lead	0.03	0.0014	0.0030	0.0032	0.0034	0.0023	0.0014	0.0021	0.0015	0.0015
Strontium	7	0.5352	0.4631	0.6184	1.7931	1.3910	0.7269	1.1327	0.9331	1.3920
Fluoride	1.5	0.55	0.66	0.52	0.88	0.74	0.40	0.36	0.56	0.72
Zinc.	1.0	0.0021	0.0013	0.0022	0.0031	0.0016	0.0021	0.0056	0.0012	0.0032
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		70.0	53.5	58.0	64.0	70.0	62.0	48.5	76.0	52.0
Magnesium		8.0	7.5	7.0	11.0	17.0	8.0	7.5	8.5	10.9
Sodium	200	25.0	25.0	21.5	31.5	50.0	19.5	21.0	30.0	29.5
Sukhoi Design Bureau (100 ml)		n/a	13.0	19.6	2.6	12.0	3.3	18.6	6.6	5.3

Note: MPC : Maximum Permissible Concentration

The parameter	MPC	The value of the parameter at the point control (mg/l)								
		1E.	**2E.**	**3E.**	**4E.**	**1W**	**2W**	**3W**	**4W**	**5W**
The level, m		0.8	0.7	4.85	4.28	8.87	1.79		12.67	3.00
The PH		8.0	7.56	7.46	7.5	7.56	7.81	7.76	7.80	7.88
BOD5		0.31	0.27	0.24	0.29	0.26	0.58	0.76	0.73	0.62
GVA total, mg-equiv/dm3										
Airborne substances		<3.0	<3.0	<3.0	<3.0	4.5	24.0	25.2	19.60	5.7
Dry balance		280.0	523.0	404.0	420.0	502.0	423.0	326.0	295.0	267.0
bicarbonate		240.00	277.64	247.13	300.20	253.23	183.06	197.15	190.05	164.75
Carbonates		0	0	0	0	0	0	0	0	0
Sulphates	500	157.8	155.6	103.3	90.70	154.3	113.2	110.80	95.65	58.4
Chlorides	350	7.2	5.63	4.58	8.70	10.21	36.61	23.25	15.42	9.15
Nitrates	45	0.78	1.20	1.10	<0.10	2.50	4.30	3.25	3.42	4.76
nitrite	3.3	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.025
Ammonia and ammonium ions	2.6	0.120	<0.05	<0.05	0.45	<0.05	<0.05	<0.05	<0.05	<0.05
Synthetic surfactants		<0.025	<0.025	<0.025	<0.025	0.054	0.048	<0.025	<0.025	0.056
Petroleum products		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.0020	0.0030	0.0035	0.0054	0.0037	0.0021	0.0034	0.0032	0.0043
Cadmium	0.001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Manganese	0.1	0.0031	0.0022	0.0023	0.0012	0.0021	0.0031	0.0042	0.0021	0.0014
Copper	1.0	0.0025	0.0019	0.0031	0.0019	0.0026	0.0022	0.0034	0.0024	0.0021
Arsenic	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	0.03	0.0021	0.0029	0.0018	0.0041	0.0017	0.0031	0.0022	0.0017	0.0019
Strontium	7	1.3341	1.2832	0.7712	0.9839	1.1990	1.2932	0.9185	1.3110	1.1494
Fluoride	1.5	0.60	0.74	0.60	0.50	0.62	0.61	0.58	052	0.54
Zinc.	1.0	0.0034	0.0022	0.0041	0.0031	0.0052	0.0031	0.0033	0.0031	0.0028
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		124.0	123.5	113.5	124.5	106.5	71.5	70.8	68.6	62.5
Magnesium		15.0	19.5	13.5	16.0	18.5	15.5	15.3	12.8	10.5
Sodium	200	32.5	37.5	29.5	40.5	49.5	63.0	26.5	23.5	19.5
Sukhoi Design Bureau (100 ml)		10.3	16.3	9.3	10.0	10.6	2.6	3.3	2.0	13.6

Note: MPC : Maximum Permissible Concentration

Parameters	2012 Concentration (mg/l)	2013 Concentration (mg/l)	Maximum Permissible Concentrations
Groundwater - Tailings Dam (boreholes 1n, 2n, 3n, 16n, 17n, 18n)			
Nitrite	0.38	0.134	3.3
Cadmium	0.0024	0.0012	0.001
Arsenic	0.028	0.0165	0.05
Sodium	83.75	59.55	200
Strontium	1.621	1.775	7.0
Fluorine	0.34	0.28	1.5
Nitrates	16.95	9.27	45
Ammonium Salt	0.25	0.145	2.6
Sulphate	464.9	463.08	500
Chloride	46.3	53.25	350
Oil	0.051	0.026	0.1
Manganese	0.029	0.012	0.1
Zinc	0.0088	0.0077	1.0
Groundwater - Bezymyanniy Brook Valley (borehole 4n)			
Nitrite	0.037	0.042	3.3
Cadmium	0.0002	0.0003	0.001
Arsenic	0.0036	0.005	0.05
Sodium	82.75	90.6	200
Selenium	0.0036	0.004	0.01
Lead	0.0004	0.0003	0.03
Strontium	2.12	1.736	7
Fluorine	0.36	0.77	1.5
Nitrates	5.53	6.18	45
Sulphate	552.48	682.17	500
Chloride	55.88	66.45	350
Oil	<0.05	<0.05	0.1
Manganese	0.074	0.058	0.1
Zinc	0.0064	0.0017	1.0
Iron	0.018	0.009	0.3
Surface Water - Bezymyanny Brook			
Nitrite	0.44	0.018	3.3
Cadmium	0.00012	0.0001	0.001
Arsenic	0.0048	<0.01	0.05
Sodium	64.12	50.3	200
Selenium	0.0008	0.0008	0.01
Lead	0.0002	0.0003	0.03
Fluorine	0.34	0.33	1.5
Nitrates	7.7	7.09	45
Sulphate	405.3	381.4	500
Chloride	43.5	39	350
Oil	0.012	<0.05	0.1
Manganese	0.0056	0.0045	0.1
Zinc	0.0029	0.0015	1.0
Iron	0.025	0.0255	0.3

Parameters	2012 Concentration (mg/l)	2013 Concentration (mg/l)	Maximum Permissible Concentrations
Mine Drainage Water			
Nitrite	0.027	0.0515	3.3
Cadmium	0.0071	0.0058	0.001
Arsenic	0.176	0.185	0.05
Sodium	99.9	97.05	200
Selenium	0.0094	0.024	0.01
Lead	0.0007	<0.01	0.03
Strontium	2.3746	0.76	7
Fluorine	0.4	0.37	1.5
Sulphate	556.2	566.25	500
Chloride	56.62	65.77	350
Nitrates	5.06	3.3	45
Ammonium Salt	0.185	0.11	2.6
Oil	0.04	0.1	0.1
Iron	0.034	0.037	0.3
Manganese	0.018	0.031	0.1
Copper	0.008	0.0016	1.0
Zinc	0.0052	0.013	1.0

Appendix 4.8.2 – Bakyrchyk Surface Water Quality Data - July 2015.

The parameter, mg/dm3	MPC	Cipher sample															
		PES1	PES2	PES3	PES3a	PES4	PES4a	PES5	PES6	PES7	PES8	PES9	PES10	PES11	PES12	PES13	PES14
1		*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
pH		8.36	8.20	7.78	7.86	8.24	8.01	7.75	7.80	8.28	8.18	8.07	8.24	8.40	7.99	7.95	8.30
Smell (at 200C), score		1	2	1	1	1	1	0	1	1	1	1	0	1	1	2	1
Color, degrees		50	34	68	46	23	29	42	46	62	39	29	29	<20	39	48	25
Taste,score		1	1	0	0	0	1	1	1	1	1	1	0	0	1	1	1
Turbidity		1.93	>4.64	3.25	1.65	0.85	<0.58	0.85	0.85	1.65	1.65	>4.64	0.85	2.45	<0.58	<0.58	<0.58
Hardness com MG-equiv/dm3		4.5	4.2	3.75	3.88	2.73	5.87	13.93	11.31	8.15	4.62	6.64	5.09	7.41	5.59	6.58	5.28
БПК5, mg ON2 / dm3		1.99	2.03	0.43	0.44	2.50	3.54	1.39	1.41	0.58	1.98	0.44	1.56	3.56	0.51	0.44	1.33
Airborne substances		110	270	45	130	65	5	30	38	11	130	1200	42.5	150	27.5	7.5	10
Bicarbonate		198.3	198.3	231.9	231.89	146.4	186.1	250.2	253.2	173.9	207.5	213.6	158.6	149.5	198.3	183.1	186.1
Dry balance		381.0	363.0	277.0	324.0	215.0	440.0	1238,0	1047,0	717.0	340.0	491.0	354.0	573.0	402.0	515.0	376.0
Sulphates	500	100.4	84.4	35.4	60.1	44.9	148.6	492.3	386.9	199.2	73.3	130.9	85.2	213.2	84.8	146.5	88.1
Chlorides	350	10.88	16.03	4.58	12.02	4.01	5.15	48.09	57.26	41.23	8.87	9.45	6.29	16.03	9.16	14.89	12.02
Nitrates	45	2.10	2.30	1.70	0.40	3.90	<0.10	2.70	34.0	30.0	1.75	1.90	1.30	3.70	0.68	<0.10	<0.10
Nitrite	3.3	0.022	0.13	0.054	0.019	0.025	0.006	0.053	0.181	0.04	0.043	0.065	0.018	0.04	0.037	0.011	0.014
Ammonia and ions Ammonium nitrate	2.6	0.17	<0.05	<0.05	0.15	0.16	0.26	0.13	0.18	0.63	<0.05	0.08	<0.05	0.13	0.42	0.13	0.27
Phosphates		0.038	0.043	0.103	0.05	0.058	0.025	0.310	0.380	0.377	0.053	0.035	0.038	0.020	0.138	0.068	0.035
Synthetic surfactants		<0.025	0.116	<0.025	0.067	<0.025	0.107	0.031	<0.025	0.04	<0.025	<0.025	<0.025	0.067	0.107	0.071	0.071
Petroleum Products		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	0.3	0.108	0.095	0.091	0.085	0.057	0.017	0.061	0.042	**0.317**	0.079	0.029	0.066	0.034	0.063	0.039	0.023

Note: MPC : Maximum Permissible Concentration

The parameter, mg/dm3	MPC	Cipher Sample															
		PES1	PES2	PES3	PES3a	PES4	PES4a	PES5	PES6	PES7	PES8	PES9	PES10	PES11	PES12	PES13	PES14
1		*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
Cadmium	0.001	0.0006	0.0004	0.0004	0.0004	0.0002	0.0003	**0.0012**	**0.0062**	0.0013	0.0003	0.0004	0.0004	0.0003	**0.0015**	0.0008	0.0003
Potassium		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Calcium		66.0	62.0	59.0	57.0	44.0	88.0	138.0	127.0	117.0	71.0	97.0	81.0	116.0	86.0	96.0	78.0
Magnesium		15.0	13.4	9.74	12.6	6.49	17.9	85.4	60.3	28.0	13.0	21.7	12.6	19.6	15.7	21.7	16.8
Manganese	0.1	0.004	0.004	0.004	0.009	0.004	0.002	0.091	0.004	0.013	0.004	0.007	0.005	0.01	0.006	0.006	0.008
Copper	1.0	0.0024	0.0034	0.0017	0.0019	0.0012	0.0023	0.0013	0.0028	0.0029	0.0017	0.0029	0.0014	0.0026	0.0027	0.0022	0.0017
Arsenic	0.05	0.0086	0.005	0.006	0.006	<0.001	<0.001	0.0256	0.0136	0.027	0.003	0.002	<0.001	0.004	0.026	0.013	0.004
Sodium	200	45.5	46.0	26.0	40.5	19.0	32.5	99.0	95.5	60.5	24.5	37.0	22.0	37.5	30.0	47.0	30.5
Lead	0.03	0.001	0.0002	0.0005	0.0008	<0.0001	0.001	0.0003	0.0004	0.0005	<0.0001	0.0001	<0.0001	0.0002	<0.0001	0.0005	0.0003
Selenium	0.01	0.005	0.004	0.004	0.003	0.003	0.005	0.006	0.005	0.004	0.003	0.003	<0.001	0.002	0.002	0.003	0.003
Strontium	7	0.651	0.633	0.474	0.581	0.439	0.717	2.173	1.703	1.237	0.584	0.942	0.654	0.966	0.737	0.917	0.619
Zinc.	1.0	0.0031	0.0026	0.0027	0.0028	0.0021	0.0038	0.0016	0.0022	0.0042	0.0016	0.0011	0.0009	0.0010	0.0024	0.0014	0.0019
Fluoride	1.5	1.00	1.03	0.90	0.80	0.74	0.58	0.48	0.51	0.56	0.52	0.62	0.40	0.24	0.51	0.50	0.20
Isomer ГХЦ		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DDT		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2.4 -D		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As well-radio-activity, Bq/l		<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.05	0.05	0.06	0.02	0.02	0.05	0.06	0.02	0.05	0.02
(b-radio-activity, Bq/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Well-ventilated колиформы:																	
Hurray-Faguy		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Deciphering genomes		<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	>240,000	>240,000	>240,000	>240,000	>240,000	>240,000

Note: MPC : Maximum Permissible Concentration

Annex 6

The results chemical analyzes water wells on the Kyzyl-The
The забраннои water. The time of the pumps at the station Kyzyl-The for 2014.

No.	Name	Units	January		February		March		April		May		June		July		August		September		October		November		December	
P/p.	Indicators		2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.	2JCR.	3JCR.
1	Smell	Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Taste	Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Chrominance	Degrees.	4	3	4	4	5	6	6	5	8	12	10	6	9	11	8	10	10	8	4	3	6	8	3	4
4	Turbidity	Mg/dm3	0.06	0.02	0.03	0.02	0.01	0.05	0.8	0.11	0.12	0.11	0.14	0.1	0.16	0.12	0	0	0.02	0.05	0.06	0	0	0	0	0
5	The PH		7.20	7.50	7.00	7.10	7.00	6.90	7.00	7.10	6.90	6.90	7.20	7.00	6.90	7.00	7.00	7.20	6.90	7.20	7.00	7.00	7.00	6.90	7.00	7.10
6	BOD5	Mg/dm3	1.20	0.90	0.80	0.90	1.30	0.90	0.80	0.60	0.20	0.30	0.70	0.60	0.40	0.50	0.50	0.40	0.50	0.40	0.04	0.10	0.30	0.20	0.30	0.40
7	Iron total	Mg/dm3	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.007	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.040	0.020	0.080	0.000	0.000	0.000	0.000	0.000
8	Dry balance	Mg/dm3	388	396	377	386	433	272	240	190	400	320	432	444	176	146	230	180	248	264	212	180	160	140	120	100
9	Ammonia	Mg/dm3	0.15	0.13	0.08	0.05	0.00	0.00	0.10	0.12	0.11	0.08	0.12	0.33	0.02	0.01	0.07	0.07	0.00	0.00	0.11	0.04	0.04	0.02	0.00	0.00
10	nitrite	Mg/dm3	0.000	0.00	0.003	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.010	0.040	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Nitrates	Mg/dm3	0.62	0.73	0.65	0.79	0.250	0.970	0.600	1.000	0.640	0.590	1.100	0.590	0.570	0.580	1.300	1.300	0.310	0.640	0.030	0.260	0.650	0.610	0.270	0.290
12	Hardness	Mg/dm3	6.50	6.40	6.50	6.00	4.250	5.000	5.500	5.500	5.600	5.400	6.000	5.250	5.500	5.600	5.400	5.600	5.500	3.750	5.650	5.850	5.000	4.900	5.000	4.500
13	Chlorides	Mg/dm3	5.00	5.50	5.00	4.00	4.000	4.500	6.700	6.500	6.500	7.000	7.500	5.500	7.500	7.200	6.500	6.000	5.000	5.000	6.000	5.000	5.000	5.200	5.000	5.200
14	Sulphates	Mg/dm3	96.72	72.96	73.0	96.0	148.0	165.0	160.0	120.0	96.00	108.0	96.00	96.00	72.00	48.00	120.0	96.00	96.00	72.00	72.00	96.00	68.00	92.00	86.00	96.00
15	Copper	Mg/dm3	0.070	0.030	0.050	0.100	0.090	0.090	0.030	0.010	0.080	0.026	0.000	0.000	0.050	0.040	0.060	0.020	0.200	0.180	0.200	0.090	0.060	0.010	0.050	0.030
16	Aluminum	Mg/dm3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Phosphates	Mg/dm3	0.01	0.13	0.10	0.27	0.32	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.02	0.01	0.04	0.08	0.03	0.06	0.01
18	Evaluated.In the W	Mg/dm3	0.042	0.060	0.780	0.080	0.084	0.800	0.060	0.046	0.080	0.080	0.070	0.070	0.014	0.016	0.040	0.042	0.013	0.013	0.072	0.068	0.028	0.020	0.030	0.025
	The amount of wate	M3	25927		24802		27029		26655		26128		26142		26609		31769		14499		12364		16382		14400	

Antoshka-technologist TVS: Mr..Sharipov

Appendix 4.8.3: Borehole Details

Appendix 4.8.3

Bakyrchyk Groundwater Monitoring Network - Borehole Details

	A		B	C	D	E	F	G	H	I	J	K	L
1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"												
2													
3						The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № p / p	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
6	1		1H 1H		The eastern side of the village. Auezov next to the existing tailings dam	508514.598 508514.598	544623.069 544623.069	442.114 442,114	155 155	98 98	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: a blank steel tube in the range from 0.0 to 4.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Filter column: blank portion from 0.0 to 6.0 m, perforated pipe from 6.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	08.08.2007 г. 08.08.2007 Mr.
7	2		2H 2H			508580.233 508580.233	544677.727 544677.727	445.262 445,262	155 155	98 98	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: a blank steel tube in the range from 0.0 to 4.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Filter column: blank portion from 0.0 to 4.0 m, perforated pipe from 4.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	12.08.2007 г. 12.08.2007 Mr.
8	3		3H 3H			508569.725 508569.725	544753.157 544753.157	446.368 446,368	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 6,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 6.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	16.08.2007 г. 16.08.2007
9	4		4H 4H		From the south-east side of the village. Auezov below the existing tailings dam	507901.737 507901.737	545145.981 545145.981	427.366 427,366	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 3,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 3.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 3,0 м, перфорированная труба от 4,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 3.0 m, perforated pipe from 4.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	20.08.2007 г. 20.08.2007 Mr.
10	5		5H 5H		С юго-восточной стороны пос. From the south-east side of the village. Ауэзов на левом берегу руч. Auezov on the left bank of the brook. Безымянный Nameless	507220.917 507220.917	545073.301 545073.301	416.584 416,584	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 2,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 2.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	24.08.2007 г. 24.08.2007
11	6		6H 6H		С западной стороны от могильника мышьяксодержащего шлама On the west side of the burial ground arsenic-containing sludge	510103.773 510103.773	545661.680 545661.680	480.919 480,919	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 6,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 6.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	29.08.2007 г. 29.08.2007
12	7		7H 7H		С западной стороны от могильника мышьяксодержащего шлама на правом берегу руч. On the west side of the burial ground arsenic-containing sludge on the right bank of the brook. Безымянный № 3 Unnamed number 3	509912.565 509912.565	545250.062 545250.062	487.000 487,000	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	03.010.2007 г. 03.010.2007 city

1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"											
2												
3					The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № р / р	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
13	8		7П 7Р		С юго-восточной стороны пос. From the south-east side of the village. Ауэзов на правом берегу руч. Auezov on the right bank of the brook. Безымянный Nameless	507722.982 507722.982	545092.346 545092.346	426.291 426,291	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	22.10.2007 г. 22.10.2007
14	9		8П 8Р			507719.328 507719.328	545097.385 545097.385	426.044 426,044	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	25.10.2007 г. 25.10.2007
15	10		9Н 9Н		С западной стороны пос. On the west side of the village. Ауэзов на правом берегу руч. Auezov on the right bank of the brook. Акбастаубулак Akbastaubulak	539957.379 539957.379	508640.693 508640.693	371.715 371,715	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	03.09.2007 г. 03.09.2007 Mr.
16	11		9П 9Р		С западной стороны от могильника мышьяксодержащего шлама на левом берегу руч. On the west side of the burial ground arsenic-containing sludge on the left bank of the brook. Безымянный № 3 Unnamed number 3	509930.832 509930.832	545420.631 545420.631	473.300 473,300	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	01.10.2007 г. 01.10.2007
17	12		10П 10Р			509925.048 509925.048	545425.032 545425.032	473.300 473,300	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	29.09.2007 г. 29.09.2007 Mr.
18	13		10Н 10Н		С западной стороны пос. On the west side of the village. Ауэзов на левом берегу руч. Auezov on the left bank of the brook. Акбастаубулак Akbastaubulak	508556.077 508556.077	539899.152 539899.152	370.939 370,939	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	07.09.2007 г. 07.09.2007
19	14		11Н 11Н		С восточной стороны пос. The eastern side of the village. Ауэзов, с северной стороны от нового хвостохранилища Auezov, on the north side of the new tailings	509642.802 509642.802	544549.083 544549.083	469.913 469,913	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 3,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 3.0 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	11.09.2007 г. 11.09.2007
20	15	ENVIRONMENT	11П 11Р	Наблюдательные скважины по программе производственного	С северо-восточной стороны от могильника мышьяксодержащего шлама From the north-eastern side of the cemetery arsenic-containing sludge	510465.000 510465.000	546310.000 546310.000	492.000 492,000	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	27.09.2007 г. 27.09.2007

1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"											
2												
3						The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № р / р	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
21	16		12Н 12Н	экологического контроля (ПЭК). Observation wells for industrial environmental monitoring program (EMP).	Северо-восточней п. Ауэзов, северо-западней могильника мышьяксодержащего шлама, северней дороги Ауэзов-Усть-Каменогорск North-East n. Auezov, Northwest burial arsenic-containing sludge, North Road Auezov Ust-Kamenogorsk	511178.710 511178.710	544161.512 544161.512	439.443 439,443	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	07.10.2007 г. 07.10.2007 Mr.
23	17		13Н 13Н		С северо-западной стороны от могильника мышьяксодержащего шлама, северо-восточней дороги Ауэзов-Усть-Каменогорск On the northwest side of the burial ground of arsenic sludge, the north-eastern road Auezov Ust-Kamenogorsk	510575.000 510575.000	544899.860 544899.860	468.500 468,500	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	07.10.2007 г. 07.10.2007 Mr.
25	18		14Н 14Н		С восточной стороны пос. The eastern side of the village. Ауэзов, юго-западней отвала Южный Auezov, southwest South Blade	509408.042 509408.042	543340.458 543340.458	443.052 443,052	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	02.11.2007 г. 02.11.2007 Mr.
26	19		15П 15Р			509414.204 509414.204	543337.569 543337.569	442.383 442,383	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	15.11.2007 г. 15.11.2007
28	20		15Н 15Н		С восточной стороны пос. The eastern side of the village. Ауэзов, севернее существующего хвостохранилища Auezov, north of the existing tailings	509781.000 509781.000	544223.000 544223.000	455.000 455.000	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	27.10.2007 г. 27.10.2007
29	21		16П 16Р			509777.000 509777.000	544229.000 544229.000	455.000 455.000	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	30.10.2007 г. 30.10.2007
30	22		16Н 16Н		С восточной стороны пос. The eastern side of the village. Ауэзов, северо-восточней существующего хвостохранилища Auezov, north-east of the existing tailings	509242.054 509242.054	544049.848 544049.848	456.604 456,604	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	12.10.2007 г. 12.10.2007 Mr.
31	23		17П 17Р			509237.090 509237.090	544057.740 544057.740	456.222 456,222	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	14.10.2007 г. 14.10.2007 Mr.

1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"												
2													
3						The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № р / р	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
32	24		17Н 17Н		С северной стороны существующего хвостохранилища, под дамбой нового хвостохранилища On the north side of the existing tailings dam at the new tailings	509108.853 509108.853	544548.920 544548.920	450.438 450,438	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	16.10.2007 г. 16.10.2007
33	25		18Н 18Н			509076.724 509076.724	544661.628 544661.628	454.339 454,339	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	19.10.2007 г. 19.10.2007
34	26		18П 18Р		Северо-восточней п. Ауэзов, северо-западней могильника мышьяксодержащего шлама, северней дороги Ауэзов-Усть-Каменогорск North-East n. Auezov, Northwest burial arsenic-containing sludge, North Road Auezov Ust-Kamenogorsk	511181.192 511181.192	544156.074 544156.074	439.301 439,301	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	11.10.2007 г. 11.10.2007 Mr.
35	27		19П 19Р		С северо-западной стороны от могильника мышьяксодержащего шлама, северо-восточней дороги Ауэзов-Усть-Каменогорск On the northwest side of the burial ground of arsenic sludge, the north-eastern road Auezov Ust-Kamenogorsk	510579.290 510579.290	544894.000 544894.000	468.500 468,500	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	10.10.2007 г. 10.10.2007
36	28		19Н (Ф) 19Н (F)		С северо-восточной стороны от могильника мышьяксодержащего шлама, с северной стороны дороги Ауэзов-Усть-Каменогорск From the north-eastern side of the cemetery arsenic-containing sludge, on the north side of the road Auezov Ust-Kamenogorsk	510947.000 510947.000	546269.000 546269.000	509.000 509,000	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	04.11.2007 г. 04.11.2007 Mr.
37	29		20П 20Р		С северо-западной стороны от могильника мышьяксодержащего шлама, юго-восточней дороги Ауэзов-Усть-Каменогорск On the northwest side of the burial ground of arsenic sludge, Southeast Auezov road Ust-Kamenogorsk	510234.526 510234.526	545449.024 545449.024	477.946 477,946	155 155	98 98	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Pipes left in the well: a blank steel tube in the range from 0.0 to 1.5 m - d = 168 mm plastic pipe in the range of 0,0 to 50,0m - d = 124 mm. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм. Filter column: blank portion from 0.0 to 8.0 m, perforated pipe from 8.0 to 50.0 m. The outer d = 124, d = internal 98 mm.	06.10.2007 г. 06.10.2007 Mr.
38	30	PRODUCTION WELLS EQUIPPED - IN USE AT WELLFIELD	1э 1Е		On the right bank of the stream Kyzyltu, east dam on the creek Akbastaubulak in pump box.	511787.760 511787.760	542459.408 542459.408	412.121 412,121	295 295	245 245	35 35	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 6,4 м, перфорированная труба от 6,4 до 21,0 м d=273 мм. Well equipped with pumping booth. "Filter column: blank portion from 0.0 to 6.4 m, perforated pipe from 6.4 to 21.0 m d = 273 mm.	26.11.1996 г. 26.11.1996 Mr.
39	31		2э 2Е		On the right bank of the stream Kyzyltu, on the left bank of the mouth of the creek Zhumataybastau in pump box.	511976.017 511976.017	542837.906 542837.906	417.520 417,520	295 295	245 245	41 41	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 5,8 м, перфорированная труба от 5,8 до 39,0 м d=273 мм. Well equipped with pumping booth. "Filter column: blank portion from 0.0 to 5.8 m, perforated pipe from 5.8 to 39.0 m d = 273 mm.	26.11.1996 г. 26.11.1996 Mr.
40	32		3э 3Е		On the right bank of the stream Kyzyltu near post protection water intake, pumping in the booth.	512080.874 512080.874	543331.447 543331.447	428.500 428,500	295 295	245 245	50 50	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 6,8 м, перфорированная труба от 6,8 до 40,0 м d=273 мм. Well equipped with pumping booth. "Filter column: blank portion from 0.0 to 6.8 m, perforated pipe from 6.8 to 40.0 m d = 273 mm.	26.11.1996 г. 26.11.1996 Mr.
41	33		4э 4Е		On the left bank of the creek Kyzyltu, security post east of the water intake, pumping in the booth.	511987.286 511987.286	543766.665 543766.665	435.200 435,200	295 295	190 190	50 50	Скважина оборудована насосной будкой". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 11,0 м - d=273 мм, Фильтр не устанавливался (естественный). Well equipped with pumping booth. "Pipes left in the hole: a blank steel tube in the range from 0.0 to 11.0 m - d = 273 mm, the filter is not installed (natural).	30.11.1996 г. 30.11.1996 Mr.

1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"												
2													
3						The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № р / р	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
42	34	MONITORING WELLS	4H 4H	Observation wells Kyzyltu area.	На левом берегу ручья Жуматайбастау, первая по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э. On the left bank of the creek Zhumataybastau first flow stream observation well to the north of the booth production well 2E.	512452.280 512452.280	542857.883 542857.883	423.879 423,879	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,16 до 3,2 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.16 to 3.2 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	05.06.2004 г. 05.06.2004 Mr.
43	35		5H 5H		На левом берегу ручья Жуматайбастау, вторая по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э. On the left bank of the creek Zhumataybastau second flow stream observation well to the north of the booth production well 2E.	512799.000 512799.000	542983.000 542983.000	434.030 434,030	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,92 до 7,4 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 0.92 to 7.4 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	06.06.2004 г. 06.06.2004 Mr.
44	36		6H 6H		На левом берегу ручья Жуматайбастау, третья по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э. On the left bank of the creek Zhumataybastau third stream flow observation well to the north of the booth production well 2E.	513352.027 513352.027	543199.033 543199.033	446.572 446,572	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,91 до 2,5 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 0.91 to 2.5 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	08.06.2004 г. 08.06.2004 Mr.
45	37		7H 7H		На левом берегу ручья Кызылту, вторая по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э. On the left bank of the creek Kyzyltu second flow stream observation well the northeastern booth 4E production well.	512399.000 512399.000	543997.000 543997.000	446.000 446.000	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,87 до 7,8 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 0.87 to 7.8 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	30.05.2004 г. 30.05.2004 Mr.
46	38		8H 8H		На левом берегу ручья Кызылту, первая по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э. On the left bank of the creek Kyzyltu first flow stream observation well the northeastern booth 4E production well.	512191.262 512191.262	543892.261 543892.261	439.893 439,893	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,84 до 5,4 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 0.84 to 5.4 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	31.05.2004 г. 31.05.2004 Mr.
47	39		9H 9H		На левом берегу ручья Кызылту, третья по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э. On the left bank of the creek Kyzyltu third stream flow observation well the northeastern booth 4E production well.	512548.000 512548.000	544222.000 544222.000	450.000 450.000	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,31 до 5,0 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.31 to 5.0 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	29.05.2004 г. 29.05.2004 Mr.
48	40		10H 10H		На правом берегу ручья Кызылту, северо-западней будки эксплуатационной скважины 1э. On the right bank of the stream Kyzyltu, Northwest booth production well 1E.	511728.207 511728.207	542298.139 542298.139	409.959 409,959	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,10 до 5,2 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.10 to 5.2 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	11.06.2004 г. 11.06.2004 Mr.
49	41		11H 11H		С южной стороны пос. On the south side of the village. Ауэзов, севернее будки эксплуатационной скважины 2э. Auezov, north booth production well 2E.	511446.000 511446.000	543015.000 543015.000	430.000 430.000	146 146	112 112	30 30	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,13 до 0,8 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.13 to 0.8 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	12.06.2004 г. 12.06.2004 Mr.
50	42		12H 12H		С южной стороны пос. On the south side of the village. Ауэзов, севернее будки эксплуатационной скважины 3э. Auezov, north booth 3E production well.	511445.000 511445.000	543536.000 543536.000	429.380 429,380	146 146	112 112	25 25	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,89 до 0,6 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 0.89 to 0.6 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	14.06.2004 г. 14.06.2004 Mr.
51	43		13H 13H		С юго-восточной стороны пос. From the south-east side of the village. Ауэзов, северо-восточней будки эксплуатационной скважины 4э. Auezov, Northeast booth 4E production well.	511333.000 511333.000	544507.000 544507.000	450.000 450.000	146 146	112 112	40 40	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,07 до 1,1 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.07 to 1.1 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	03.06.2004 г. 03.06.2004 Mr.
52	44		14H 14H		On the right bank of the stream Kyzyltu, east dam on the creek Akbastaubulak, Northwest booth production well 2E.	511958.000 511958.000	542055.000 542055.000	419.000 419.000	146 146	112 112	40 40	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,14 до 2,4 м - d=133 мм. Pipes left in the well: a blank steel tube in the range from 1.14 to 2.4 m - d = 133 mm. Фильтр не устанавливался (естественный). The filter is not installed (natural).	10.06.2004 г. 10.06.2004 Mr.
53	45		1p-e		On the left bank of the creek Kyzyltu first flow stream exploration and production well the northeastern booth production well 4E	512753.000 512753.000	544416.000 544416.000	458.000 458.000	326 326	208 208	50 50	Скважина оборудована бетонным воротником и оголовником под "ключ". Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.35 to 5.4 m - d = 326 mm, in the range of + 1.16 to 50.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 6.29 m, 44.87 m perforated portion, the settler there.	22.07.2004 Mr.
54	46		2p-e		On the left bank of the creek Zhumataybastau second flow stream exploration and production well to the north of the booth production well 2E.	513077.566 513077.566	543102.585 543102.585	438.606 438,606	395 395	208 208	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.6 to 7.4 m - d = 326 mm, in the range of + 1.16 to 50.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 9.84 m, 41.16 m perforated portion, the settler there. The depth of the perforated portion of the filter from 8.84 to 50.0 m, d 14 mm hole, 950 pcs. per meter, porosity - 20%	21.01.2005 Mr.

1	Координаты скважин ТОО "Бакырчикское горнодобывающее предприятие" Coordinates well LLP "Bakyrchik miner"												
2													
3						The coordinates in the '42		Height	Diameter (mm)				
4	№ п/п № р / р	Category	ID wells.	Type of monitoring points	Description of location	x x	y at	z z	outdoor	Home	Budgeted depth	Информация по конструкции скважин Information on the design of wells	Date of drilling
5	1 1		2 2	33	44	5 5	6 6	7 7	8 8	9 9	10 10	11 11	12 12
55	47	PRODUCTION WELLS NOT EQUIPPED - NOT IN USE	3р-е	Разведочно-эксплуатационные скважины участка Кызылту. Exploration and production wells Kyzyltu area.	On the left bank of the creek Zhumataybastau third flow stream exploration and production well to the north of the booth production well 2E.	513558.925 513558.925	543166.788 543166.788	445.884 445,884	343 343	208 208	42 42	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.4 to 7.73 m - d = 326 mm, in the range of 0.76 to 42.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 8.75 m, perforated portion of 34.0 m, no settler, d holes 14 mm, 950 pcs. per meter, porosity - 20%	02.10.2004 Mr.
56	48		15р-е		On the south side of the village. Auezov, on the right bank of the upper stream Akbastaubulak alignment.	512671.875 512671.875	541373.070 541373.070	419.031 419,031	395 395	208 208	42 42	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.5 to 4.55 m - d = 326 mm, in the range of + 1.0 to 42.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 6.0 m, 38.0 m perforated portion, no settler, d holes 14 mm, 900 pcs. per meter, porosity - 20%	07.10.2004 Mr.
57	49		16р-е		From the south-western side of the village. Auezov, south of the farm "Cold-key".	512551.000 512551.000	539917.000 539917.000	396.000 396.000	395 395	208 208	70 70	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.4 to 7.78 m - d = 326 mm, in the range of + 0.81 to 70.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 5.81 m, perforated portion of 65.0 m, no settler, d holes 14 mm, 900 pcs. per meter, porosity - 20%	20.07.2004 Mr.
58	50		17р-е		From the south-east side of the village. Auezov, Northeast booth 4E production well.	511251.218 511251.218	544452.730 544452.730	448.270 448,270	395 395	208 208	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.4 to 2.2 m - d = 326 mm, in the range of + 1.0 to 50.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 5.36 m, perforated portion of 65.0 m, no settler, d holes 14 mm, 900 pcs. per meter, porosity - 20%	27.05.2004 Mr.
59	51		18р-е		From the south-east side of the village. Auezov, Northeast booth 4E production well.	511573.051 511573.051	544872.860 544872.860	462.994 462,994	395 395	190 190	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.4 to 5.6 m - d = 326 mm. The filter is not installed.	04.11.2006 Mr.
60	52		19р-е		On the left bank of the creek Kyzyltu second flow stream exploration and production well the northeastern booth production well 4E	512414.000 512414.000	544007.000 544007.000	443.000 443,000	395 395	190 190	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.4 to 7.5 m - d = 326 mm. The filter is not installed.	19.09.2006 Mr.
61	53		20р-е		On the left bank of the creek Zhumataybastau first exploration and production well to the north of the booth production well 2E.	512467.000 512467.000	542865.000 542865.000	424.080 424,080	343 343	208 208	50 50	Well equipped with a concrete collar and end cap under the "key". Pipes left in the well: in the range from 0.2 to 5.0 m - d = 326 mm, in the range of + 1.0 to 50.0 m - d = 219 mm. Filter column of the outer d = 219, d = internal 208 mm, the total length of the upper part of the hollow 6.0 m, perforated portion of 45.0 m, no settler, d holes 14 mm, 950 pcs. per meter, porosity - 20%	8/3/2005 03/08/2005
62	54	MINE WATER	1sh	Observation wells for monitoring program of mine water	On the southern edge of the quarry №5-6	510013.000 510013.000	540942.000 540942.000	386.000 386.000	146 146	112 112	50 50	Well equipped with a concrete collar and end cap under the "key".	2004
63	55		2sh		Career №5-7 south on the left bank of the stream Alaigyr	510334.000 510334.000	541020.000 541020.000	390.500 390,500	146 146	112 112	50 50	Well equipped with a concrete collar and end cap under the "key".	2004
64	56		3sh		The first well to the south waste rock dump number 1, 3, 4, 7	510406.000 510406.000	542181.000 542181.000	417.000 417,000	146 146	112 112	50 50	Well equipped with a concrete collar and end cap under the "key".	2004
65	57		4sh		The second well to the south waste rock dump number 1, 3, 4, 7	510902.000 510902.000	542239.000 542239.000	424.000 424.000	146 146	112 112	50 50	Well equipped with a concrete collar and end cap under the "key".	2004
66	58		5sh		The third well to the south waste rock dump number 1, 3, 4, 7	511354.000 511354.000	542299.000 542299.000	408.650 408,650	146 146	112 112	50 50	Well equipped with a concrete collar and end cap under the "key".	2004

Appendix 4.8.4: Groundwater Levels

Приложение 1. Результаты ежемесячного контроля уровня и температуры воды в мониторинговых скважинах для ТОО "Бакырчикское горнодобывающее предприятие" за отчетный период

№ п/п	ID скв.	Тип точки мониторинга	Описания места расположения	Координаты в системе 42 года		Высота	Диаметр (мм)		Проектная глубина	Информация по конструкции скважин	Дата бурения	Фактическая глубина	Высота над поверх-ностью	Требуется			Measured WL (mbdat)	
				x	y	z	внешний	внутренний						пок-раска	оголо-вник	фунда-мент	Jun-15	Jul-15
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	19
1	**1Н**		С восточной стороны пос. Ауэзов рядом с дамбой существующего хвостохранилища	508514.598	544623.069	442.114	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 4,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 6,0 м, перфорированная труба от 6,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	08.08.2007 г.	47.37	0.73	*		*	**2.41**	**2.47**
2	**2Н**			508580.233	544677.727	445.262	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 4,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 4,0 м, перфорированная труба от 4,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	12.08.2007 г.	51.08	0.82	*			**2.15**	**2.37**
3	**3Н**			508569.725	544753.157	446.368	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 6,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	16.08.2007 г.	49.21	0.79	*			**3.19**	**3.72**
4	**4Н**		С юго-восточной стороны пос. Ауэзов ниже дамбы существующего хвостохранилища	507901.737	545145.981	427.366	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 3,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 3,0 м, перфорированная труба от 4,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	20.08.2007 г.	50.68	0.92	*			**1.38**	**1.8**
5	**5Н**		С юго-восточной стороны пос. Ауэзов на левом берегу руч. Безымянный	507220.917	545073.301	416.584	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 2,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	24.08.2007 г.	10.8	1		*		**0.97**	**1.08**
6	**6Н**		С западной стороны от могильника мышьяксодержащего шлама	510103.773	545661.680	480.919	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 6,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	29.08.2007 г.	51.34	0.83	*			**2.38**	**2.83**
7	**7Н**		С западной стороны от могильника мышьяксодержащего шлама на правом берегу руч. Безымянный № 3	509912.565	545250.062	487.000	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	03.10.2007 г.	49.43	0.77			*	**15.6**	**16.69**
8	**7П**		С юго-восточной стороны пос. Ауэзов на правом берегу руч. Безымянный	507722.982	545092.346	426.291	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	22.10.2007 г.	51.48	0.88	*	*	*	**6.32**	**4.51**
9	**8П**			507719.328	545097.385	426.044	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	25.10.2007 г.	52.7	0.77		*	*	**4.59**	**5.78**
10	**9Н**		С западной стороны пос. Ауэзов на правом берегу руч. Акбастаубулак	539957.379	508640.693	371.715	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	03.09.2007 г.	51.66	1.14		*		**2.86**	**2.83**
11	**9П**		С западной стороны от могильника мышьяксодержащего шлама на левом берегу руч. Безымянный № 3	509930.832	545420.631	473.300	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	01.10.2007 г.	49.04	0.96			*	**0.82**	**1.06**
12	**10П**			509925.048	545425.032	473.300	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	29.09.2007 г.	45.26	0.54			*	**0.9**	**1.16**
13	**10Н**		С западной стороны пос. Ауэзов на левом берегу руч. Акбастаубулак	508556.077	539899.152	370.939	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	07.09.2007 г.	50.6	0.9	*	*		**1.06**	**0.47**
14	**11Н**		С восточной стороны пос. Ауэзов, с северной стороны от нового хвостохранилища	509642.802	544549.083	469.913	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 3,0 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	11.09.2007 г.	52.12	0.88	*			**14.76**	**15.72**
15	**11П**	**Наблюдательные скважины по программе производственного экологического контроля (ПЭК).**	С северо-восточной стороны от могильника мышьяксодержащего шлама	510465.000	546310.000	492.000	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	27.09.2007 г.	49.18	0.82	*			**11.86**	**12.73**
16	**12Н**		Северо-восточней п. Ауэзов, северо-западней могильника мышьяксодержащего шлама, северней дороги Ауэзов-Усть-Каменогорск	511178.710	544161.512	439.443	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	07.10.2007 г.	52.46	0.7				**3.28**	**5.44**
17	**13Н**		С северо-западной стороны от могильника мышьяксодержащего шлама, северо-восточней дороги Ауэзов-Усть-Каменогорск	510575.000	544899.860	468.500	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	07.10.2007 г.	51.22	0.78	*			**4.21**	**4.74**
18	**14Н**		С восточной стороны пос. Ауэзов, юго-западней отвала Южный	509408.042	543340.458	443.052	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	02.11.2007 г.	40.32	0.68			*	**8.5**	**11.5**
19	**15П**			509414.204	543337.569	442.383	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	15.11.2007 г.	38.92	0.74	*			**7.96**	**10.97**
20	**15Н**		С восточной стороны пос. Ауэзов, севернее существующего хвостохранилища	509781.000	544223.000	455.000	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	27.10.2007 г.	51.37	0.63	*		*	**2.6**	**3.14**
21	**16П**			509777.000	544229.000	455.000	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	30.10.2007 г.	47.77	0.73			*	**2.9**	**3.29**
22	**16Н**		С восточной стороны пос. Ауэзов, северо-восточней существующего хвостохранилища	509242.054	544049.848	456.604	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	12.10.2007 г.	51.86	0.89	*		*	**7.59**	**7.97**
23	**17П**			509237.090	544057.740	456.222	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	14.10.2007 г.	49.2	0.8	*		*	**7.2**	**7.59**

24	**17Н**		С северной стороны существующего хвостохранилища, под дамбой нового хвостохранилища	509108.853	544548.920	450.438	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	16.10.2007 г.	50.53	0.82	*		*	**1.46**	**1.79**
25	**18Н**			509076.724	544661.628	454.339	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	19.10.2007 г.	39.1	0.9			*	**4.39**	**5.03**
26	**18П**		Северо-восточней п. Ауэзов, северо-западней могильника мышьяксодержащего шлама, северней дороги Ауэзов-Усть-Каменогорск	511181.192	544156.074	439.301	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	11.10.2007 г.	44.59	0.71				**3.12**	**5.29**
27	**19П**		С северо-западной стороны от могильника мышьяксодержащего шлама, северо-восточней дороги Ауэзов-Усть-Каменогорск	510579.290	544894.000	468.500	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	10.10.2007 г.	51.74	0.82	*			**3.99**	**4.51**
28	**19Н (Ф)**		С северо-восточной стороны от могильника мышьяксодержащего шлама, с северной стороны дороги Ауэзов-Усть-Каменогорск	510947.000	546269.000	509.000	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	04.11.2007 г.	52.46	0.7			*	**19.44**	**19.2**
29	**20П**		С северо-западной стороны от могильника мышьяксодержащего шлама, юго-восточней дороги Ауэзов-Усть-Каменогорск	510234.526	545449.024	477.946	155	98	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 1,5 м - d=168 мм, пластиковая труба в интервале 0,0 до 50,0м - d=124 мм. Фильтровая колонна: глухая часть от 0,0 до 8,0 м, перфорированная труба от 8,0 до 50,0 м. Наружный d=124, внутренний d=98 мм.	06.10.2007 г.	49.28	0.72				**0.04**	**0.37**
30	**1э**	**Эксплуатационные скважины участка Кызылту.**	На правом берегу ручья Кызылту, восточнее запруды на ручье Акбастаубулак, в насосной будке.	511787.760	542459.408	412.121	295	245	35	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 6,4 м, перфорированная труба от 6,4 до 21,0 м d=273 мм.	26.11.1996 г.	34.25	0.25				**0.57**	**0.8**
31	**2э**		На правом берегу ручья Кызылту, на левом берегу устья ручья Жуматайбастау, в насосной будке.	511976.017	542837.906	417.520	295	245	41	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 5,8 м, перфорированная труба от 5,8 до 39,0 м d=273 мм.	26.11.1996 г.	43.44	0.16				**0.24**	**0.7**
32	**3э**		На правом берегу ручья Кызылту, рядом с постом охраны водозабора, в насосной будке.	512080.874	543331.447	428.500	295	245	50	Скважина оборудована насосной будкой". Фильтровая колонна: глухая часть от 0,0 до 6,8 м, перфорированная труба от 6,8 до 40,0 м d=273 мм.	26.11.1996 г.	51.55	0.45				**2.85**	**4.85**
33	**4э**		На левом берегу ручья Кызылту, восточнее поста охраны водозабора, в насосной будке.	511987.286	543766.665	435.200	295	190	50	Скважина оборудована насосной будкой". Трубы оставленные в скважине: глухая стальная труба в интервале от 0,0 до 11,0 м - d=273 мм, Фильтр не устанавливался (естественный).	30.11.1996 г.	15.58	0.42				**3.16**	**4.28**
34	**4Н**	**Наблюдательные скважины участка Кызылту.**	На левом берегу ручья Жуматайбастау, первая по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э.	512452.280	542857.883	423.879	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,16 до 3,2 м - d=133 мм. Фильтр не устанавливался (естественный).	05.06.2004 г.	25.27	1.16	*			**0.27**	**0.52**
35	**5Н**		На левом берегу ручья Жуматайбастау, вторая по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э.	512799.000	542983.000	434.030	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,92 до 7,4 м - d=133 мм. Фильтр не устанавливался (естественный).	06.06.2004 г.	25.85	0.92	*			**1.72**	**2.48**
36	**6Н**		На левом берегу ручья Жуматайбастау, третья по потоку ручья наблюдательная скважина севернее будки эксплуатационной скважины 2э.	513352.027	543199.033	446.572	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,91 до 2,5 м - d=133 мм. Фильтр не устанавливался (естественный).	08.06.2004 г.	25.38	0.91	*			**0.42**	**0.59**
37	**7Н**		На левом берегу ручья Кызылту, вторая по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э.	512399.000	543997.000	446.000	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,87 до 7,8 м - d=133 мм. Фильтр не устанавливался (естественный).	30.05.2004 г.	24.52	0.97	*		*	**0**	**0**
38	**8Н**		На левом берегу ручья Кызылту, первая по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э.	512191.262	543892.261	439.893	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,84 до 5,4 м - d=133 мм. Фильтр не устанавливался (естественный).	31.05.2004 г.	25.26	0.84	*		*	**0.29**	**0.57**
39	**9Н**		На левом берегу ручья Кызылту, третья по потоку ручья наблюдательная скважина северо-восточней будки эксплуатационной скважины 4э.	512548.000	544222.000	450.000	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,31 до 5,0 м - d=133 мм. Фильтр не устанавливался (естественный).	29.05.2004 г.	25.27	1.31	*		*	**2.27**	**3.14**
40	**10Н**		На правом берегу ручья Кызылту, северо-западней будки эксплуатационной скважины 1э.	511728.207	542298.139	409.959	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,10 до 5,2 м - d=133 мм. Фильтр не устанавливался (естественный).	11.06.2004 г.	24.88	1.65	*		*	**0.02**	**0.13**
41	**11Н**		С южной стороны пос. Ауэзов, севернее будки эксплуатационной скважины 2э.	511446.000	543015.000	430.000	146	112	30	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,13 до 0,8 м - d=133 мм. Фильтр не устанавливался (естественный).	12.06.2004 г.	30.28	1.13	*		*	**16.34**	**16.69**
42	**12Н**		С южной стороны пос. Ауэзов, севернее будки эксплуатационной скважины 3э.	511445.000	543536.000	429.380	146	112	25	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +0,89 до 0,6 м - d=133 мм. Фильтр не устанавливался (естественный).	14.06.2004 г.	25.42	0.89	*	*		**3.28**	**4.1**
43	**13Н**		С юго-восточной стороны пос. Ауэзов, северо-восточней будки эксплуатационной скважины 4э.	511333.000	544507.000	450.000	146	112	40	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,07 до 1,1 м - d=133 мм. Фильтр не устанавливался (естественный).	03.06.2004 г.	20.09	1.07	*		*	**1.42**	**1.75**
44	**14Н**		На правом берегу ручья Кызылту, восточнее запруды на ручье Акбастаубулак, северо-западней будки эксплуатационной скважины 2э.	511958.000	542055.000	419.000	146	112	40	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: глухая стальная труба в интервале от +1,14 до 2,4 м - d=133 мм. Фильтр не устанавливался (естественный).	10.06.2004 г.	41.64	1.14	*			**3.23**	**39**
45	**1р-э**	**Разведочно-эксплуатационные скважины участка Кызылту.**	На левом берегу ручья Кызылту, первая по потоку ручья разведочно-эксплуатационная скважина северо-восточней будки эксплуатационной скважины 4э	512753.000	544416.000	458.000	326	208	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,35 до 5,4 м - d=326 мм, в интервале + 1,16 до 50,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 6,29 м, перфорированной части 44,87 м, отстойника нет.	22.07.2004 г.	47.85	0.61				**0**	**0**
46	**2р-э**		На левом берегу ручья Жуматайбастау, вторая по потоку ручья разведочно-эксплуатационная скважина севернее будки эксплуатационной скважины 2э.	513077.566	543102.585	438.606	395	208	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,6 до 7,4 м - d=326 мм, в интервале + 1,16 до 50,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 9,84 м, перфорированной части 41,16 м, отстойника нет. Глубина перфорированной части фильтра от 8,84 до 50,0 м, d отверстий 14 мм, 950 шт. на погонный метр, скважность - 20%	21.01.2005 г.	34.13	1.07		*	*	**0.03**	**0.36**
47	**3р-э**		На левом берегу ручья Жуматайбастау, третья по потоку ручья разведочно-эксплуатационная скважина севернее будки эксплуатационной скважины 2э.	513558.925	543166.788	445.884	343	208	42	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,4 до 7,73 м - d=326 мм, в интервале + 0,76 до 42,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 8,75 м, перфорированной части 34,0 м, отстойника нет, d отверстий 14 мм, 950 шт. на погонный метр, скважность - 20%	02.10.2004 г.	40.53	1.02			*	**0**	**0**
48	**15р-э**		С южной стороны пос. Ауэзов, на правом берегу верхнего створа ручья Акбастаубулак.	512671.875	541373.070	419.031	395	208	42	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,5 до 4,55 м - d=326 мм, в интервале + 1,0 до 42,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 6,0 м, перфорированной части 38,0 м, отстойника нет, d отверстий 14 мм, 900 шт. на погонный метр, скважность - 20%	07.10.2004 г.	47.5	1				**0.59**	**0.72**
49	**16р-э**		С юго-западной стороны пос. Ауэзов, южнее фермы "Холодный ключ".	512551.000	539917.000	396.000	395	208	70	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,4 до 7,78 м - d=326 мм, в интервале + 0,81 до 70,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 5,81 м, перфорированной части 65,0 м, отстойника нет, d отверстий 14 мм, 900 шт. на погонный метр, скважность - 20%	20.07.2004 г.		0.75		*	*		**0**
50	**17р-э**		С юго-восточной стороны пос. Ауэзов, северо-восточней будки эксплуатационной скважины 4э.	511251.218	544452.730	448.270	395	208	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,4 до 2,2 м - d=326 мм, в интервале + 1,0 до 50,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 5,36 м, перфорированной части 65,0 м, отстойника нет, d отверстий 14 мм, 900 шт. на погонный метр, скважность - 20%	27.05.2004 г.	47.95	0.76	*		*	**0.54**	**0.75**
51	**18р-э**		С юго-восточной стороны пос. Ауэзов, северо-восточней будки эксплуатационной скважины 4э.	511573.051	544872.860	462.994	395	190	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,4 до 5,6 м - d=326 мм. Фильтр не установлен.	04.11.2006 г.	3.29	0.47	*	*	*	**0.01**	**0.3**
52	**19р-э**		На левом берегу ручья Кызылту, вторая по потоку ручья разведочно-эксплуатационная скважина северо-восточней будки эксплуатационной скважины 4э	512414.000	544007.000	443.000	395	190	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,4 до 7,5 м - d=326 мм. Фильтр не установлен.	19.09.2006 г.		0.31		*	*		**0**
53	**20р-э**		На левом берегу ручья Жуматайбастау, первая разведочно-эксплуатационная скважина севернее будки эксплуатационной скважины 2э.	512467.000	542865.000	424.080	343	208	50	Скважина оборудована бетонным воротником и оголовником под "ключ". Трубы оставленные в скважине: в интервале от +0,2 до 5,0 м - d=326 мм, в интервале + 1,0 до 50,0 м - d=219 мм. Фильтровая колонна наружный d=219, внутренний d=208 мм, длина общая верхней глухой части 6,0 м, перфорированной части 45,0 м, отстойника нет, d отверстий 14 мм, 950 шт. на погонный метр, скважность - 20%	03/08/2005	53.55	0.73			*	**0.49**	**0.79**
54	**1Ш**		На южном борту карьера №5-6	510013.000	540942.000	386.000	146	112	50	Скважина оборудована бетонным воротником и оголовником под "ключ".	2004 г.	50.66	0.67	*			**5.29**	**6.13**

55	**2Ш**	**Наблюдательные скважины по программе мониторинга шахтных вод**	Южнее карьера №5-7 на левом берегу ручья Алайгыр	510334.000	541020.000	390.500	146	112	50	Скважина оборудована бетонным воротником и оголовником под "ключ".	2004 г.	49.79	0.91	*			**1.42**	**1.51**
56	**3Ш**		Первая скважина южнее отвала пустых пород № 1, 3, 4, 7	510406.000	542181.000	417.000	146	112	50	Скважина оборудована бетонным воротником и оголовником под "ключ".	2004 г.	3.06	0.73	*	*	*		
57	**4Ш**		Вторая скважина южнее отвала пустых пород № 1, 3, 4, 7	510902.000	542239.000	424.000	146	112	50	Скважина оборудована бетонным воротником и оголовником под "ключ".	2004 г.	49.4	0.8	*			**13.11**	**12.67**
58	**5Ш**		Третья скважина южнее отвала пустых пород № 1, 3, 4, 7	511354.000	542299.000	408.650	146	112	50	Скважина оборудована бетонным воротником и оголовником под "ключ".	2004 г.	49.03	1.07	*			**2.63**	**2.9**

Динамика изменения глубины залегания уровня воды в скважинах №№1рэ, 19рэ, 8н, 9н в 2009-2014гг

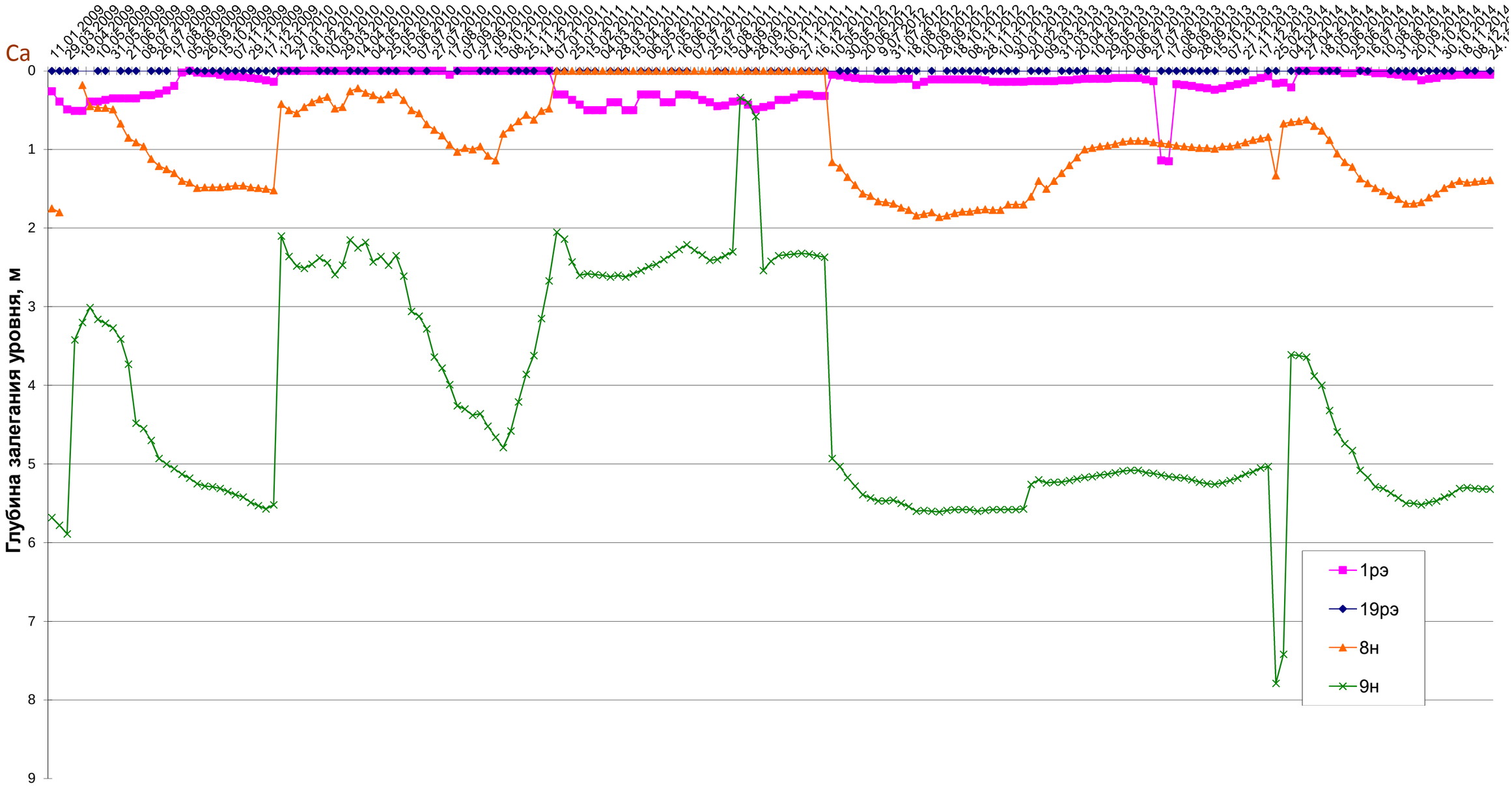


Рисунок 4

Динамика изменения глубины залегания уровня воды в скважинах 2рэ, 3рэ, 20рэ, 4н, 5н, 6н в 2009-2014гг

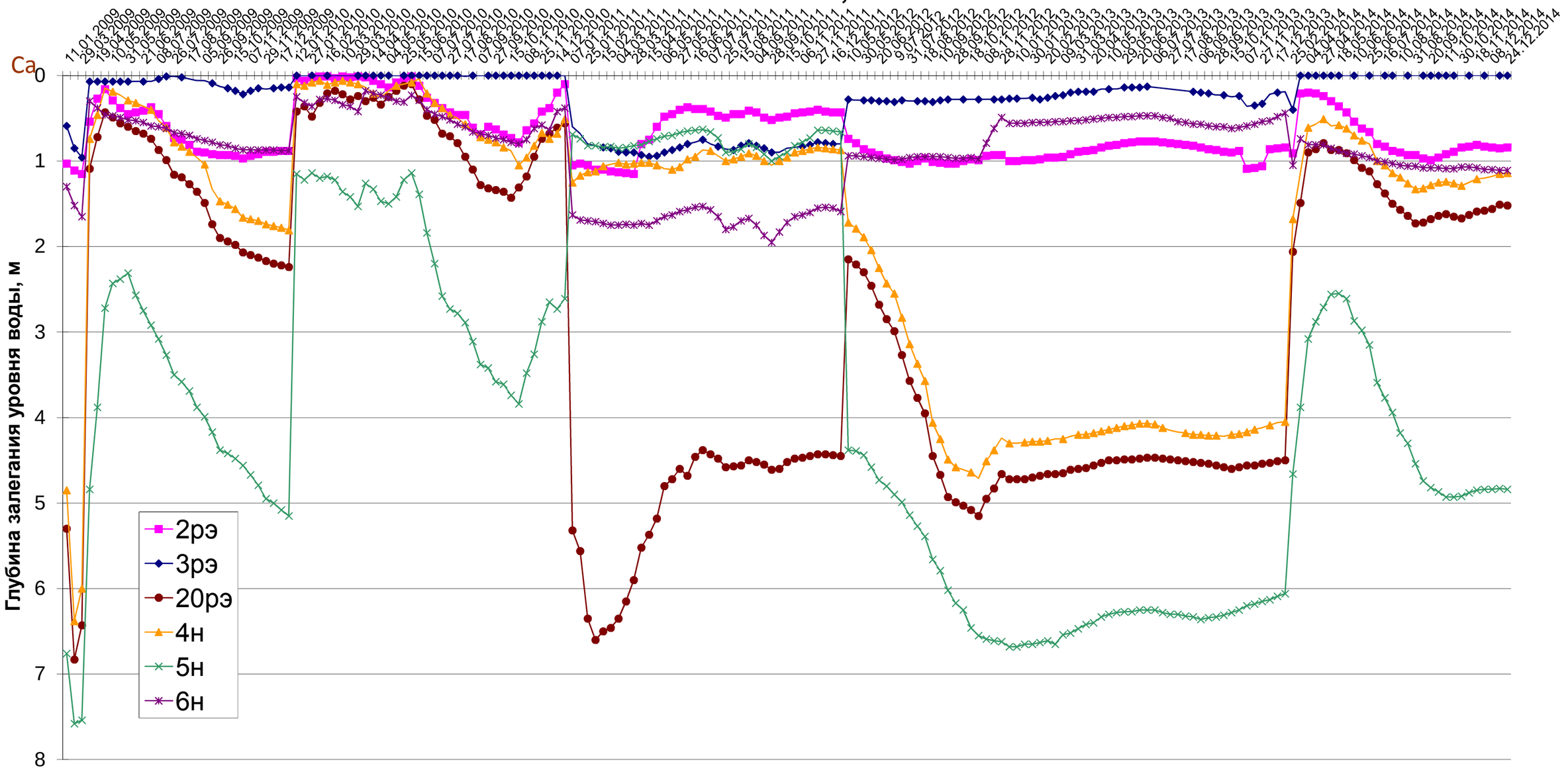


Рисунок 5

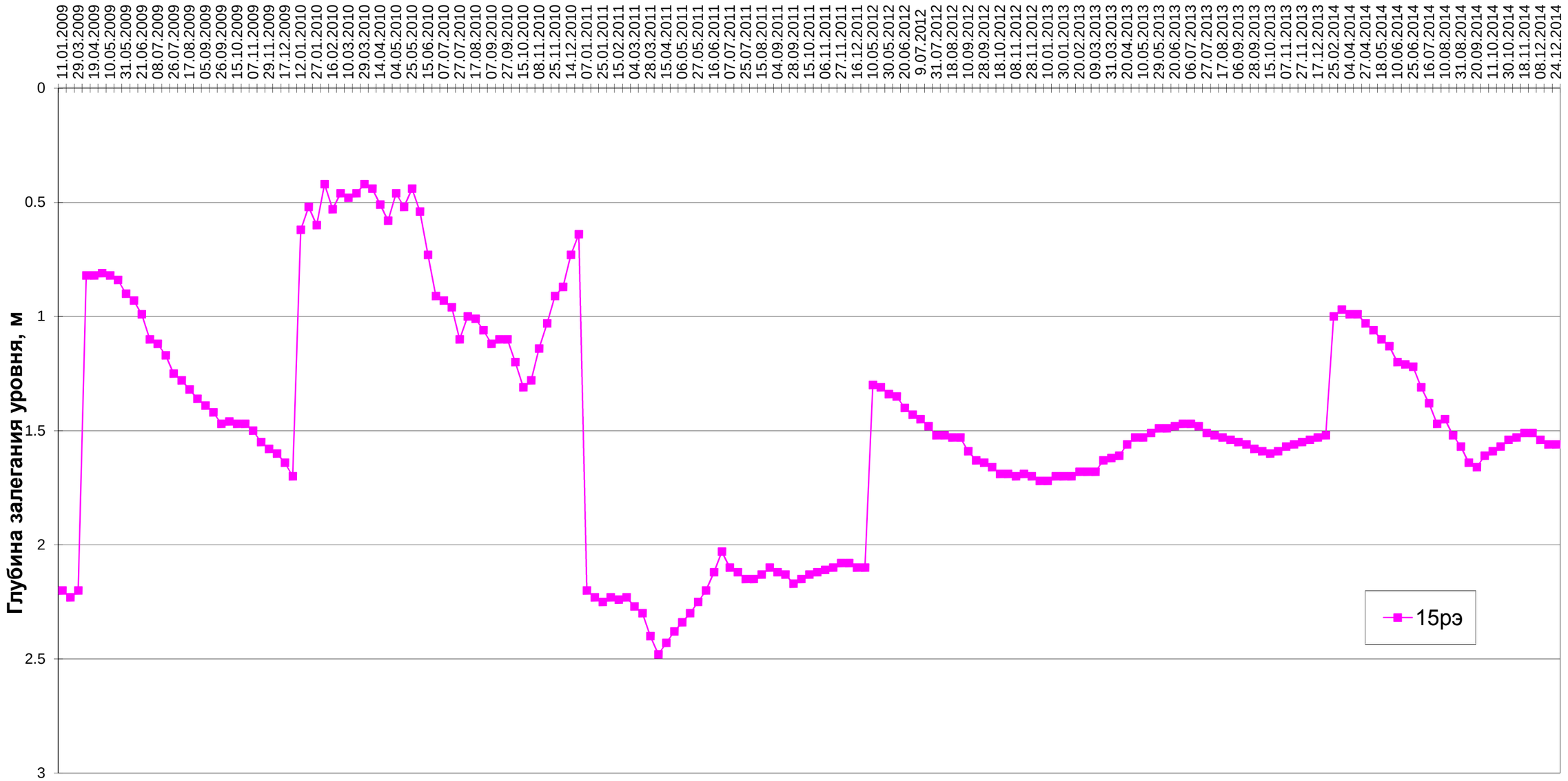

Динамика изменения глубины залегания уровня воды в скважине 15рэ в 2009-2014гг
Глубина залегания уровня, м
0
0.5
1
1.5
2
2.5
3
11.01.2009
29.03.2009
19.04.2009
10.05.2009
31.05.2009
21.06.2009
08.07.2009
26.07.2009
17.08.2009
05.09.2009
26.09.2009
15.10.2009
07.11.2009
29.11.2009
17.12.2009
12.01.2010
27.01.2010
16.02.2010
10.03.2010
29.03.2010
14.04.2010
04.05.2010
25.05.2010
15.06.2010
07.07.2010
27.07.2010
17.08.2010
07.09.2010
27.09.2010
15.10.2010
08.11.2010
25.11.2010
14.12.2010
07.01.2011
25.01.2011
15.02.2011
04.03.2011
28.03.2011
15.04.2011
06.05.2011
27.05.2011
16.06.2011
07.07.2011
25.07.2011
15.08.2011
04.09.2011
28.09.2011
15.10.2011
06.11.2011
27.11.2011
16.12.2011
10.05.2012
30.05.2012
20.06.2012
9.07.2012
31.07.2012
18.08.2012
10.09.2012
28.09.2012
18.10.2012
08.11.2012
28.11.2012
10.01.2013
30.01.2013
20.02.2013
09.03.2013
31.03.2013
20.04.2013
10.05.2013
29.05.2013
20.06.2013
06.07.2013
27.07.2013
17.08.2013
06.09.2013
28.09.2013
15.10.2013
07.11.2013
27.11.2013
17.12.2013
25.02.2014
04.04.2014
27.04.2014
18.05.2014
10.06.2014
25.06.2014
16.07.2014
10.08.2014
31.08.2014
20.09.2014
11.10.2014
30.10.2014
18.11.2014
08.12.2014
24.12.2014
15рэ

Рисунок 6

Динамика изменения глубины залегания уровня воды в скважинах 17рэ, 18рэ, 13н в 2009-2014гг

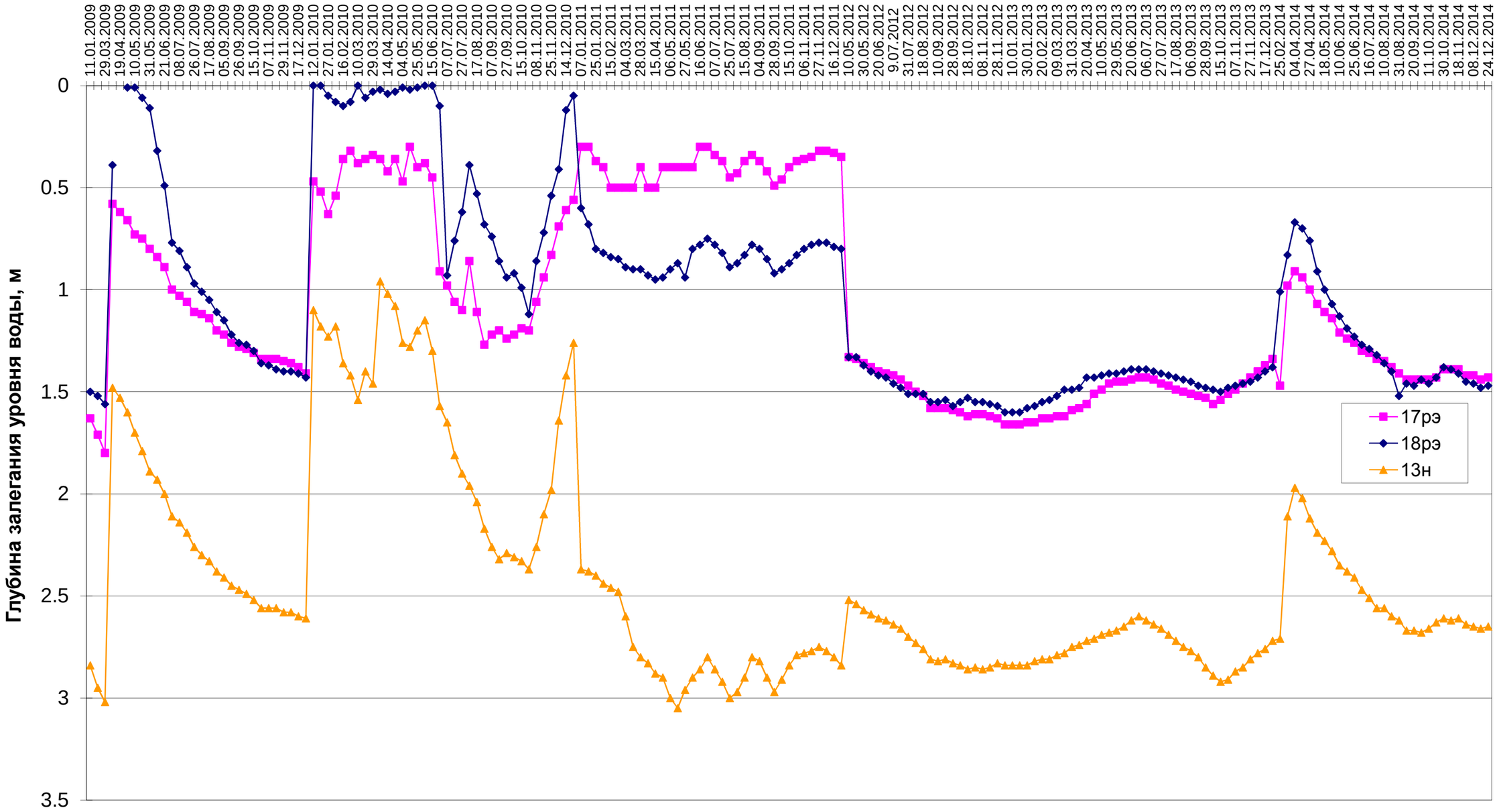


Рисунок 7

Динамика изменения глубины залегания уровня воды в скважинах №№ 10н, 11н, 12н, 14н в 2009-2014 гг.

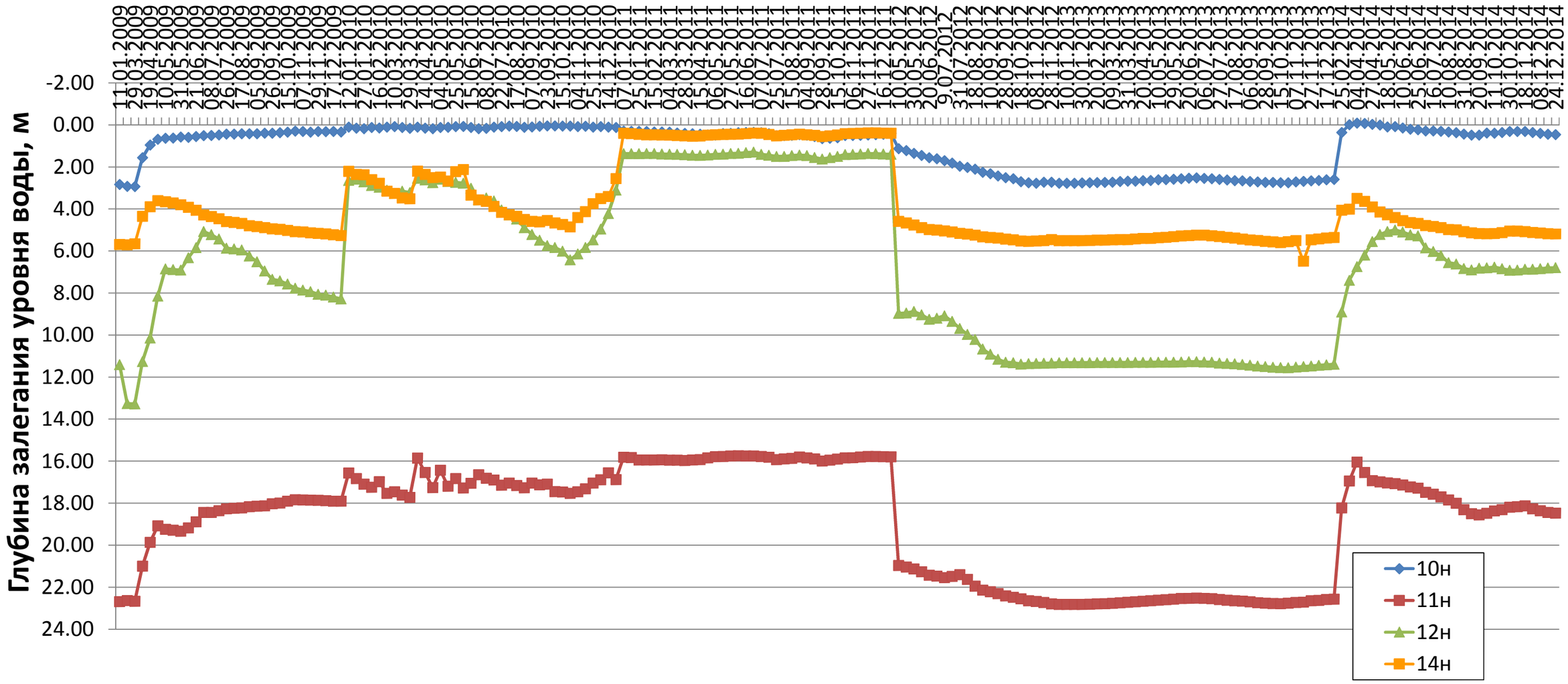


Рисунок 8

5 ENVIRONMENT AND SOCIAL IMPACT ASSESSMENT

This Chapter sets out the potential environmental and social impacts of the Project in all its phases (construction, operation and closure). It identifies the sources of impact associated with the Project's infrastructure and activities, as set out in Chapter 3. It also considers impacts induced by social changes associated with the Project, including direct employment as well as economic inputs and demographic changes. Impacts are assessed with regards to the regulatory framework and Project-specific criteria.

The assessment has been organised into the following main subject areas:

Environmental

- greenhouse gas emissions
- geochemical;
- air quality;
- noise and vibration;
- soils and land capacity;
- water resources; and
- biodiversity.

Social

- archaeology and cultural heritage;
- transport;
- governance, demography and culture;
- social infrastructure, health and education;
- economy, livelihoods and vulnerable groups; and
- ecosystems services.

The approach to environmental impact assessment differs to that of social impact assessment. The differing approaches are reflected in the methodologies described below.

5.1 General Approach for Environmental Impact Assessment

The discussion for each subject area generally follows a format that identifies and addresses:

- **Project Activities –** Describes the Project activities and/or sources of potential impact for that particular aspect;
- **Potential Impacts** – Describes the method used within each subject area to assess potential impacts, and explains any assumptions or modification to the general impact assessment methodology described here;

- **Mitigation Measures** – Describes the engineering design that has been incorporated to reduce impacts to acceptable levels;
- **Residual Impacts** – Re-assesses significance of impacts after mitigation is applied (assuming effective implementation of mitigation measures); and
- **Monitoring and audit** - Identifying the level of monitoring that will be necessary, over a defined period, to ensure that mitigation measures remain appropriate and maintain actual impacts within acceptable limits is considered in Chapter 8.

Within the ESIA, the methodology for assessing environmental impacts is distinct from that used in the social impact assessment. This is due to the qualitative nature of the analysis required for the social studies combined with the potential for significant positive change to take place, in social terms, subject to appropriate policies defined within management plans. In contrast, environmental impacts have generally been derived using quantitative assessment techniques related to aspects of the mine design and operation. In addition, the mitigation measures are generally focussed on reducing the effect of predicted impacts that, without the intervention of the appropriate mitigation, would result in a significant adverse effect. Environmental aspects have been summarised assessing significance from a combination of direction, duration, receptor sensitivity and magnitude. Significance is given over the short and long term with mitigation during construction and operation phases, providing a summary of mitigation measures.

5.1.1 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, within a general framework set out below.

Where quantitative techniques can be used, the approach adopted has been to model the natural environment and calculate the magnitude of the potential impact as a consequence of the Project activities. Where appropriate, the details of the methodologies used for the impact assessment have been considered within individual sections.

The predictions derived in the impact assessment chapters are subject to a degree of uncertainty, and this uncertainty is explained within each topic together 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 (see Drawings 5.1.1 and 4.12.1).

5.1.2 General Methodology

Four attributes that have been applied to determine the degree of significance have been defined as:

Direction

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

Duration

The duration of potential impacts associated with the Project is categorised as short-term or long-term, as defined in the context of each environmental aspect to take account of the receptor. However, for the majority of the environmental aspects, short-term has been defined as the construction and/or operational life of the Project and long-term effects are those that remain and continue after the post-closure phase of the Project.

Receptor Sensitivity

Receptor sensitivity has been defined in Table 5.1.1.

Table 5.1.1: Receptor Sensitivity Scale

	Sensitivity of receptor	**Description of receptor**
1	Minor	Low importance/receptor with low sensitivity; Abundant; Local importance or scale; Resilient to change; Potential for substitution within the local area.
2	Medium	Low to medium importance/receptor with low to medium sensitivity; Relatively abundant; Regional important or scale; Reasonably resilient to change; Potential for substitution.
3	High	Medium to high importance/receptor with medium to high sensitivity; Relatively rare; National importance or scale; Fragile and susceptible to change; Limited potential for substitution.
4	Very High	Very high importance/receptor with 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 Table 5.1.1 have been developed for each environmental aspect, taking into account the relevant performance standards that are applicable.

Magnitude

The magnitude of change has been defined in Table 5.1.2.

Table 5.1.2: Magnitude of Change Scale

	Magnitude of change	Description of change
1	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.
2	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.
3	Moderate	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.
4	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.

Defining Significance

Using the qualitative descriptions from the Receptor Sensitivity (Table 5.1.1) and Magnitude of Change (Table 5.1.2), scales have been mapped to produce an Impact Significance Matrix (Table 5.1.3).

Table 5.1.3: Impact Significance Matrix

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

Significant effect are those where the impact is moderate or greater, whereas minor and negligible are not significant. Positive changes are identified as a benefit to the receptor.

5.1.3 Mitigation Measures and Residual Impacts

Adverse effects rated as Significant must be mitigated in order to reduce the level of significance of the residual impact. Monitoring measures are required to ensure effectiveness of the mitigation.

The potential impacts, with mitigation imposed, have then been reassessed to derive residual effects as a result of Project activities. This assessment is based on the same methodology and Impact Significance Matrix as used to assess unmitigated impacts. The residual effect is determined as a result

of the impact and implemented through appropriate risk analysis based on the monitoring programme targeted to audit the effectiveness of the mitigation measure targeted on the potential impact.

5.2 Social Impact Assessment General Approach

Social impact assessment methodologies have been developed in accordance with international good practice to help decrease the adverse impacts from a Project and to maximise the benefits that a Project can have relating to the environment, communities and wider society. Similar to environmental aspects, impacts have been based on the development of the Project as outlined in the Feasibility Study and described in the Project Description section of this ESIA (Chapter 3).

Potential impacts associated with the Project are the factual description of the changes on a particular aspect of the social assessment. To assess the potential impact of the Project on a particular aspect, the degree of change caused to that aspect by the relevant components of the Project has been determined using a range of quantitative and qualitative techniques.

For the purposes of the SIA, potential impacts are therefore a descriptor of the change in social environments compared to the baseline conditions that have been identified and described in Chapter 4. The impact assessment methodology has considered impacts pre- and post-mitigation for the construction, operation and closure phase of the Project development. The methodology for each aspect of the study has been described in the relevant sections of the Chapter.

Effects which define the significance of a change in the socio-economic baseline conditions are based on the sensitivity of a specific receptor. The assessment of significance of these changes to the baseline has been based on the magnitude of the change and the sensitivity of the receptor to that change. IFC PS 1 (Assessment and Management of Environmental and Social risks) relates directly to the need to manage environmental and social risks throughout all stages of a Project. Therefore, where significant effects have been identified, the approach to mitigation and/or compensation has been defined through references to framework management plans. Appropriate mitigation measures for all anticipated social impacts have been based on the IFC mitigation hierarchy, as applied to environmental aspects (Figure 5.2.1).

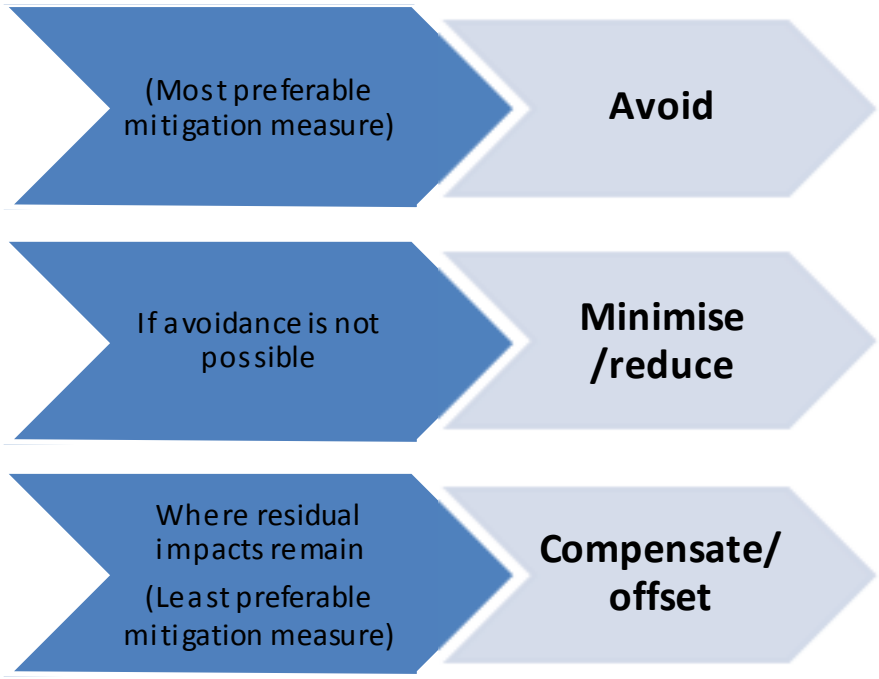


Figure 5.2.1: Mitigation hierarchy based on IFC guidance

Project impacts have been categorised as short-term or long-term, with long-term impacts identified as those which remain as permanent residual impacts from construction and operation of the actual Project, even after mitigation measures have been applied. The residual effect is determined as a result of the impact and implemented through appropriate risk analysis based on the monitoring programme targeted to audit the effectiveness of the mitigation measure targeted on the potential impact. A summary of impacts, including residual impacts, has been provided at the end of each section.

The SIA process relates to a range of social subjects that have been identified in the scoping study as being impacted by the development of the Project, including:

- Demography, culture and governance;
- Social infrastructure;
- Economy, Livelihoods and Labour;
- Community health and
- Human rights impacts.

Where significant effects are identified, the approach to mitigation has been cross referenced to framework management plans to include social management planning for construction, operation and closure phases. Polymetal has established their own Environmental and Social Management system (ESMS). The ESIA is accompanied by a range of essential framework management plans that Polymetal should continue to develop before the Project becomes fully operational. These management plans will be an essential part of the ESMS.

All significant socio-economic impacts have been described and the recommended mitigation or enhancement measures are then stated, alongside a summary of any residual impacts. The following criteria, derived from the International Association of Impact Assessment [1] (IAIA) and amended by WAI are used to classify the socio-economic impacts:

Impact Nature: Socio-economic impacts may be positive or negative in nature. Impacts that enhance the social and economic dimensions of people's lives are classed as positives. In contrast, impacts that debilitate the socio-economic dimensions of people's lives are deemed to be negative [2].

Impact Causality: Socio-economic impacts can also be direct, indirect or cumulative. Conventionally, direct socio-economic impacts are considered to be the first socio-economic impacts in a chain of causation from the Project source. Indirect socio-economic impacts are the second, third, or subsequent impacts in a chain of causation from the Project source. Cumulative socio-economic impacts result from more than one direct or indirect impact acting together, or from the incremental impact of an action when added to other past, present or future actions [3].

To adequately enable socio-economic impacts to be determined, the calculation below factors in both the magnitude of impact (duration of impact and scope of impact), which for socio-economic impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity of communities and considers whether vulnerable people are affected).

The following criteria have been used to calculate significance of the socio-economic impacts and have been derived from the International Association of Impact Assessment (IAIA) methodology and adapted by WAI for Kyzyl.

Total socio-economic impact = Qti (duration of impact) x Qsi (scope of impact) x Qji (intensity of impact)

Based on this calculation, the significance of the socio-economic impact is categorised into the following groups:

- Negligible: 1 to 2 (adverse or positive);
- Low: 3 to 12 (adverse or positive);
- Moderate: 13 to 31 (adverse or positive); and
- High: 32 to 64 (adverse or positive).

The potential socio-economic risk or opportunity is a function of combining the significance of the

[1] IAIA (2000*) Development of SIA*. Web Page. www.ext.nodak.edu/IAIA

[2] Vanclay, F. (2000) *Social Impact Assessment*. In *Handbook of Environmental Impact Assessment*, Vol. 1 (ed. J. Petts), pp. 301-326. Oxford: Blackwell Science.

[3] Barrow, C (1997) *Environmental and Social Impact Assessment*. London: Arnold.

socio-economic impact with the probability of the socio-economic impact occurring.

5.2.1 Definitions:

Impact Scope: This relates to the number of people affected by the impact. Table 5.2.1 contains the classifications used to quantify the scope of the impact:

Table 5.2.1: Scope of Impact ($Q^{s}i$)		
Scale (qualitative)	**Scale (quantitative)**	**Score**
Very low number	Less than 100 people	1
Low number	100 – 1,999 people	2
Medium number	2,000 – 9,999 people	3
High number	More than 10,000 people	4

Impact Duration: This relates to the time period of the impact. Duration of impacts have been defined in accordance with the Project timetable. The following table (Table 5.2.2) contains the classifications used to quantify the duration of the impact:

Table 5.2.2: Duration of Impact ($Q^{t}i$)		
Scale (qualitative)	**Scale (quantitative)**	**Score**
Short-term	Up to 1 year	1
Medium-term	1-9 years	2
Medium to long-term	10-20 years	3
Long-term	More than 20 years	4

Impact Intensity: Impact intensity relates to the level of costs and benefits associated with the impact. Determination of intensity is context dependent and therefore a factor of a number of variables including; the relative cost or benefit to potentially impacted groups and individuals given their proximity, resilience, adaptability, and vulnerability. The following table (Table 5.2.3) outlines the classifications used to quantify the level of benefits and costs to impacted groups and individuals:

Table 5.2.3: Impact Intensity - Impacts (Qji)	
Intensity	**Score**
Negligible – Negligible adverse impact intensity/beneficial impact. Very low cost:benefit ratio to potentially impacted groups/individuals based on them being: distant communities/individuals or groups of people who are very highly resilient and adaptable. Minimal impact on identified vulnerable groups of people.	1
Low – Low adverse impact intensity/beneficial impact. Low cost:benefit ratio to potentially impacted groups; distant communities that are highly resilient and adaptable; Low impacts on identified vulnerable groups of people.	2
Moderate – Moderate adverse impact intensity/beneficial impact. Moderate cost:benefit ratio to potentially impacted groups/individuals based on them being: less distant communities/individuals that are moderately resilient and adaptable; Moderate impacts on identified vulnerable groups	3
High – High adverse impact intensity/beneficial impact. High cost:benefit ratio to potentially impacted groups/individuals based on them being: close communities/individuals with low levels of resilience and adaptability; Large impacts on identified vulnerable groups people	4
Note: For positive impacts the cost:benefit ratio is reversed so benefit:cost is considered	

Once the total significance of the pre-mitigation socio-economic impact has been calculated, it is reassessed using the same significance scoring but assuming that recommended mitigation or enhancement measures are in place. The purpose of the mitigation and enhancement measures is to avoid/minimise/compensate/offset the total negative socio-economic impacts or maximise the total positive socio-economic impacts. The Stakeholder Engagement Plan (SEP – Management Plan10) provides management measures to assist in maximising the positive impacts from the Project and minimising adverse impacts. In line with typical EIA methodology, the SIA methodology has been used

to calculate significance of impacts for all Project activities over each phase of the Project (construction, operation and closure), with both pre- and post-mitigation measures in place.

The SIA has also included an assessment of Risk, which is the process of quantifying the probability of harmful effects to individuals or populations as a consequence of human activities:

Risk = impact significance x likelihood (probability) of occurrence

To enable this calculation to be made, a categorisation of probability (likelihood) has been made as negligible, low, moderate and high. Risk has been considered in the context of socio-economic impacts, where the probability of something occurring is more easily distinguishable based on socio-economic impacts on communities. Mitigation measures for socio-economic impacts have been developed to account for risk of occurrence.

Mitigation and Enhancement of Socio-Economic Impacts

The purpose of mitigation and enhancement measures is respectively to avoid, reduce/minimise or offset/compensate the total significance of adverse socio-economic impacts or to maximise the total significance of positive socio-economic impacts. Having ascertained the total significance of the pre-mitigation or pre-enhancement socio-economic impacts, the impacts are then reassessed using the same significance scoring method outlined above but assuming that recommended mitigation or enhancement measures are in place to address the impact. In this way, the total significance of post-mitigation or post-enhancement impacts, known as the residual impacts, are obtained.

Monitoring of Socio-Economic Impacts

There are a multitude of variables involved in all major Projects that can affect the scope and accuracy of the assessment of socio-economic impacts in advance. This challenge becomes even greater when it involves assessing Project actions and impacts many years in advance of their likely occurrence. Therefore, a purely ex ante approach is inadequate; it will thus be necessary for Polymetal to implement a comprehensive socio-economic monitoring programme.

5.3 Application of the Methodology for Specific Environmental and Social Aspects

Within each section of the impact assessment, the application of the approach and methodology has been considered with specific reference to the relevant IFC Performance Standard and other relevant criteria and/or targets that relate to the discipline. In addition to the general environmental and social impact methodologies outlined above, specific methodologies or modifications have been applied for biodiversity, community health and safety, transport and cultural heritage impact assessment. These are described in detail in the relevant sections.

Defining the significance of effects has been used as the basis for determining the appropriate mitigation strategies in combination with identifying the need and scope of management plans. The structure and approach to the Environmental and Social Management Plan (ESMP) has been considered in Chapter 8.

5.4 Greenhouse Gas Emissions and Climate Change

This chapter evaluates and assesses the greenhouse gas (GHG) emissions attributable to the construction, operation and closure of the Kyzyl Project, and the potential effects climate change could have on the Project (such as temperature and precipitation changes).

The chapter has been prepared in accordance to the International Finance Corporation (IFC) 2012 Performance Standards[1] (PSs), as well other relevant best practices which are referenced at the appropriate parts of this chapter (see Table 5.4.1).

Table 5.4.1: IFC Performance Standards Key Relevant Requirements

Greenhouse Gases	Climate Change
PS1 requires that the risks and impacts identification process evaluates emissions of GHG.	**PS 1** requires that the risks and impacts identification process considers the relevant risks associated with a changing climate and the adaptation opportunities.
PS 3 requires consideration of measures for improving efficiency in consumption of energy, water, as well as other resources and material inputs. Also, options should be considered to reduce project-related GHG emissions during the design and operation of the project. For projects producing >25,000 tonnes of carbon dioxide equivalent (tCO_2e) per year, the direct GHG emissions within the physical project boundary and indirect emissions associated with offsite production of energy (i.e. purchased electricity) should be quantified in accordance to internationally recognized methodologies (i.e. IPCC).	**PS 4** requires that projects should take into account the fact that communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts from project activities since climate change effects may exacerbate their vulnerability; and projects must identify and mitigate risks and potential impacts on priority ecosystem services that may be exacerbated by climate change.

All data relating to the volume of emissions and the processes involved and calculations included in this assessment have been based on information contained in the Feasibility Study for the project and supplied by the Client. Wherever possible this data has been corroborated to ensure it is consistent and realistic and that the methodology behind any calculations is correct but a detailed audit of the data has not been undertaken.

5.4.1 Introduction

The biggest potential impacts associated with carbon emissions and greenhouse gases are global warming and climate change. At the project level global warming may seem distant, disconnected and irrelevant but IFC Performance Standard 3 now requires projects producing more than 25,000 tonnes of CO_2 annually quantify these emissions each year in accordance with internationally recognised methodologies. Understanding the volume of these emissions and consequently working

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

to reduce them can make considerable savings, not just for the country in which the project is based but also at the global level.

GHG emissions are of particular interest in the Country: "*Kazakhstan's total greenhouse gas (GHG) emissions are about 250 million tons of carbon dioxide equivalent, representing the highest level per capita of Central Asia and corresponding to one of the highest carbon intensities (5.41 kilograms of carbon dioxide per unit of gross domestic product in 2008) in the world. Climate change poses serious threats to the economic growth, quality of life, and energy security of Kazakhstan, over and above current environmental problems. Climate patterns are already changing, with significant adverse impacts expected in coming decades— including reduced glacier extent and river runoff, lower water availability, increased risk of mudslides, and more frequent extreme weather events*."[2]

In addition to reducing Climate Change impacts, improved energy efficiency measures and greater deployment of renewable technologies can have benefits for local people living near the mine as well as for the mining company itself.

Energy efficiency measures can help to avoid stresses being placed on the local power distribution grid and as well as saving money for the operators. Making use of the renewable technology can reduce on site emissions by offsetting energy from diesel generators, thereby improving local air quality. Renewable technologies are also likely to reduce the need for deliveries of fossil fuel to site and hence reduce the number of fuel deliveries and potentially leave a positive legacy for local people after the mine closure.

5.4.2 Scope of Assessment

Greenhouse gas (GHG) emissions have been calculated for the project based on both an annual and cumulative basis. The calculations have assessed the net gain in GHG emissions attributable to the Zyzyl Project, acknowledging that it is an existing mine that has been in care and maintenance for over 5 years and that the new proposals represent a considerable expansion in to previously unmined ground. The Project will inevitably generate new GHG emissions. The extent of these emissions has been calculated using standard methodologies as defined by the Greenhouse Gas Protocol [3].

The Greenhouse Gas Protocol divides emissions into three categories as follows and illustrated in Figure 5.4.1:

- Scope 1 – direct emissions: from sources owned or under the operational control of the company or project;

[2] "*Environmental Assessment (Summary)*" Asian Development Bank - Country Partnership Strategy: Kazakhstan 2012–2016, based on Asian Development Bank. 2011. Country Environment Note-Kazakhstan; Analytical Report on Climate Change Impacts and Response Measures (Kazakhstan); and Climate Risk Management and Adaptation Roadmap. Manila (unpublished consultant's reports, November)

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

- 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.

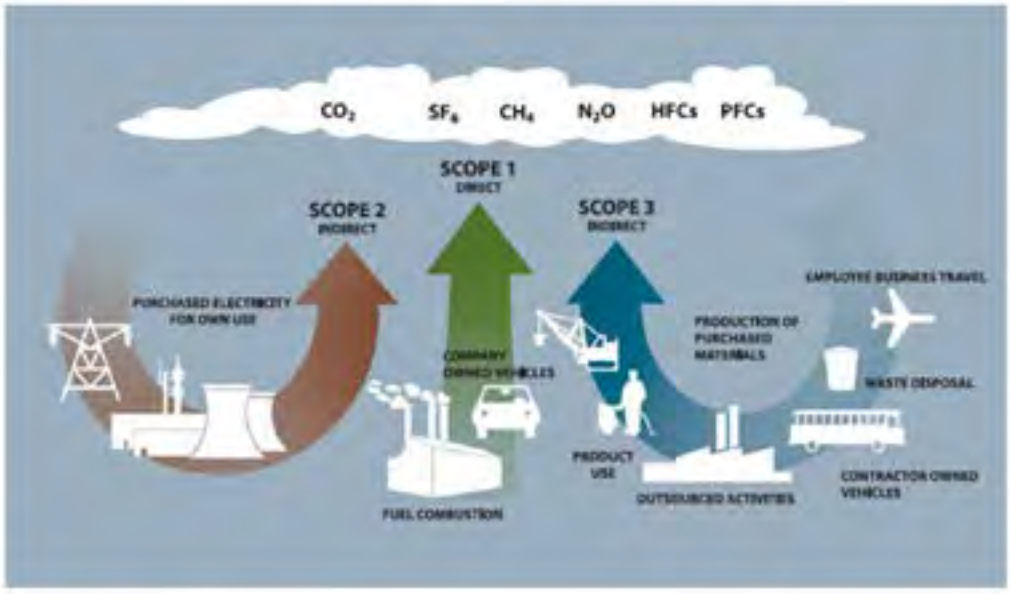


Figure 5.4.1: GHG Emissions Boundary (Source: Greenhouse Gas Protocol)

Consistent with the requirements of the IFC Performance Standards, the scope of emissions that have been assessed for the Kyzyl Project are within scopes 1 and 2.

5.4.3 Scope 2: Indirect Emissions - Kazakhstan Power Grid

Consideration of emissions arising from electricity produced off-site and imported to the site through the Kazakhstan National Grid has been based on the EBRD-commissioned report, "*Carbon Emission Factors Report for Kazakhstan*"[4].

This report identifies the expected composition of electricity generation to the year 2020 (see Figure 5.4.2 below). Although low carbon generation in the form of renewable energy, hydropower and nuclear power, can be seen to be increasing throughout the period this is offset by the increase in overall energy generation and the electricity mix remains dominated by fossil fuels and chiefly coal-fired power plants.

[4] "*Carbon Emission Factors Report for Kazakhstan*" European Bank for Reconstruction and Development (EBRD) commissioned report produced by Laymeyer International, 2012 (LI 260574)

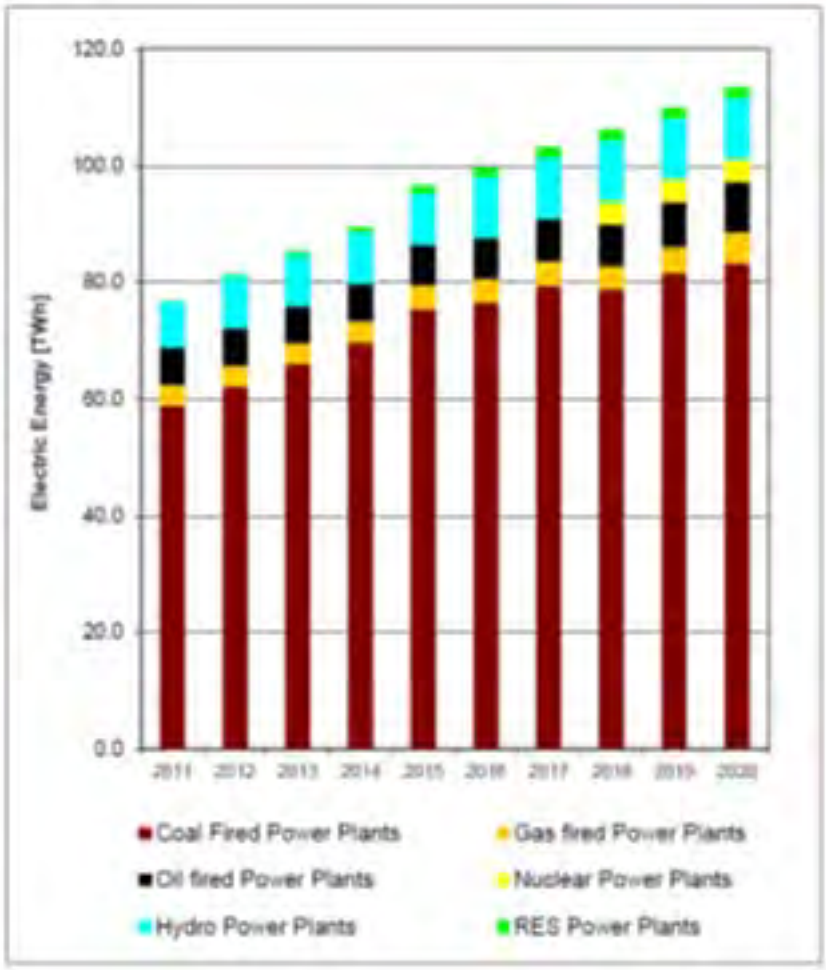


Figure 5.4.2: Forecast Kazakhstan grid energy mix

(Carbon Emission Factors Report for Kazakhstan – EBRD)

Emissions factors indicating the amount of CO_2 that will be produced per MWh of electrical generation have also been provided within this report, based on the projected energy mix. The figures are reproduced below in Table 5.4.2.

Table 5.4.2: Demand-Side Carbon Emissions Factors for Period 2011-2020

[*t CO_2/MWh*]	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
UPS Kazakhstan	1.004	1.002	1.000	1.001	0.995	1.003	0.998	0.918	0.921	0.919

Although emissions factors are only given to 2020 for the purposes of these calculations an assumption has been made that the 2020 factor of 0.919 will continue to the end of the life of mine following decommissioning in 2041. In reality this is unlikely to be the case with the expected decarbonisation of the grid helping to reduce emissions associated with the project.

5.4.4 Project Activities Giving Rise to GHG Emissions

Potential GHG emissions arising from the Project will occur during exploration, construction, operations, and decommissioning phases of the project as follows:

- Exploration phase emissions are associated with activities and travel to date and will be reported in the Carbon and Energy Management Plan (see Table 5.4.2);
- During the construction phase of the project, Scope 1 emissions from GHGs will be emitted from the following activities:
  - Clearing of vegetation (land use change) for mine pit, tip and tailings damand construction of project facilities (land use change is applied to the life of the mine as the construction of new elements of the mine are undertaken through its operational life);
  - Construction vehicles and equipment for construction of mine facilities;
  - Fuel use from diesel generators;
  - Any blasting required as part of the construction works;
- During construction, Scope 2 indirect emissions will arise from electricity that is sourced from the Kazakhstan grid. Such activities may include the use of power tools, cement mixers, lighting, compressors, electric heating etc. Electricity will also be required for welfare facilities for employees during the construction phase and for ancillary equipment. Usage has been estimated based on figures provided by the client;
- During operations, GHG will arise from both Scope 1 (direct) and Scope 2 (indirect) sources. The operational phase is divided into two stages: open pit mining and underground mining. Sources include:
  - On-road vehicles for hauling of ore and barren material;
  - Non-road vehicles for mining of ore;
  - Explosives for blasting;
  - Mineral processing;
  - Heating requirements within the site
  - Scope 2 indirect emissions will come from electricity that is sourced from the Kazakhstan grid. This electricity will be used for equipment including pumping and ventilation ancillary and welfare facilities. This includes a 100 seat canteen at the ore processing site. Some facilities will be maintained within Auezov including some accommodation (the Kazakhstan hotel and Block A hotel). It is expected that all other employees would be commuting from their homes to the Project site and these emissions have not been taken into account;
- 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 and waste facilities.

5.4.5 GHG Emissions during Construction

GHG emissions will be emitted from clearing of land, and use of both on-road and non-road vehicles for the construction of mine facilities. Steppe grassland is not a known carbon sink so the loss of this soil type in itself is likely to have a negligible effect on the volume of emissions.

As part of the construction work a tailings dam will be constructed which will be lined and flooded as required. The aim will be to keep the volume of water within the tailings dam to a minimum but this will nonetheless have a footprint of 1,380,000m^2 and this area will need to be cleared of vegetation and fitted with a waterproof liner. Given the arid environment and the limited vegetation that exists on-site vegetation clearance is not expected to contribute greatly to emissions. The land allocation for the construction and operation of the Kyzyl Project and processing plant covers approximately 2328.8 hectares of land[5].

The initial phase of mine construction (involving the open pit development) will be mainly focused over a two year period 2016-2017, with minor construction works taking place over the following years leading up to phase two (the underground phase). Construction activities will restart in 2022 in preparation for phase two in 2025 and continue works which will again reduce once phase two becomes operational. Construction activities are expected to halt around 2029 following completion of the second phase of construction works. The underground mining operation will continue to operate until 2039 when the mine closure plan will be enacted and decommissioning will commence.

On-road vehicles such as diesel powered trucks and non-road vehicles such as bulldozers will be used throughout the construction phase. It is estimated that during the construction period approximately 4100 tonnes of diesel fuel will be consumed.

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 time span. For this reason CO_2 associated with cement has 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 therefore have been included.

The use of electricity from the Kazakhstan grid for the lighting, heating, and operations of the temporary construction camp and offices for employees will contribute to GHG emissions, however

[5] Bakyrchik Mining Venture LLC, "The Bakyrchik Gold Deposit Mine and Process Plant Construction Feasibility Report - Volume 5: Infrastructure and power supply system" Polymetal Engineering JSC, St Petersburg, 2015 (Table 1.1, page 27)

will be minimal. During 2017, the year of heaviest construction works, the developer has estimated approximately 1300MWh of electricity would be used. Diesel generators would be operational in the case of electricity shortage. For this analysis, it is assumed that there will be transportation for employees from the temporary construction camp to main mining site.

The estimated GHG emissions for the entire duration of the construction phase amount to 17,581 metric tonnes of carbon dioxide equivalent (tCO_2e) which are summarized in Table 5.4.3 below. It is not particularly helpful to consider average annual emissions in relation to the construction phase as there is considerable variation in the levels of construction activities throughout the lifetime of the mine. It should be noted that there are some elements of construction that will take place throughout the lifetime of the project but most construction activities will be focused in the years, when the open pit phase of the mining operations will be largely constructed, and also in when the mining operations move to the underground phase of development.

Table 5.4.3: Summary of Total GHG emission from Construction Phase

	CO_2	CH_4	N_2O	CO_2e[iii]
	tonnes	tonnes	tonnes	tonnes
Fuel Use [i]	12777	0.672	0.672	13000
Electricity[ii]				4582
Blasting				0
Total				17582

Notes:
(i) CO_2, CH_4, N_2O emissions have been estimated based on IPCC National Inventory Methodology, Volume 2 Chapter 1. See also Table 1 in Appendix 5.4.1 for detailed table of GHG emissions due to fuel use
(ii) See Table 2 in Appendix 5.4.1 for detailed table of GHG emissions due to electricity
(iii) CO_2e emissions were estimated based on a global warming potential of 1, 21, and 310 for CO_2, CH_4, and N_2O, respectively (40 CFR Part 98, Subpart C).

5.4.6 GHG Emissions during Operation

The Kyzyl Project is proposed to operate in two stages:

i. 2016-2024 - Open pit mining; and
ii. 2025-2039 – Underground mining

The calculated annual GHG emissions for the operation of the mine during each of these stages are presented in Table 5.4.4 and Table 5.4.5 and were based upon the following:

- Direct emissions from use of on-road and non-road vehicles, which will be emitted during the operational phase of the project. On-road vehicles such as haul trucks will be used to transport ore and barren material. Over the lifetime of the project, ore will be transported from the Bakyrchik deposit to the mineral processing plant. Ore mined from the open pit will be transported to the primary crushing plant by diesel haul trucks. Additionally, barren rock from the open pit will be hauled to the overburden dump. GHG emissions from use of on-road and non-road vehicles will

vary each year the mine is under operation based upon the final mining sequence. For the purposes of this chapter, given this potential variation, which will only be resolved once operations commence, a conservative approach has been adopted by using the estimated highest volume of fuel required.

- The use of diesel fuel to transport employees from apartments and hotel accommodation in Auezov Town to the site. It is estimated that during the open-pit stage 608 personnel will be required on site daily and this will increase to 1084 personnel during the underground stage. Shift personnel will be transported to site by passenger vehicles. Transportation services would be available 365 days per year.
- Additionally, emissions from the ANFO blasting agent and primer (Ammonite) will contribute to direct operating GHG emissions. The amount of ANFO used will vary depending on the stage of operation. During the open-pit stage consumption of ANFO is expected to be approximately 18,000t per year, reducing to about 2400t/y once operations move underground.
- Indirect GHG emissions will arise from electricity generation needed to power equipment, ancillary facilities, processes, and the hotel accommodations for employees. Electricity will be sourced from the national Kazakhstan grid. It is estimated that the project facilities will use on average 109,735MWh of electricity per year from the Kazakhstan grid during the open pit operation and 76,911MWh per year once the mining operations move underground. The grid emission factors used in this analysis have been based on figures produced for the EBRD report, *"Carbon Emission Factors Report for Kazakhstan"*[6].

Table 5.4.4: Summary of Mean Annual GHG Emissions from the Open-Pit Operational Phase

	CO_2	CH_4	N_2O	CO_2e
	Tonnes/year	Tonnes/year	Tonnes/year	Tonnes/year
Direct Emissions				
All vehicles and equipment – fuel use(i)	81,646	3.927	3.927	82,945
Heating (Coal Boiler)(ii)	8,892	0.001	0.001	8,915
Blasting – use of explosives(iii)				3,092
Indirect Emissions				
Electricity(iv)				113,207
Total				208,160

Notes:
(i) See Table 3 in Appendix 5.4.1 for detailed table of GHG emissions due to fuel use
(ii) See Table 4 in Appendix 5.4.1 for detailed table of GHG emissions due to coal
(iii) See Table 5 in Appendix 5.4.1 for detailed table of GHG emissions due to explosives
(iv) See Table 6 in Appendix 5.4.1 for detailed table of GHG emissions due to electricity

[6] *"Carbon Emission Factors Report for Kazakhstan"* European Bank for Reconstruction and Development (EBRD) commissioned report produced by Laymeyer International, 2012 (LI 260574)

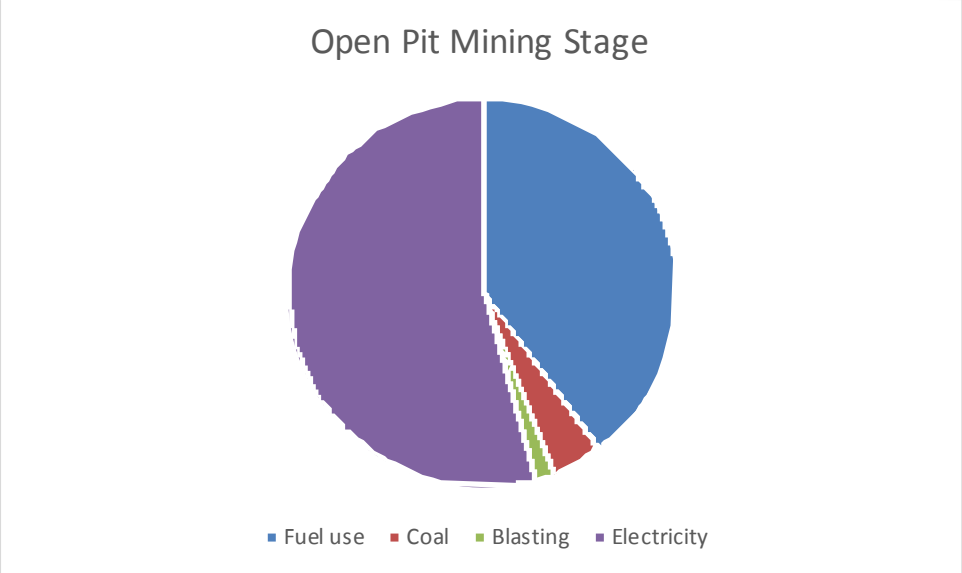


Figure 5.4.3: Ratios of GHG Emissions in CO_2e arising from Open Pit Mining Stage

As shown in Figure 5.4.3 and Figure 5.4.3, indirect emissions are the main source of operational GHG emissions during the open pit stage, followed by diesel use. The indirect emissions are elevated in part due to the very high emissions factor in Kazakhstan.

Table 5.4.5: Summary of Mean Annual GHG Emissions from the Underground Operational Phase

	CO_2	CH_4	N_2O	CO_2e
	Tonnes/year	Tonnes/year	Tonnes/year	Tonnes/year
Direct Emissions				
All vehicles and equipment – fuel use[(i)]	15,930	0.838	0.838	16,207
Heating (Coal Boiler)[(ii)]	10,829	0.001	0.001	10,856
Blasting – use of explosives[(iii)]				408
Indirect Emissions				
Electricity[(iv)]				157,711
Total				185,183

Notes:
(i) See Table 3 in Appendix 5.4.1 for detailed table of GHG emissions due to fuel use
(ii) See Table 4 in Appendix 5.4.1 for detailed table of GHG emissions due to coal
(iii) See Table 5 in Appendix 5.4.1 for detailed table of GHG emissions due to explosives
(iv) See Table 6 in Appendix 5.4.1 for detailed table of GHG emissions due to electricity

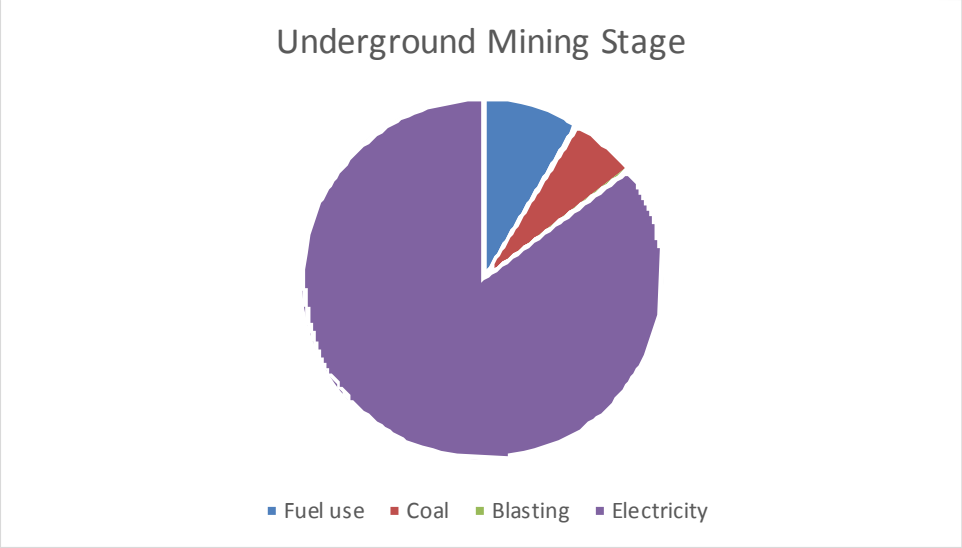


Figure 5.4.4: Ratios of GHG Emissions in CO_2e arising from Underground Mining Stage

As shown in Table 5.4.5 and Figure 5.4.4, the main source of operational GHG emissions during the underground mining stage is still indirect emissions associated with imported electricity. Electricity consumption actually increases considerably in the underground phase with more power required for pumping and ventilation. Renewable policies which have recently been employed in Kazakhstan may begin to reduce the emissions factor associated with grid electricity into the next decade but at this stage it is not possible to account for this.

Conversely, the amount of diesel being consumed drops significantly as less truck movements are required with extraction being more focussed. Coal use increases slightly to account for the slightly higher heating requirements. Emissions associated with blasting are expected to reduce considerably once operations move underground due to a reduction in the amount of ANFO required.

Overall the average annual emissions associated with the open pit phase of operation are slightly higher than those associate with the underground phase, with total emissions modelled at 208,160 tCO_2e/yr and 185,183 tCO_2e/yr, respectively.

5.4.7 GHG Emissions during Mine Closure and Decommissioning

Emissions associated with the closure and restoration of the mine have been estimated based on predicted decommissioning and remediation works.. This equates to 42,472 tCO_2e over the two year period from 2040-2041. Any land use change associated with re-vegetation as part of the mine rehabilitation plan, which would provide a carbon sink, has not been included in these calculations. Emissions associated with mine closure are estimated to be as summarised in Table 5.4.6.

Table 5.4.6: Summary of Total GHG emission from Closure and Decommissioning Phase				
	CO_2	CH_4	N_2O	CO_2e[iv]
	tonnes	tonnes	tonnes	tonnes
Fuel[i] Use	20060	1.056	1.056	20,410
Heating (Coal Boiler) [ii]	21657	0.001	0.001	21,713
Electricity [iii]				175
Total				42,472

Notes:
(i) CO_2, CH_4, N_2O emissions have been estimated based on IPCC National Inventory Methodology, Volume 2 Chapter 1. See also Table 7 in Appendix 5.4.1 for detailed table of GHG emissions due to fuel use
(ii) See Table 8 in Appendix 5.4.1 for detailed table of GHG emissions due to coal
(iii) See Table 9 in Appendix 5.4.1 for detailed table of GHG emissions due to electricity
(iv) CO_2e emissions were estimated based on a global warming potential of 1, 21, and 310 for CO_2, CH_4, and N_2O, respectively (40 CFR Part 98, Subpart C).

Following rehabilitation, there will be the potential for carbon sequestration through plant growth and capture into soil biomass and organic matter. However, for the purpose of this assessment, in the early years post closure, it has been assumed that carbon sequestration will be minimal and not sufficient to calculate an offset of the carbon emissions associated with the heavy plant and equipment required for closure and rehabilitation (see Table 5.4.6).

5.4.8 GHG Emissions: Cumulative Emissions

The profile of emissions from the mine during its full life-cycle is presented in Figure 5.4.5. This shows the relative difference in annual emissions for the different project stages, and also the cumulative GHG emissions of 4.4644 million metric tonnes of CO_2e for the life-time of the mine.

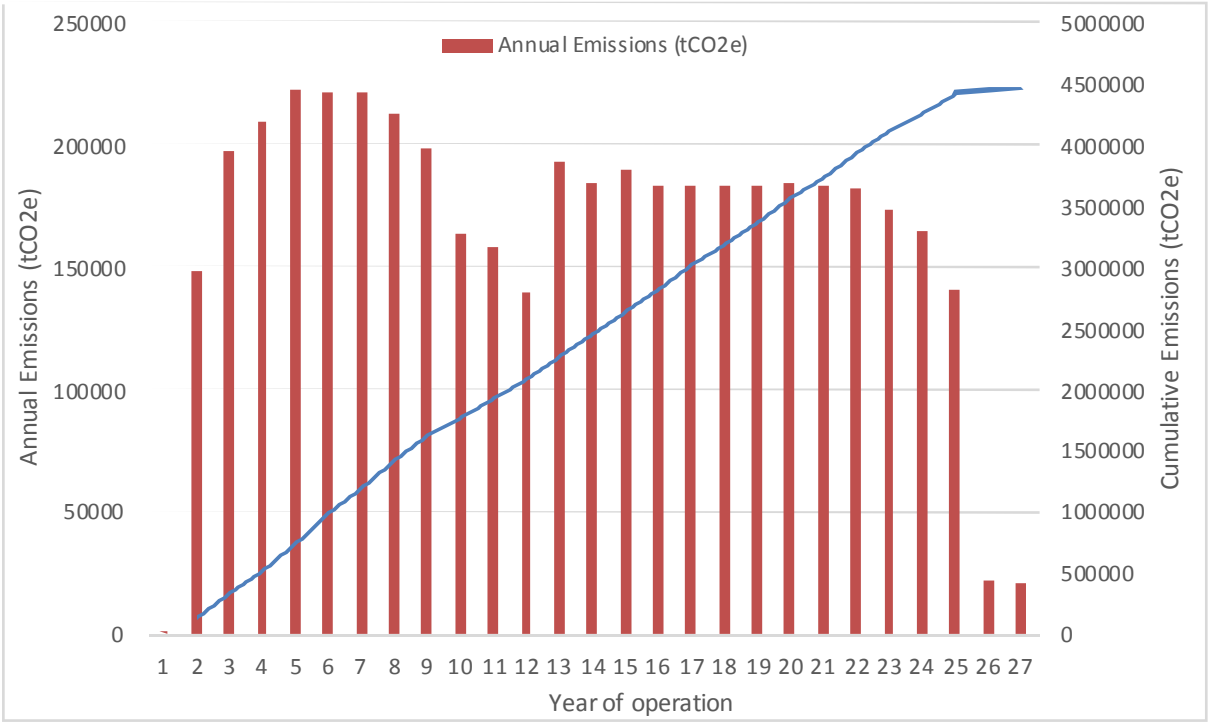


Figure 5.4.5: Cumulative GHG Emissions

5.4.9 Mitigation Measures

Section 5.4.4 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;
- design of the site to ensure minimised distances of travel from the mine site to the overburden dump;
- design of the site to ensure minimised distances of travel from the mine site to the mineral processing facility;
- inclusion of heat insulation on water pipes in water recycling facility
- provide insulation for buildings to minimize heat losses;
- use of vegetation clearance and implementation of a liner in the tailings dam to reduce potential for methane emissions from submerged vegetation; and
- the use of modern, energy efficient electrical equipment and mobile plant with fuel-efficient engines.

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

- Consideration will be given to the choice of vehicles used for the mine 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. As shown in Figure 6.4.2, a particular focus on the excavation and haulage activities is merited due to their large GHG contribution;
- The upgrading of energy-intensive machinery such as the crusher plant 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; and
- As identified previously, the Kazakhstan national power grid is supplied primarily by coal-fired power plants. Although there is some low carbon generation within the energy mix it is currently still a relatively small proportion and many of the power-stations are aging. Nevertheless, the country has recently adopted a much more progressive renewable energy policy and if this continues the amount of low carbon generation should accelerate beyond that predicted in Figure 5.4.2. This trend would

indirectly reduce the Project's GHG emissions associated with the currently proposed electrical demand. Future changes to the amount of renewable energy generation in the grid supply will be reported in the annual GHG emissions report required by IFC Performance Standard 3.

- Consideration will be given to employing renewable generation directly on site to reduce emissions and potentially reduce operating costs. Although the area is known to have relatively low wind speeds and hence wind turbines are unlikely to be viable, the solar potential in Kazakhstan is good with solar insolation levels in Semey recorded as averaging 1441kW/m^2/yr[7]. Further consideration will also be given to the viability of other renewable sources.
- As part of the decommissioning phase upon mine closure it may be possible to implement the construction of wetland areas on the site which would promote the sequestration of carbon.

5.4.10 Residual Impacts

The Project will continue to seek to reduce its GHG emissions throughout its lifecycle. Reporting, in compliance with 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 5.4.7 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 Kyzyl 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.

[7] Second National Communication of the Republic of Kazakhstan to the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), 2009.

Table 5.4.7: Impact Summary – GHG Emissions

Impact	Source	Primary Receptor (1)	Phase (2)		Significance (3)		Mitigation Measures	Management Plan (4)
			C	O	ST	LT		
Greenhouse Gas Emissions	Offsite power generation, onsite mobile plant and heating plant emissions	A	X	X	N	M-	• Energy efficiency measures incorporated into engineering design. • Require use of modern, energy-efficient mobile plant. • Implement logistics management of haulage and excavation activities to avoid idling and double-handling • Perform regular maintenance on mobile plant. • Seek additional opportunities for GHG emissions reduction throughout Project lifecycle, including consideration of renewable energy opportunities, if it is supplied as a separate generation source through the Grid. • During detailed design, energy-intensive uses such as the crusher plant will be assessed for energy efficiency opportunities.	Air Quality Management Plan incorporating GHG Emissions

Notes:
(1) Primary Receptors: A = atmosphere, E = employees, Fa = fauna, Fl = flora, R = residents
(2) Project Phase: C = Construction, O = Operations,
(3) Expected Significance Rankings: ST = short-term with mitigation, LT = long-term with mitigation, S + = significantly improved, S - = significantly adverse, M - = moderately adverse, N = neutral, M + = moderately improved
(4) The 'Air Quality Management Plan incorporating GHG Emissions' will be prepared during 2016.

5.5 Geochemical Impacts

5.5.1 Introduction

The potential impacts of the construction, operation and closure of the Kyzyl Gold Project from acid rock drainage (ARD) and metal leaching have been assessed with reference to soil and water resources. Assessment of impacts on soils and water from ARD requires an understanding of the acid generating and acid neutralisation potential of a given rock material and the quantity of potentially acid forming (PAF) materials to be deposited in external emplacements, and exposed in the walls of the open pit and underground workings. The geochemical mechanisms associated with generation of ARD and metal leaching have been described in the Geology and Seismology baseline (Chapter 4.6). This Chapter should be considered in conjunction with soil and water resource impact assessments (Section 5.8 and 5.9 respectively).

The chapter has been prepared in accordance with the International Finance Corporation (IFC) 2012 Performance Standards[1] (PSs) (Table 5.5.1).

Table 5.5.1: IFC Performance Standards Key Relevant Requirements

Geochemical Impacts
PS 1 requires that the risks and impacts identification process considers the relevant risks associated with a changing climate and the adaptation opportunities.
PS 4 requires that projects should take into account the fact that communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts from project activities since climate change effects may exacerbate their vulnerability; and projects must identify and mitigate risks and potential impacts on priority ecosystem services that may be exacerbated by climate change.

5.5.2 Project Activities

The Project activities which may result in ARD and metal leaching could result in the following potential impacts:

- Contamination of mine water (in open pit and underground sumps) from exposure of arsenic-rich and sulphidic mineralogy in the pit walls and underground workings.
- Generation of ARD and/or metal leachate from the cemented waste material used as backfill in the exhausted underground stopes.
- Generation of contaminated ARD and/or metal-rich water through runoff and seepage from PAF waste rock material stored in the WRD.
- Contamination from Carbon cake storage facilities from runoff and seepage.
- Contamination from the TSF through seepage and/or pumped supernatant tailings water.

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

- Generation of contaminated water from stored ore material, particularly from low grade ore stockpiles left for extended periods.

The construction phase of the Project, which includes the reactivation of an old mining site, includes the disturbance of old deposits of waste rock material, low grade ore and pilot roasting plant tailings (which are known to be high in As).

The primary disturbance of the operation of the new mining Project will be the development and operation of the open pit and then underground mine workings; emplacement of the waste rock material in a dump (WRD); tailings disposal in a storage facility (TSF); and carbon cake storage (CCSF).

Closure of the mine will include decommissioning and rehabilitation of the remaining open pit voids, and all remaining waste facilities at the site, and will need to ensure the long term post-closure geochemical stabilisation of all wastes.

5.5.3 Prediction and Evaluation of Impacts

The method used to assess potential geochemical impacts is consistent with that detailed at the start of the Chapter. The significance of geochemical impacts has been assessed from a combination of duration, receptor sensitivity and magnitude. There are no positive Impacts of ARD or metal leaching, so the direction of impact is not applicable. Any geochemical impacts negatively affect the 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 construction and operation of the Project, through to closure of the site; and the long term, following site rehabilitation into monitoring of the post-closure period.

The predictions derived in the impact assessment are subject to a degree of uncertainty, due to the lack of geochemical testwork on products from the revised processing circuit. These uncertainties are explained together with the assumptions on which impact assessment is consequently based.

5.5.4 Duration

The duration of most potential geochemical impacts associated with the Project are by definition long-term, by the nature of geochemical reactions that can occur in rock material over a period of time. Only gold-bearing ore material is unlikely to present a long-term potential impact source, given that all ore stockpiles are expected to be processed during the mine life. Waste rock will be contained in the WDF, which is a permanent feature of the mine development.

5.5.5 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 determined in terms of 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 the mine site is considered to be ***Minor***, given that the soil types in the area are not unique, are abundant and available outside of the affected area. Top soil around the mine site within the footprint of mine infrastructure will be removed and stockpiled for later use in rehabilitation. While the site- and neighbouring soils are not necessarily resilient to change from geochemical impact affects, these local soils do not constitute an important local resource, given that fertility is low, and land-use on these soils outside of the mine site is for pasture and summer hay.

The water resource of the area is considered to be of ***Medium*** sensitivity. Natural water occurrences in the area are generally of good quality and are utilised by local communities, ecological biodiversity and by the Project itself for potable water source. Although the water resource receptor is highly seasonal in abundance, and is regional in nature given the connectivity with both groundwater and downstream rivers, this is countered by resilience to change. The resilience of the water receptor is dependent upon the dilution effect of rainfall and snow melt; transient or very short residence time; attenuation through interaction with the geology it passes through; and dispersion over time and spatially.

5.5.6 Magnitude

The magnitude of impacts is described in terms of the area of soil and water resources affected and the degree of hindrance 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. While the effects of any ARD are likely to be buffered and diluted in water with dispersion to groundwater and/or to surface downstream rivers, the local impact is liable to be continuous and long-term. Once instigated, acid generation from sulphides, and dissolution and mobilisation of arsenic, are difficult to mitigate and will continue for as long as the source rock is exposed, available and under conducive oxidising or leaching conditions.

5.5.7 Project Stages

Construction: Although construction of the mine works will not expose new potentially acid forming material located below surface, construction activities are likely to disturb old waste materials from previous mining at site. While the old waste rock material tested in geochemical studies, were non-acid forming (NAF), the tailings produced from the roasting pilot work was shown to be very high in arsenic, which was readily released and mobilised. Disturbance of this material has the potential to impact on both soils and water resources at site through arsenic leaching. However, as the quantity of this material is very small and disturbance possibly avoidable, the impact is therefore considered to be ***minor*** and the impact during construction is ***not significant***.

Operations: The operation of the mine is likely to expose potentially acid forming mineral waste as the mining pits are opened up to extract the ore. Potentially acid forming material comprises only a small part of the total mineral waste, both in the WRD and the TSF, but there is the potential for metal contaminated and acidic leachate to run off, especially from the carbon cake facility, causing an adverse impact on surface water and quality of adjacent soils. There could also be contaminated runoff from the ROM and any LGO stockpiles if left for too long. Summary of the geochemical studies indicate that there may be a delay of potential acid formation, and that there is buffering capacity in the waste to reduce the impact. However, in the absence of mitigation, the potential impacts from operations to water quality, and although of low value, to neighbouring soils, is therefore ***moderate***, and are generally ***significant***.

Closure: The potential for acid generation from waste emplacements and continuing metal leachate may persist in the long term after closure of the mine. In the absence of mitigation the potential impact following closure will continue to be ***moderate***, with ***significant*** effects.

5.5.8 Identified Impact Sources

Contamination of mine water (in open pit and underground sumps) from exposure of arsenic-rich and sulphidic mineralogy in the pit walls and underground workings: Potential receptors include the aquifer system from infiltration of sump and U/G mine water; the river network from pumping of mine water to surface. Magnitude, ARD may result from high sulphide mineralogy exposed in pit walls and underground excavations, however, the general mineralogical studies of the deposit geology indicates that there is likely to be considerable neutralising potential in the surrounding rock to effectively buffer any acid generated. Arsenopyrite exposed in mining surfaces could however release arsenic, even in neutral to alkaline water, as is evidenced by the elevated As levels in mine water monitored in the baseline study. The potential for contamination of mine water is therefore considered to be ***minor to moderate*** and conservatively the impact during operations ***significant***.

Generation of ARD and/or metal leachate from the cemented waste material used as backfill in exhausted underground stopes: The receptor for this potential impact is the aquifer system in connectivity with the underground mine workings, and the river network when mine sump water is pumped to surface. The geochemical studies undertaken for the cemented backfill have been on roasting process tailings, not from the proposed flotation tailings. Nevertheless, the study results can be used to give an indication of the magnitude of impact from backfill, and suggest that ARD will not be an issue, especially given the highly alkaline conditions and consolidation from the cement additives. However, As was mobilised from the tested cemented backfill material, even under the alkaline pH. While it is understood the roast tailings were highly concentrated in As, compared to the likely content of the flotation tailings, there is still a low potential for some As release from the cemented backfill. While this will require further testing, a low magnitude value gives a ***minor*** impact significance, and the effect is expected to be ***not significant***.

Generation of contaminated ARD and/or metal-rich water through runoff and seepage from PAF waste rock material stored in the WRD. Receptors for this potential impact are both the soil in the immediate vicinity of the WRD and the surface water and groundwater resources (river network and aquifer system) that may receive waste rock contact water. The geochemical characterisation of the waste rock samples indicate that only a very small proportion is likely to be PAF, and the majority of waste rock will have a high neutralising potential for buffering any acid generated. The waste rock should also be relatively low in arsenopyrite which will largely report to ore. The magnitude of the contamination impact from the WRD is therefore low, with a ***negligible to minor*** impact, and is ***not significant***.

Contamination from Carbon cake storage facilities from runoff and seepage: Both soil in the immediate vicinity of the CCSF, and the surface water and groundwater resources (river network and aquifer system) that could receive contact water, are receptors. The carbon product is generally higher in S% content than the tertiary flotation tailings, and although there may also be an increased neutralising capacity of this material, as there has been no geochemical characterisation yet, the magnitude ARD risk is conservatively classed as moderate. Until further testwork is undertaken to define the ARD and metal leaching risk, the contamination impact from the CCSF is therefore considered ***moderate***, and the potential effect is ***significant.***

Contamination from the TSF through seepage and/or pumped supernatant tailings water. Receptors for contaminated water from the TSF are both local soils and the surface water and groundwater (river network and aquifer system) resources from accidental leakage or seeping from the TSF pond. However, the sulphur analyses of pilot plant tailings are all >0.3%S, and arsenic is 0.13%. Geochemical characterisation and ARD testwork will be undertaken on the flotation tailings, but given these preliminary chemical analyses, the indicated magnitude of geochemical risk from the tailings is low, giving a ***minor*** significance, and is likely to be ***not significant***. However, given the current lack of testing, a conservative approach to the management of the TSF ARD and leaching risk is taken.

Generation of contaminated water from stored ore material, particularly from low grade ore stockpiles left for extended periods: Both local soils and water resources are receptors for any potential impact from stockpiled ore materials. Although the Bakyrchik ore is a high geochemical risk material, due to the nature of the sulphidic mineralisation, with the gold associated with-, and hosted by arsenopyrite, the ARD study indicates that there is likely to be a time lag before the onset of acid generation. This reduced sulphide reactivity (to oxidisation) and time lag of 2 to 6 months, means that ARD may not be an issue provided ore material is not stored for long periods. Susceptibility of ore material to arsenic release is not yet defined, but could present a higher risk. Given the magnitude of this contamination, the potential impact from ore stockpiles is ***moderate***, which without mitigation, gives a ***significant*** effect.

Several sources of impact have been identified as having potentially a detrimental effect on the surface water and groundwater resources (river network and aquifer system). This may be significant in the general area of the mine site, as the river system is well developed with several main streams

draining the project area and the aquifer system, present across the entire area of the mine site, has a significant thickness and water storage capacity and represents an important source of water.

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

5.5.9 Mitigation Measures

While adverse effects rated as Significant must be mitigated in order to reduce the level of significance of the residual impact, some impacts with not significant effects should also be mitigated, especially where uncertainties exist. Given that there are uncertainties of the geochemical character of several of the materials to be exposed and handled by the Project, a conservative approach is taken to the management of ARD and metal leaching risks. Some of the measures described here may be found to unnecessary once the properties of different waste materials are further defined.

Monitoring measures are also defined to assess the efficacy of the mitigation measures.

A key overarching element of planning for mitigation of all the identified geochemical impacts will be the development and implementation of mineral waste management as part of the project Environmental and Social Management Plan (ESMP, see Chapter 8), and include:

- Continued geochemical characterisation;
- Management of potentially PAF and high As material;
- Design and operation of mineral waste emplacements; and
- Suitable rehabilitation and closure.

These areas will be developed during completion of the 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 As-containing materials and the future land use plans for the site.

The mitigation hierarchy requires that measures are structured to avoid or prevent, then reduce, isolate and control potential impacts. The fundamental requirement that underpins the entire approach to mineral waste management is the need to adequately characterise and continuously validate characterisation of mine waste and ore in terms acid-forming characteristics and metal leaching risk.

All mine waste and low grade ore stockpile management structures will incorporate measures in their design, construction and operation to:

- Prevent or minimise the generation of ARD;
- Control any metal leachate generation;
- Ensure geochemical stability, with WRD and TSF designs being reviewed by an appropriately qualified and experienced engineer;

- Control surface water ingress and runoff, specifically for ARD generation and metals release; and
- Prevent migration of metal leachate or ARD to surface water, groundwater and soils.

Detailed mineral waste and low grade ore stockpile management measures are described below. All of 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 is through the design and engineering of the proposed mine plan, and operational management measures. This includes designing the ore stockpiles; and carbon-cake, waste rock and tailings storage facilities to prevent or reduce the potential for oxidation of sulphides or release of metal contaminants. Design of the water management system to collect all mine contact water for re-use within the operations in a largely closed system is also fundamental to the control of ARD and/or metal leaching.

Design considerations include:

Plant Ore surge Stockpile: 0.5m clay impervious liner to be installed, with any collected drainage directed to the TSF. As the ore material is likely to be high in As% and S%, there is the potential for any run-off/seepage from stockpiled ore to contain ARD and dissolved metals, all ore stockpiles will be lined with perimeter collection ditches to capture any water discharge for recirculation.

Carbon product Storage: This material is predicted to be higher in sulphur than the tailings, and as such, potentially more susceptible to acid generation. The CC storage facility is to be lined with 1.5mm Polyethylene. Run-off will be collected in ditches and directed to a settlement pond, and filtered through the pond dam wall to a sump for pumping to the TSF. The ditches, settlement pond and sump will all be compacted and lined with clay to prevent infiltration to the underlying soil. Monitoring wells around the facility will detect any migration to groundwater.

Tailings TSF: The tailings facility is to be lined with welded 1mm PE liner. The dam walls will have 1.5mm HDP liner, and the two liners will be overlap welded. All entrained water is expected to collect at surface as the tailings consolidate, with excess surface evaporation causing a 'suction' effect. An under-drainage system composed of finger drains filled with crushed aggregate will be installed beneath the liner to capture any seepage/leakage, with any captured water returned to the TSF pond. Supernatant water will be re-circulated back for use in the processing plant and excess water will evaporate.

Waste Rock Dump: The WRD will be placed on a pre-prepared footprint, cleared of vegetation and topsoil, and with under-drainage installed. Operational management of the waste rock will delineate any high risk, potentially PAF rock in the pit, as part of the geological grade control system. This material will be preferentially placed away from the edges of the dumping footprint, effectively

encapsulated within the majority NAF waste rock. Seepage and runoff will collect in perimeter drains and be directed to a sump prior to pumping to the TSF as necessary.

All open pit sump water and underground dewatering water will be collected and redirected to the pit drainage water settling sump.

The main operational management for the mitigation of ARD and metal leach impacts from the Project is direct excess mine contact water to the Mine Water Treatment plant, prior to discharging to the Akbastaubulak. Wherever practicable, all mine contact water will be re-used within the Project, largely for processing, but also for summer-time dust suppression and engineering maintenance requirements.

The mitigation strategy for acid rock drainage and metal leaching is conservative at this stage, where all >0.5%S material is assumed to be acid-forming; and all elevated As material is expected to be leachable. In practice geochemical studies suggest that some >0.5%S material may be non-acid generating and that there is sufficient neutralising material to buffer any ARD produced. Further studies will seek to refine these estimates such that a more accurate measure of potentially acid-generating material and As leaching is known prior to mining of high risk material.

5.5.10 Closure Measures

The provisional Mine Closure and Rehabilitation plan for managing long-term geochemical impacts is for the following actions and procedures:

Open Pit: The post-closure plan for the open pit is for pit lake formation, which will take 35 years after underground mining ceases, to settle to final levels. During operations, there will be on-going modelling from the developing block model for prediction of final pit water quality. Final pit shell wall rock exposure of sulphides and arsenic-rich rock will be known for some years prior to closure, as production continues from underground, and this allows 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.

WRD: The final WRD height will be 105m, the dump developed in 2 tiers, the lower covering 390ha (3500 x 1500m) with 20m safety berms and slope angle of 34o. No post mining grading will be required. The final dump surface will be compacted and covered with 0.2m of soil for revegetation. Long-term drainage channels will divert surface water away from the WRD and reduce erosion from runoff on the dump surface.

Carbon Cake Storage Facility: The CCSF will be developed in a single tier up to 15m high over 55,600m2, at a natural slope angle of repose of 27°. The facility is to be covered with a 10-20cm clay layer and compacted, using a geonet on the slopes, prior to revegetation. The drainage system will continue to divert surface water away from the facility, and direct runoff to a settling pond.

TSF: At closure, the TSF supernatant pond water is to be removed, drained and released to the environment, providing discharge has been approved. All tailings distribution and pumping infrastructure is to be removed. Once the water content is sufficiently reduced and the tailings consolidated, the TSF surface is to be compacted and covered with 0.6m of rock debris and rubble. Surface water is to be diverted, and catchment rainfall directed away from the TSF dam wall, to the river, through grading the surface slope to the diversion ditch. The graded surface will be covered with a 0.2m soil layer and revegetated with trees and shrubs.

5.5.11 Residual Impacts

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

With these measures in place the impact of acid rock drainage and metal leaching on soil and water resources 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 constant 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 will be reduced to ***negligible***, and during operations will be reduced to ***minor***. Once the mine reaches the closure stage, the revegetation of the external waste rock emplacements will have been in place for some years, so the effectiveness and longevity of ARD and metal leaching controls will have been monitored for an extended period. Acid rock drainage and As leaching is not therefore expected to cause significant impact in the long term, unless the control system fails. In this event soils and vegetation over and adjacent to the waste emplacements and downstream water quality could be damaged leading to a continuing minor risk of impact on soils and water after closure.

The results of mitigation measures on residual impacts are summarised in Table 5.5.2 below.

Table 5.5.2: Summary of Mitigation and residual impacts

Impact	Mining Stage	Impact before mitigation	Key Mitigations	Residual Impacts
Release of ARD or metal leachate from disturbance of old waste rock or tailings	Construction	Minor	Careful removal and new storage of all old waste rock and pilot plant tailings. Collection and storage of all contact water during construction.	Negligible
Contamination of mine water from PAF and As-rich rock exposed in pit walls and underground workings.	Operations	Moderate	Characterisation, identification and delineation of any PAF and As-rich rock in the pit shells and U/G workings. Collection of all pit sump and U/G dewatering water for re-use within the Project, with storage in the TSF. Modelling of final pit shell geology for predicting post closure risk of ARD prior to complete pit flooding. Monitoring of groundwater around the mine workings to ensure the effectiveness of mitigations	Minor
	Closure	Moderate		Minor
Generation of metal leachate from cemented backfill	Operations	Minor	Continue geochemical test studies of cemented flotation tailings to clarify risk. Collection of any initial water seepage from backfill for return to TSF. Monitoring of mine- and ground-water to assess backfill leaching.	Negligible
	Closure	Minor		Negligible
Contamination from ARD and/or metal leachate from WRD runoff and seepage	Operations	Minor	Characterisation, identification and delineation of PAF and high As risk waste rock in the block model and open pit Containment and encapsulation of any identified PAF waste rock within the WRD Collection and management of all runoff and seepage from the WRD On-going monitoring and refinement of ARD and metal leaching controls and waste emplacement operation. Covering, sealing and revegetation of WRD as soon as open pit mining ceases and there is no further surface storage of waste rock.	Negligible
	Closure	Minor		Negligible
ARD or metal contaminated runoff or seepage from Carbon cake storage facilities.	Operations	Moderate	Management of carbon cake in a closed system, with all contact water collected and directed to the TSF. Monitoring of groundwater in the vicinity of the CCSF to inform the management measures Cover, seal and vegetate the facility as soon as carbon flotation ceases.	Minor
	Closure	Moderate		Minor
Contamination from TSF seepage or supernatant tailings water	Operations	Minor	Undertake continuing characterisation studies on flotation tailings to define the risk from ARD and metal leaching.	Negligible
	Closure	Minor		Negligible

			Ensure the TSF operates as a closed system with all seepage and contact water returned to the TSF pond. Monitor groundwater around the TSF to identify any seepage/leakage. Cover, seal and vegetate the TSF surface as soon as there has been sufficient consolidation.	
Generation of contaminated water from ore stockpiles	Operations	Moderate	Design and construct the ore stockpiles to contain all runoff and seepage Collect all contact water and reuse within the Project, with storage at the TSF if necessary Avoid long-term storage of ore materials (<2 months). If LGO stockpiling is necessary, they will be lined, and managed as a closed system. Ensure processing and/or removal of all ROM and LGO stockpiles at end of mine life.	Negligible
	Closure	Minor		None

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 forming material and high-risk As containing material. Further studies will continue to be undertaken to define the risk of ARD and metal leaching, and update appropriate necessary control measures.

ESMP measures include:

- Continued delineation and characterisation of potentially acid-generating material by:
  - ongoing ARD/metal leaching investigation programme;
  - routine sampling of the waste material to provide on-going information regarding the acid generation potential and As content;
  - sulphur analysis of production drill cuttings; and
  - delineation of working mine faces with visual markers to facilitate selective handling.
- Arsenic analysis of production drill cuttings.
- Selective handling and segregation of high-risk material in waste emplacements.
- Covering with inert or buffering materials to provide a physical barrier.
- Shaping waste emplacement surfaces to reduce ponding and infiltration of rainfall.
- Installation of underdrains to collect and separate any leachate from the emplacement.
- Provisions for leachate treatment if required to comply with the discharge criteria for receiving waters; and
- Monitoring of leachate from waste rock emplacements, carbon cake storage, and TSF; groundwater from appropriately located monitoring wells; and all contact mine water.
- Periodic monitoring of soil quality compared with baseline condition.

5.5.12 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 ongoing geochemical studies gives more robust confidence in the potential for ARD and metal leaching at the mine.

The primary objectives of the mine water, mineral waste and stockpiles monitoring program are to:

- Provide information that will determine 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.
- Confirm impacts of particular 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 SEMP and Mine Water Management Plan, but will include:

- Monitoring of surface runoff and seepage water quality from the WRD, CCSF, TSF and all ore stockpiles initially on a weekly basis until management measures are seen to be effective. This can then be dropped to monthly.
- Water quality monitoring from wells located around, or downstream from all of the potential geochemical impacts source areas – pit and UG workings; WRD; CCSF; TSF; and ore stockpiles.
- Monitoring of the integrity of the WRD and TSF (with a focus on signs of erosion or seepage in the outer bunds and faces, and dam wall) and operating procedures (i.e., water levels).
- Regular (once per shift) inspection of the WRD, CCSF and stockpiles water collection channels and ponds.
- Continuous monitoring of pump pressure (automatic systems) to detect failure.
- 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 a focus on the identification of environmental impacts associated with ARD and metal leaching and compliance with applied standards. As all contact water is to be recycled at site there is not a need for discharge criteria, but compliance limits will apply to any accidental discharge. The monitoring data collected shall 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.
- Register and report incidents to the relevant authorities.

5.6 Air Quality

5.6.1 Impact Assessment

The potential impact of pollution resulting from emissions to air is identified in PS 3 and requires an assessment of the Project-affected area and communities. 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 development by Polymetal.

The definitions for assigning receptor sensitivity are described in Table 5.6.1. The definitions for determining the magnitude of the impact are described in Table 5.6.2.

The significance of any environmental effect is determined by the interaction of magnitude and sensitivity. The impact significance matrix used for assessing air quality related impacts is the same as the default matrix defined in Section 5.1 (Table 5.1.3).

Table 5.6.1: Methodology for Determining Sensitivity

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 5.6.2: 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%).
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]	

5.6.2 Project Activities Related to Air Quality

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**: Gas and particulate matter generated by internal combustion engines (heavy and light vehicles, equipment motors, generators) as well as emissions from coal-fired boilers and ; and
- **Nuisance odours**: Non-health-related (aesthetic) gas emissions affecting nearby neighbours and/or employees.

Potential Fugitive Dust Sources

The proposed method of mining at the Bakyrchik Deposit comprises the sinking and hauling of overburden from the open pit to the external waste rock dump to the north. Ore will be transported by haul road to the process plant to the south east, where it will be stockpiled before being processed.

The sources of dust and fine particulate matter which have the potential to lead to the most significant dust effects at the five dust sensitive receptors, are considered to be the extraction of rock and ore from the open pit and its subsequent transportation using dump trucks along the haul roads to the waste rock dump and process plant.

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

The extraction of rock and ore will take place using electric and hydraulic shovels, with the openpit being progressively deepened as this work takes place. The potential for dust and fine particulate matter emissions is therefore considered to be highest in the early stages of the mine, as in the later stages work will take place below the ground level.

The erosive action of vehicle traffic on haul roads is considered to be a major 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 upon particle size and meteorological conditions. The erosivity of haul roads depends on the number and size of wheels, vehicle speeds and the moisture content of the surface material.

The waste rock dump is located more than 1km from the majority of the five dust sensitive receptors, with only DSR 5 being located at a closer distance. However, this is still located approximately 910m from the closest part of the dump and therefore any dust associated with the dumping of overburden will have been deposited, and fine particulate matter will have dispersed, before reaching this location in Auezov.

Combustion Emission Sources

Gas and particulate emissions from blasting, mobile equipment, and the ADR facility will occur during operations. ADR facility combustion emissions are expected to be minor in comparison to other combustion emissions sources at the Project.

Nuisance Odours

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

Summary of Air Quality Emission Sources

Table 5.6.3 below presents a summary of the various types of emissions that could affect air quality during construction and operations, by Project component.

Table 5.6.3: Potential Sources of Emissions

Project Component	Releases and Effects	Fugitive Dust	Combustion Gases	Nuisance Odours	Potential Arsenic in Dust	Characteristics
Construction: Stage 1 and Stage 2						
Earthworks, site clearance, building demolition and construction	• Dust and dust blown from exposed surfaces.	X			X	Fugitive dust generated by truck movements and earth moving equipment; short duration. Arsenic only in rehandled material (e.g. waste dumps)
	• Vehicle exhaust emissions		X			NO_x, SO_x, CO, CO_2, and diesel particulates; short duration.
Mining						
Stage 1 Drilling and blasting	• Dust from drilling	X			X	Fugitive dust generated during drilling activities, mitigated by dust filters; short duration, intermittent.
	• Dust from blasting	X			X	Fugitive dust (clouds) generated instantaneously during blasting; intermittent, periodic effects.
	• Blasting gas		X			Combustion gases from blasting.
Stage 1 and Stage 2 Loading, hauling and related mine traffic	• Dust generated by loading and vehicle entrainment	X			X	Fugitive dust from ore/waste rock emitted during material handling; dust from haul vehicle entrainment travelling on unpaved haul roads controlled with watering of haul roads and at loading areas
	• Vehicle exhaust emissions		X			NO_x, SO_x, CO, CO_2 and particulate emissions.
Stage 2 Backfill plant	• Cement dust	X				Fugitive dust when loading material into cement storage silos
Stage 1 and Stage 2 Waste dump	• Stage 1: Dust from barren material tipping, grading, and wind blow. • Stage 2: Dust from wind blow only	X			X	Fugitive dust particles possible nuisance source; emissions only during dry conditions; source increases in size with time until year 2026
	• Vehicle exhaust emissions		X			NO_x, SO_x, CO, CO_2 and particulate emissions.
Ore Preparation and Processing						
Ore buffer stockpile (ROM stockpile); crushed ore stockpile	• Dust	X			X	Fugitive dust from wind blow, dependent on weather conditions; controlled with water sprays.
Crushing	• Dust	X			X	Fugitive dust escaping from crusher building and transfer points to crushed ore stockpile; controlled with water sprays, enclosure, and dust extraction system.
Carbon Concentrate	• Dust with high	X				Carbon concentrate

Table 5.6.3: Potential Sources of Emissions

Project Component	Releases and Effects	Fugitive Dust	Combustion Gases	Nuisance Odours	Potential Arsenic in Dust	Characteristics
Storage	carbon content from wind blow					material will have relatively high moisture content which mitigates dust emissions during handling; wind blown fugitive dust may be generated once stockpile dries out; very fine particle size due to milling
Concentrate drying and bagging	• Dust from handling	X				Concentrate dried before bagging; very fine particles due to milling; dust emissions from handling; mitigated by enclosure and dust extraction systems
Reagent delivery and handling	• Vehicle exhaust emissions		X			NO_x, SO_x, CO, CO_2 and particulate emissions.
Support Infrastructure						
Auezov sewage treatment plant	• Bad odour			X		Rotten smell, bad odours as a result of potential sewage leaks, spillages, or pipeline blockages; mitigated by careful monitoring and correct operation of facilities
Mine sewage treatment plant	• Bad odour			X		Rotten smell, bad odours as a result of potential sewage leaks, spillages, or pipeline blockages; mitigated by careful monitoring and correct operation of facilities
Stage 2 Coal-fired boiler houses; Heating units for ventilation air	• Flue gas from coal combustion		X	X		NO_x, SO_x, CO, CO_2 and particulate emissions (ash); potentially odours if off-gas not dispersed or inefficient combustion
Stage 2 Ash and coal stockpiles	• Dust from material handling and wind blow	X				Fugitive dust from wind blow, dependent on weather conditions; controlled with water sprays
Closure						
Decommissioning activities	• Dust	X				Dust generated from demolition activities, earthworks, reshaping heap and dump sides. Water spray where necessary.
	• Vehicle exhaust fumes		X			

5.6.3 Sensitive Receptors

As previously discussed, 95% of particles are associated with mineral workings have been found to be between 10 and 75µm, and therefore have a relatively high mass and settling velocity (see Chapter 4.4 on baseline air quality). As a result, these particles tend to fall out of the atmosphere within 500m of

the point of release (with those particles larger than 30µm dropping out between 60-90m, and those between 10 and 30µm within 250 and 500m).

There would also be a small contribution of PM_{10} and $PM_{2.5}$ from ore preparation facility emissions and overburden handling operations, but these would make up only a small proportion of the remaining 5% of particles. These smaller particles would generally be carried by the wind for a distance of up to 1km, before dilution and dispersion would reduce their concentration to background level.

As a result, the assessment of the potential effects associated with dust and fine particulate matter has focused on a study area of approximately 1km from the potential sources of emissions. Sensitive receptors have been identified using mapping data for the local area. The assessment has focused on six receptors in the settlement of Auezov and nearby hamlet of Solnechnoye, all of which are residential in nature. The details of these receptors are provided in Table 5.6.4. The location of the receptors relative to project infrastructure is shown in Drawing 5.6.1.

Table 5.6.4: Sensitive Receptors

Receptor	Sensitivity to	Location	Grid Reference		Direction from Site
			X	Y	
DSR 1	Dust and gas	Location in northern part of Solnechnoye village	14543265	5507899	South
DSR 2	Dust and gas	Location in north western part of Auezov	14541444	5509255	South
DSR 3	Dust and gas	Location in northern part of Auezov	14542596	5509187	South
DSR 4	Dust and gas	Location in south western part of Auezov	14542679	5508904	South
DSR 5	Dust and gas	Location in north western part of Auezov	14542809	5509205	South
DSR 6	Gas only	Location in north western part of Auezov	14540885	5508467	South

The potential effects of gaseous emissions from boiler houses are assessed for the same sensitive receptors identified for dust effects.

The distances from these receptors to the main sources of dust associated with the operation of the Bakyrchik mine are detailed in Table 5.6.5.

Table 5.6.5: Approximate Distances of Receptors Sensitive to Dust Sources

	Distance from receptor to			
Receptor	final pit edge (m)	Waste Dump (m)	Pit-Plant Haul Road (m)	Ore Preparation Facility (m)
DSR 1	1750	2100	1260	1210
DSR 2	500	1420	1710	2500
DSR 3	410	1030	610	1350
DSR 4	690	1240	690	1230
DSR 5	400	900	420	1150

The distances from the receptors to the main sources of gaseous emissions, other than vehicles exhaust emissions, are detailed in Table 5.6.6. Receptors and emission sources shown in Drawing 5.6.1

Table 5.6.6: Approximate Distances Of Receptors Sensitive to Gaseous Emission Point Sources

Receptor	Distance from receptor to new Auezov boiler house (m)	Distance from receptor to heating unit, western area (m)	Distance from receptor to heating unit, central area (m)	Distance from receptor to heating unit, eastern area (m)	Distance from receptor to mine boiler house (m)
	EM1	EM2	EM3	EM4	EM5
DSR 1	2820	3150	2160	1670	1080
DSR 2	1230	870	680	1490	2360
DSR 3	2220	1980	770	490	1200
DSR 4	2230	2140	1020	680	1070
DSR 5	2420	2170	930	350	1010
DSR 6	360	1230	1620	2300	2910

Significance Criteria – Sensitive Receptor

The significance of an environmental effect is determined not only by the magnitude of the effect itself but also by the sensitivity of the receptor, the criteria for which are shown in Table 5.6.1. According to this criteria, all five sensitive receptors (i.e. DSR 1 to DSR 6) are considered to be of medium sensitivity to dust and gaseous emissions due to the residential nature of each receptor.

5.6.4 Potential Impacts to Air Quality

Local Weather Conditions

In order to provide information on how air emissions and dust deposition might be affected by local weather conditions, wind speed and wind direction data have been obtained from the Shalabay weather station[2] for the period 1938-2013. Wind data is only available from 1986 to 2009. Details of the weather and climate conditions are discussed in Section 4.2 on Climate.

Wind data presented in Table 4.2.3 suggest that calm conditions are most prevalent in the local area (i.e. 24% in an average year), but when winds are present, the predominant direction is from the south east (i.e. 21% in an average year). There are however seasonal variations in the predominant wind direction, in particular during the summer months when there are spells of dry and windy weather.

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

[2] Bakyrchik Mining Venture LLC, The Bakyrchik Gold Deposit, MINE AND PROCESS PLANT CONSTRUCTION, 34.01.06.001.00 PZ3, St Petersburg, 2015

(measured at the British Meteorological Office standard height of 10 metres above ground level) is required to raise some dust, but significant amounts would only have the potential to 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.

Although a detailed breakdown of wind speeds for each wind direction is not available from the Shalabay weather station, a summary of the wind speed data, over the 23 year period, is included in Table 4.2.4. The data presented in Table 4.2.4 suggests that calm or very low wind speeds (i.e. 1m/s or less) occur for 50% of the time. The majority of wind speeds recorded (i.e. 98%) are below 10m/s. Maximum gust speeds, measured at Shalabay over the period 1994 – 2013, are generally more than 12m/s higher than the average wind speed and measuring in the range 14 to 18m/s.

Temperature and precipitation data from Shalabay weather station suggests that the highest temperatures and precipitation are observed in July, with an average temperature of 20°C and an average precipitation rate of 43mm. Temperatures drop to an average of -15°C in January and February, with an average precipitation rate of 16mm. On average, snow cover is present between 8 November and 2 April (Section 4.2.3), so much of the precipitation during the colder months is in the form of snow.

Assessment of Nuisance Dust Effects

It is possible that dust may be generated through site activities which may occur occasionally or throughout the whole working year.

The assessment has considered the situation in 2025, when the open pit and waste rock dump will be at their maximum extent, and therefore is considered to adopt a worst case approach.

From the information provided, it is understood that the mine will operate continuously throughout the day (i.e. with two 12 hour shifts) for 340 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 5.6.7.

Table 5.6.7: Number of Working Hours per Year Where Dust May Be Emitted From the Site

Direction	N	NE	E	SE	S	SW	W	NW	Calm	Total
Number of Hours Per Year	978	653	734	1714	1469	734	898	978	1958	8160

Table 5.6.8 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 effect.

Table 5.6.8: Total Number of Hours in an Average Year during which Wind May Blow Dust Towards Sensitive Receptor Locations within 1km of Site Workings

Receptor	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
DSR 1	307-35	NW-NE	1100	32	2609
DSR 2	313-95	NW-E	500	41	3343
DSR 3	286-101	W-E	410	52	4241
DSR 4	290-89	W-E	700	52	4241
DSR 5	283-103	W-E	400	52	4241

The distances of the dust sensitive receptors to the closest areas of working have been identified. The closest potential source of dust to four of the five dust sensitive receptors (i.e. DSR 2 to DSR 5) is the open pit. The haul road is located closest to DSR 1, in Solnechnoye. All five dust sensitive receptors are however located more than 250m from the closest areas of working. It is therefore, predicted that larger dust particles, and a large proportion of medium size particles, will be deposited before reaching the sensitive receptors.

The assessment detailed in Table 5.6.8 has taken into account wind direction data from the Shalabay weather station, in determining the proportion of time when the dust sensitive receptors may be located downwind of the Bakyrchik mine. 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 suggests that approximately 88% of winds would be expected to be 5m/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 5.6.8) is considered to be an overestimate, as it includes lower windspeed data that cannot be isolated in this analysis.

It has not been possible to consider the effects of precipitation on the potential for dust dispersion and effects for dust sensitive receptors. The assessment considers wind data from all conditions at the Shalabay weather station; however in reality, significant emissions of dust should not occur in wet conditions (i.e. for periods when rainfall is more than 0.2mm).

Although precipitation levels in the local area are not considered to be high, due to the continental type climate, there is an average annual precipitation rate of 335mm. This includes the approximately 150 days per year when mean temperatures are below 0°C, and therefore precipitation will occur as sleet and/or snow. During these conditions, the potential for dust dispersion is low. In addition, during the period of snow cover, dust emissions are also considered to be low.

Taking into account the distances involved and the local weather conditions, the effect magnitude is considered to be negligible (according to Table 5.6.2). Applying medium receptor sensitivity and negligible magnitude to Table 5.1.3 indicates the effect is likely to be negligible, and so the impact will not be significant.

Assessment of Fine Particulate Matter Effects and Respirable Size Fraction Dust (PM_{10})

The principal sources of fine particulate matter are combustion activities, such as vehicle exhausts, woodstoves, boiler houses, and so on. As previously discussed, the Bakyrchik Deposit, and the nearby settlements of Auezov and Solnechnoye, are located in a residential area with very little road traffic. The main sources of fine particulate matter are likely to be domestic emission sources and the unpaved roads within Auezov, and are therefore likely to be low. Short term monitoring of PM_{10} has been carried out in Auezov, near the location of DSR 5. This location is near an unpaved road, and monitoring took place only during July and August. The unpaved road will likely have generated elevated dust levels at the monitoring point. As shown in Table 4.4.7, the 24 hour average for PM_{10} particulate concentration during the July monitoring periods was 29.69µg/m^3. Between the hours of 1:30 and 5:30 the average PM_{10} concentration dropped to 15µg/m^3. Although not recorded, it is likely that during this period of time there is little to no road traffic, and levels of 15µg/m^3 may be a more accurate representation of typical baseline conditions at Auezov. Since only two months of data has been collected, insufficient data is presently available for a fully representative understanding of baseline conditions.

The USEPA dispersion screening model AERMOD Screen[1] provides a methodology to estimate maximum short term particulates from mine related operations. Emission rates will be based on the nature of operations that take place within the open pit, or subject to fugitive emissions from operations such as crushing, material handling, and vehicle entrainment along unpaved haul roads. The screening model estimates worst case dispersion of PM_{10} from the source of the emission and the rate of fall out is predicted in Figure 5.6.1.

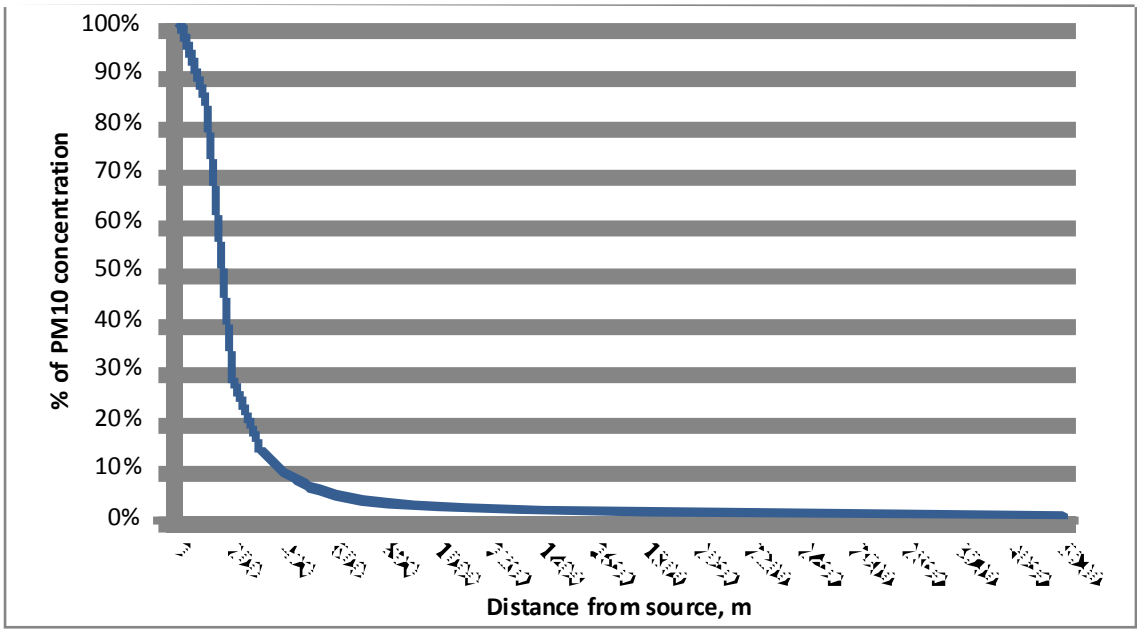


Figure 5.6.1: Relative Inhalable Dust Levels with Distance from Source

Fine particulate matter would generally be carried by the wind for a distance of up to 1km from a source, before being dispersed and diluted to background levels. Figure 5.6.1 identifies that, in worst case conditions, the majority of PM_{10} emitted from the Project (over 95%) will be deposited within 1km from the site, with over 90% deposited within 400m of the source. Four of the five dust sensitive receptors are located within 1km of the closest source (the open pit). As shown in Table 5.6.5, DSR 3 and DSR 5 are closest to the pit edge (410 and 400m respectively). Prevailing wind conditions will, on average, blow dust away from these receptors, but occasional gusty wind conditions may raise PM_{10} levels above background conditions at receptors for short durations.

The distance the receptors are from the open pit dust source represent a worst case scenario. When the pit begins development, activities will take place at a greater distance from receptors than is the case at the end of open pit mining when the pit will have reached its full extent. As the pit edge moves closer to receptors, the pit also becomes deeper. Thus mining equipment movements and activities take place below the original ground level, allowing the pit wall to form a dust suppression barrier between the mobile plant (the actual dust source within the pit) and the dust sensitive receptors.

Dust sensitive receptor DSR 5 is also located 420m from the haul road that leads from the pit to the ore preparation facilities. This haul road will have a fixed position for the full duration of the project and, due to its proximity to both the open pit and haul road sources, will likely record the highest respirable dust concentrations. The concentrations at all receptors will still be less than 10% of the emitted levels (as shown in Figure 5.6.1).

Based on the distance from Project activities, PM_{10} and $PM_{2.5}$ concentrations, should not exceed the guideline values shown in Table 4.4.1, and repeated below:

- PM_{10} 20µg/m³ (1yr average) 50µg/m³ (24hr average)
- $PM_{2.5}$ 10µg/m³ (1yr average) 25µg/m³ (24hr average)

The Air Quality Management Plan (Management Plan 6) 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 distance from the source to receptors, and the low PM_{10} baseline conditions (assuming the lower 15 µg/m³ average during night is representative), respirable dust concentration from the Project dust sources is expected to be low at the dust sensitive receptors.

According to with Table 5.6.2, the magnitude of change is considered to be Low. As already discussed in Section 5.6.3, all dust sensitive receptors are considered to have Medium sensitivity. In terms of Table 5.1.3, impact significance from respirable dust will be a Minor, adverse impact. This is considered to be an insignificant effect on the receptors.

Arsenic in Dust

Baseline monitoring (Section 4.4.5) has shown arsenic concentrations in total suspended particulates at the site to be on the high end of the range of concentrations expected globally. The arsenic concentrations are at the levels expected near non-ferrous smelters. Chronic inhalation of inorganic arsenic is associated with skin and mucous membrane irritation, and other health effects, but medical staff serving the communities have not reported any of these issues amongst the population in Auezov.

Only the respirable fraction of dust, PM_{10}, represents a potential human health hazard. No data is available for arsenic concentrations in the respirable dust fraction at the project, but, for the purpose of the impact assessment, it will be assumed that concentrations of arsenic in TSP are similar to those in the PM_{10} fraction.

The main source will be any construction or operational activity that generates fugitive dust emissions by disturbing material with elevated arsenic concentrations, such as ore and waste rock, and existing waste dumps. Table 5.6.3 provides a list of these potential sources, however the risk of arsenic emissions will vary with time depending on how the mineral composition of the ore and waste rock varies during the life of the project. These emissions will follow the same pathways as for respirable dust discussed previously, and so concentrations of arsenic suspended in the air will decay in a similar manner to that of PM_{10} (Figure 5.6.1).

The arsenic waste landfill site, to the east of the Project area, was previously used to dispose arsenic waste material that was generating from ore processing. The arsenic waste material was stored in sealed bags in the facility. The facility is no longer in use, and will not be used for the Project. It has

been rehabilitated by capping with a 0.5mm plastic geotextile and a 0.5m layer of sandy loam material, and so is not considered to be a source of fugitive dust emissions containing arsenic.

Arsenic in dust should not exceed the standards set out in Table 4.4.1, namely:

- 3.0µg/m^3 in TSP daily mean
- 30µg/m^3 in TSP one-time

With respect to arsenic in dust from construction and operational dust source, respirable dust concentration of arsenic from the Project dust sources is expected to be low at the dust sensitive receptors. According to with Table 5.6.2, the magnitude of change is considered to be Low. As already discussed in Section 5.6.3, all dust sensitive receptors are considered to have Medium sensitivity. In terms of Table 5.1.3, impact significance from respirable dust will be a Minor, adverse impact. This is considered to be an insignificant effect on the receptors.

Combustion Emissions

Mobile Plant

The significance of vehicle exhaust gasses from vehicles operating within the Project footprint was considered with regard to the DMRB3 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 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, or if there are no receptors within 200m, 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 pit to

[3] Design Manual for Roads and Bridges (Volume 11, Section 3, Part 1, HA 207/07

the waste dump and ore preparation facilities. The combustion/gas emission receptor closest to the haul road is DSR 5 (see Table 5.6.5), located approximately 420m away. In terms of the DMRB methodology, this receptor is located more than 200m from the road combustion source. All other sensitive receptors are located even further from the haul road than DSR 5, and so the air quality impact on all receptors is considered neutral using the DMRB method.

Applying the ESIA impact assessment methodology, described in Section 5.1.2 and refined by Table 5.6.1 and Table 5.6.2, receptor sensitivity is **Medium**, impact magnitude is **Negligible**, and Impact significance is **negligible**. The effect of mobile plant combustion emissions is therefore considered insignificant.

Stack Emissions

During Stage 1 of the Project, two new boilerhouses will be constructed and the existing Auezov boiler house will be decommissioned. One boilerhouse, located to the west of Auezov, will be dedicated to providing for Auezov's heating needs. The second boilerhouse will be located at the ore processing facility, and provide heating for the mining and processing facilities' needs. See Drawing 5.6.1.

Both of the new boilers will be coal-fired, and combustion gas emissions will leave the boilerhouse via a stack. The height of the stacks will be decided upon in detailed design, but are expected to be between 20 and 25m high. The mine boilerhouse is rated at 13.1MW and is expected to burn 5190t of coal per year. The Auezov boilerhouse is rated at 7.5MW, and expected to burn approximately 370t of coal per year.

Stage 2 of the project will require additional heating capacity for underground ventilation. MTEU-VNU power supply and heating units will be installed at each ventilation shaft area. Installed capacity will be 30MW at the western area ventilation shaft, 22.5MW at the eastern area shaft, and 40MW at the central (Capital) shaft area. The MTEU-VNU units are also coal-fired and will consume up to 19000t of coal per year at during peak years. Average annual coal consumption during Stage 2 will be about 15000t per year.

The mine boilerhouse, installed during Stage 1, will increase heat supply and coal consumption during Stage 2, increasing it from 5190t to 6320t per year.

A summary of the emission sources for the project is provided below in Table 5.6.9:

Table 5.6.9: Fixed Combustion Emission Sources for the Project

Emission Source	Installed Capacity (kW)	Coal Consumption (tonnes/year)
Boiler – during Stage 1	31000	5190
Boiler – during Stage 2	31000	6320
MTEU – VNU 10 x 4 units	40000	5760
MTEU – VNU 10 x 3 units	30000	4182
MTEU – VNU7.5 x 3 units	22500	8995

A preliminary air quality assessment was carried out using. SCREEN3 software, which is a single source Gaussian plume model that provides maximum ground-level concentrations based on a full range of meteorological conditions, including all stability classes and wind speeds. The model provides estimates of "worst-case" 1-hour concentrations for a single source, without the need for hourly meteorological data. Screen3 is intended to produce concentration estimates that are equal to or greater than the estimates produced by air dispersion models with a fully developed set of meteorological and terrain data.

As the model only takes account of a single point source, the multiple stacks were modelled by merging emissions into a single "representative" stack. The details of the representative stack are provided in Table 5.6.10.

Table 5.6.10: Details of Representative Stack

Parameter	Description
Stack diameter (m)	2.0
Stack height (m)	25
Exist gas velocity (m/s)	15m/s
Temperature of the stack (K)	393

The emission rates were calculated using the IFC's emission standards for thermal power plants[4]. The results of these calculations are shown in Table 5.6.11.

Table 5.6.11: Emission Factors for Pollutants from Thermal Power Plants

Pollutant	Emission Factor (Nm^3/hr)	Emission factor (g/s)
Particulate Matter (PM)	50	0.44
Nitrogen Oxides (NO_x)	510	4.49
Sulphur dioxide (SO_2)	850	7.48

The incremental worst case 1-hour concentrations due to project activities, calculated by SCREEN3, have been provided in Table 5.6.12. These SCREEN3 model and are compared to 24 hour maximums measured during baseline data collection (Tables 4.4.3, 4.4.5, and 4.4.7) and the ambient air quality standard for the Project (Table 4.4.1).

Table 5.6.12: Estimated Concentrations

Pollutant	Incremental concentrations ($\mu g/m^3$; 1-hour maximum)	Baseline Concentration ($\mu g/m^3$; 24-hour maximum)	Ambient air quality standard ($\mu g/m^3$; 24-hour mean)
Particulate Matter (PM)	2.50	PM_{10}: 39.54	TSP: 150.00 PM_{10}: 50.00
Nitrogen Oxides (NO_x)	25.51	NO_2: 20.53	NO_2: 40.00
Sulphur dioxide (SO_2)	42.49	8.47	20.00

[4]http://www.ifc.org/wps/wcm/connect/dfb6a60048855a21852cd76a6515bb18/FINAL_Thermal%2BPower.pdf?MOD=AJPERES&id=1323162579734

As described above, these estimates are "worst-case" 1-hour concentrations and indicate that the project will have an impact on the ambient air quality, particularly in the case of SO_2 emissions at potential receptor locations. In terms of the impact assessment methodology, using this worse-case scenario, magnitude of change would be **High** for SO_2 because the guidance level would likely be frequently exceeded. With the receptor sensitivity already identified as **Medium**, the impact will be **Moderate** (according to Table 5.1.3). This would be considered a significant impact.

Although a significant impact has been identified as a result of point source emissions from boilers, this impact has been identified using a worse-case scenario screening model. A detailed air quality assessment needs to be carried out using an air quality modelling systems such as AERMOD, paired with detailed meteorological conditions, to more accurately assess the nature of impacts associated with the project, and ensure that proposed mitigation strategies are appropriate.

Nuisance Odours

Sources of nuisance odours include vehicle and process emissions, but the facilities with the most likelihood of causing significant nuisance odours, should appropriate operations not be maintained, are the sewage treatment systems. There will be two such facilities within the Project area – the existing Auezov sewage treatment facility, and the new sewage treatment facility to be constructed at the ore processing facility for mining use.

Improper operation of the Auezov sewage facility has the potential to cause moderate short-term local impacts to aesthetic air quality at nearby receptors, especially receptor DSR 6. This is only likely during weather conditions that place DSR 6 downwind of the sewage treatment plant. Wind blows from the south west about 9% of the time, so improper operation of the facility would have to coincide with a 9% chance that wind blows in the correct direction for an impact to be experienced. On the occasions when these conditions do coincide, the receptors with Medium sensitivity will experience a Moderate magnitude of change, resulting in a Moderate impact. This would create a significant effect at those times.

Residential receptors will not be in close proximity to the mine sewage treatment facility, and so the magnitude of change at receptors, in the case where the sewage facility is not managed properly, will be Negligible. The impact from the mine sewage treatment facility will be Negligible, and so the effect is not significant.

Appropriate mitigation measures will be implemented to manage nuisance odours, as described below.

5.6.5 Mitigation Measures

The following sections summarise key air quality impact mitigating actions, both incorporated into the Project's engineering design and into its construction, operation, and closure stages.

Fugitive Dust Mitigation Measures

To decrease potential impacts to air quality to the extent practical, substantial fugitive dust controls will be incorporated into the detailed engineering design. These will include

- Enclosing the primary crusher and screens in a building and fitting dust extraction and filtration devices over transfer points and major dust emission points.
- Placing the crushed ore stockpile over an underground tunnel. Crushed ore will be fed into the tunnel conveyor via gravity, avoiding handling with front-end-loaders on surface that would generate more fugitive dust.
- Installing dust extracting systems in the crushed ore stockpile tunnel for dust control.
- Enclosing the conveyor that transports crushed or from the crushed ore stockpile to the SAG mill.
- Using wet-milling processes for grinding ore, which prevent fugitive dust from being generated.
- Using water sprays at conveyor discharge points and other identified dust emission points.
- Using dust extraction system over concentrate filtration and drying equipment that captures fugitive dust and recycles it to the process to be recovered.
- Installing a fire water and dust suppression water pipeline network for underground dust suppression.

Additional dust control measures will be systematically utilised by the Project during construction and operations, and include:

Road control programmes - Polymetal will carry out appropriate dust suppression techniques including spraying roads with water and/or application of stabilising agents such as salt (winter), gravel, or environmentally inert chemicals, as appropriate. In addition, Polymetal will supply adequate equipment and personnel to maintain road surfaces to control dust on the haul and access roads. The current design makes provision for water trucks, graders, bulldozers, and roller compactors for road maintenance;

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 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;

Blasting restrictions – Only undertake blasting when prevailing wind direction will blow dust plume from blast away from Auezov.

Combustion Mitigation Measures

Combustion emissions from mobile plant will be 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, 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;

Combustion emissions from stack emission point sources for the Project will be reduced in the following ways:

- Construct boilerhouses and heating units with sufficiently high stacks so that combustion gas emissions do not mix close to the ground and so increase pollutant concentrations at receptor locations;
- Use of dry low NO_x type coal burners of proven, advanced design to reduce NO_x emissions;
- Explore options to reduce SO_2 emissions, through selection of coal with low sulphur content if feasible;
- Install an automatic emissions monitoring system on the stack to measure emissions of SO_2, NO_x and particulate matter
- Ambient air quality monitoring stations to be installed within Study Area to obtain such measurable parameters, while periodic air quality monitoring using high/low volume samplers to be conducted at other locations;

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.

5.6.6 Residual Impacts

The AQMP (Management Plan 6) will therefore be implemented to minimise nuisance dust emissions and control fine particulates. With appropriate mitigation measures it is considered that the impact on human receptors will be of minor significance in the short term and negligible significance in the long term.

If design mitigation measures are appropriately applied to boilerhouse and heating unit point sources, emissions of SO_2 and NO_2 could be reduced to acceptable levels.

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

Table 5.6.13: Impact Summary - Air Quality				
Impact	**Mining Stage**	**Impact before mitigation**	**Key Mitigations**	**Residual Impacts**
Fugitive Dust and Particulate emissions from Blasting, Drilling, Loading, Haulage, Crushing, Paste backfill,	Construction Operations	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 stabilising agents on high dust areas. Top-wet truckloads of dusty material. Spray water on unpaved roads and traffic areas. Maintain gravel cover on unpaved roads and traffic areas. Install dust suppression / control equipment at loading/unloading, storage, and material transfer points. Crusher contained within a purpose designed building, with dust extraction equipment	Negligible
Inorganic arsenic in particulates	Construction Operations Closure	Minor	All mitigation measures as for fugitive dust/particulates (above) Monitor local community health clinics for signs of adverse arsenic health effects Restrict access to arsenic waste dump to authorised personnel only	Negligible
Combustion emissions from Engine sources (mobile plant and other vehicles)	Construction Operations Closure	Minor (from major haul vehicle routes)	Enforce speed limits for heavy equipment and general traffic on unpaved roads. Install appropriate emissions control equipment on vehicles. Perform regular maintenance and inspection of vehicles and mobile equipment, including their emissions control systems.	Negligible
Point Source Emissions from boilerhouse and heating unit stacks	Operations	Moderate	Construct boilerhouses and heating units with sufficiently high stacks so that combustion gas emissions do not mix close to the ground and so increase pollutant concentrations at receptor locations; Use dry low NOx type coal burners of proven, advanced design to reduce NOx emissions; Explore options to reduce SO_2 emissions, through selection of coal with low sulphur content if feasible;	Minor
Nuisance Odours from sewage treatment facilities	Operations	Minor (under specific weather conditions)	Practice appropriate waste reduction and recycling procedures to minimise waste generation. Incorporate appropriate waste handling and disposal procedures. Operate sewage treatment facilities properly and monitor operational performance (including odours).	Negligible

5.6.7 Monitoring and Audit

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

Table 5.6.14: 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 at least 2011 in order to establish baseline conditions at key locations within the Project licence area and at local settlements (see Chapter 4.4).	
Level 2 Management Plan	The AQMP (Management Plan 6) provides the details of mitigation measures to control emissions of dust, particulates and combustion gases, associated with mobile plant, boilerhouses, and heating units		
Level 3 Standard Operating Procedures	The AQMP (Management Plan 6) will be underpinned by 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 open pits, haul roads, crushing plant, and waste dump. • Meteorological station – location, download procedures, analysis of results and persons responsible for data collection and dissemination. The maintenance requirements for the met station 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 and recording samples (sample number, date, time and location reference), procedure to ensure that samples are not contaminated between the sampling location and site offices, and procedures for shipment to accredited laboratory. Chain of custody documentation. • Location of equipment and collection and replacement of nuisance dust samples, to follow similar procedures as those for SO_2 and NO_2 sampling. • Environmental sampling and maintenance procedures for continuous TSP, PM_{10}, and PM_{25} monitors. • The location of the monitoring instruments will be determined in a revision of the Level 2 AQMP. Dependent on suitable positions, this Standard Operating Procedure 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 Standard Operating Procedure 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 and Equipment Suggestions			
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 curve, appropriate to this methodology.	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.

Table 5.6.14: Air Quality Monitoring and Audit			
Air quality, Monitoring and Audit programme and procedures			
Dust and arsenic content in dust	DustScan DS100 (or equipment with similar specifications for continuous monitoring)	Multi-directional sticky pad gauge which collect airborne dust as it passes over them. They are held in place and protected with a removable rain cap. The sampling head has a North marker which is aligned to magnetic North and the sample cylinders are fitted with North markers to ensure directional information is obtained. Dust deposition is measured as a % of the effective area covered (EAC), over the sampling period.	%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. Dust adhering to pads analysed for arsenic concentration in dust
Particulates	Osiris Turnkey Monitor (or equipment with similar specification for continuous monitoring)	The Osiris monitor measures total suspended particulates TSP, PM_{10}, and $PM_{2.5}$ and will be deployed as a semi-permanent installation at two locations	In its semi-permanent configuration, with a mains power supply, the meter continuously measures particulate levels and can determine trends when used long term. Results are data logged in the unit and are usually expressed as $mg/m^3/hr$. The monitor is MCERTS accredited and requires regular maintenance and calibration. Two monitors are to be used for the AQMP.
Arsenic in particulates	Migunov M-852 with PM_{10} filter (or equipment with similar specifications for continuous monitoring)	The Migunov M-852 can be fitted with filters to collect PM_{10} dust for later gravimetric analysis	Quarterly 24 hour run at particulate continuous monitoring location to check whether arsenic concentrations in inhalable particulate fraction exceed thresholds. Frequency of monitoring to be modified should thresholds be exceeded.

5.7 Noise

5.7.1 Project Activities and Sources of Potential Impact

Ambient noise levels will increase with commencement of the Project, and will decline in future years when operations move below the surface, and cease post-closure. Site noise will originate from the operational opening year of 2016. Operational noise will result from open pit mining, mobile plant including the transportation of ore and waste rock from the open pit and underground mine, to the ore preparation plant.

Existing sensitive receptors for operational-related noise and vibration increases include residents in the nearby settlements of Auezov and Solnechnoye.

5.7.2 Assessment Methodology

No environmental noise monitoring has been carried out to quantitatively determine the baseline noise conditions in and around Auezov at potential noise receptor locations. Therefore in the absence of background noise data at sensitive receptors, the potential noise impact of the proposed mining operations have been compared to noise levels specified in relevant international guidance and national regulatory limits.

5.7.3 Impact Significance Criteria

The significance of an environmental impact for noise and vibration is determined by the interaction of magnitude of change in ambient noise level and sensitivity of the receptor. The methodology for determining the magnitude of impact and sensitivity of the receptor with regard to noise and vibration is shown in Table 5.7.1 and Table 5.7.2.

Table 5.7.1: 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 5.7.2: 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 ultimately determined by using the magnitude criteria detailed in Table 5.7.2 above, together with the sensitivity of the receptor Table 5.7.1, as detailed above, using the significance matrix detailed in Table 5.7.3.

Table 5.7.3: Impact Significance Matrix				
Magnitude	**Sensitivity**			
	High	**Moderate**	**Low**	**Negligible**
Large	Very Substantial	Substantial	Moderate	None
Medium	Substantial	Substantial	Moderate	None
Small	Moderate	Moderate	Slight	None
Negligible / Beneficial	None	None	None	None

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

Planning Policy 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 (EHS:2007).
- World Health Organisation's Guidelines for Community Noise 1999 (WHO1999).
- Kazakh regulation 3.01.035-97 "Sanitary rules and norms for Maximum permissible noise levels in residential and public buildings and housing areas".

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

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 5.7.4, or result in a maximum increase in background noise levels of 3 dB at the nearest receptor location off-site."

The Table 5.7.4 noise level guidelines within EHS:2007, are presented within Table 5.4;

Table 5.7.4: 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, Wold 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 (WHO1999)

The WHO Guidelines for Community Noise 1999 suggest 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 day time 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
- 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
- 45 dB L_{Aeq} Night time

Kazakh regulation 3.01.035-97 "Sanitary rules and norms for Maximum permissible noise levels in residential and public buildings and housing areas"

In addition to international guidance Polymetal have provided details of national regulatory limits presented within Table 5.7.5;

Table 5.7.5: Kazakh Regulatory Limits

Type of Premises or Area	Time	Max. LA dB
Areas immediately adjacent to residential buildings, rest homes for elderly/disabled, kindergartens, schools and other educational institutions, libraries	7 am – 11pm	70
	11pm – 7am	60
Recreation areas in the territory of building estates and residential building blocks, rest houses, rest homes for elderly/disabled; playgrounds of kindergartens, schools and other educational institutions	7 am – 11pm	75
	11pm – 7am	65

It should be noted that the national regulatory limits provided in Table 5.5 are for maximum instantaneous noise impacts. Therefore the limits do not cover the L_{Aeq} average day and night-time noise levels. The noise modelling assessment contained within this chapter is based on the average L_{Aeq} noise impact during the day and night-time periods and is therefore not comparable with the limits presented in Table 5.7.5. In the absence of L_{Aeq} average national regulatory limits, it is considered appropriate to assess the potential day and night-time noise impact to the IFC EHS Guidelines as presented within Table 5.7.4.

Operations Activities Generating Noise and Vibrations

During operations, potential impacts that are likely to affect the ambient noise level will result from operations that include: drilling and blasting, product extraction, waste extraction, stockpiling, crushing, hauling, stacking, and loading activities. Mining and processing will occur 24 hours a day, for approximately 365 days per year, with hauling covering 340 days per year, resulting in the potential for increased noise levels during the day and night-time periods.

New haul roads will be constructed between the open pit and the process plant and waste dump. Haul trucks with a carrying capacity of up to 180 tonnes will transport the ore and waste from the open pit to the process plant and waste dump respectively. A fleet of up to 10 Komatsu HD 785-5 and 19 Belaz 7518 haul trucks at any one time, will be needed to maintain annual production.

Haulage will be split between the open pit, waste dump and process plant with movement's varying throughout the lifetime of the mine. Open pit mining is complemented by underground mining from 2027 onwards.

Mobile equipment operations are predicted to increase the ambient noise levels in the area, including input from light vehicle operations noise, haul trucks and heavy equipment operations noise including reversing alarms and vibrations resulting from supply truck traffic on public roads. Supply truck traffic along public roads will be restricted to day time hours for safety reasons. The traffic movements themselves will be of low number and therefore have a negligible impact on receptors. Therefore, this potential noise source has not been considered further within this assessment.

Potential Impacts

Potential impact of noise has been modelled by using the peak operational phases, to produce conservative "worst-case" assessments. The operational scenarios considered within this assessment are shown below;

- Operational Opening Year (open mine commissioning) 2016;
- Operational Phase 2019 (peak open pit mining); and
- Operation Phase 2027 (open pit and underground mining).

The following assumptions have been made through the noise modelling process to ensure "worst-case" assessments of each scenario is maintained:

- During the operational phases each item of plant is situated at the nearest operating location to the noise sensitive receptors;
- During the operational phases, all items of plant will be operating 100% of the day time periods, with the exception of the drill rigs which are likely to be operating 70% of the day time and night-time periods; and
- It is understood that all drill rigs will be fitted with enhanced mitigation measures to limit the noise emissions during operation.

Existing Sensitive Receptors

The locations considered to represent the nearest residential properties to the mine have been identified as Existing Sensitive Receptors (ESR), and their location as used in the assessment are shown in Table 5.7.6;

Table 5.7.6: Existing Sensitive Receptors			
Receptor	**Geometry**		
	x	**y**	**Z**
ESR 1 – Solnechnoye	14543265	5507899	439
ESR 2 – North West Auezov	14541444	5509255	413
ESR 3 – North East Auezov	14542596	5509187	424
ESR 4 – East Auezov	14542679	5508904	432
ESR 5 – North East Auezov	14542809	5509205	427

Operational Noise Sources

The primary noise sources, quantities, and their sound power levels used in the assessment are shown in Table 5.7.7, Table 5.7.8 and Table 5.7.9.

Table 5.7.7: Open Pit Operational Phase 2016 (Opening Year) - Primary Source Sound Power Levels		
Source	**Sound Power Level L_W(dB)**	**Quantity of Sources**
Drill rig - Pit Viper 271 Atlas Copco	100	3
Drill rig - FlexiROC D65 Atlas Copco	100	3
Rope shovel - EKG-20	116	4
Hydraulic shovel - Komatsu PC-2000	111	2
Mix-pump truck - IVECO-AMT 693903	110	5
Bulldozer - Komatsu D 275A-5	112	7
Bulldozer - Komatsu D-375-A	113	5
Dump truck - Komatsu HD 785-5	116	6
Dump truck - Belaz 7518	120	5

Table 5.7.8: Open Pit Operational Phase 2019 - Primary Source Sound Power Levels		
Source	**Sound Power Level L_W(dB)**	**Quantity of Sources**
Drill rig - Pit Viper 271 Atlas Copco	100	3
Drill rig - FlexiROC D65 Atlas Copco	100	3
Rope shovel - EKG-20	116	4
Hydraulic shovel - Komatsu PC-2000	111	2
Mix-pump truck - IVECO-AMT 693903	110	5
Bulldozer - Komatsu D 275A-5	112	7
Bulldozer - Komatsu D-375-A	113	5
Bulldozer - Komatsu D65EX-16	108	1
Dump truck - Komatsu HD 785-5	116	9
Dump truck - Belaz 7518	120	19
Ore Preparation	95	1
Air Compressor	82	1
Main Fan	88	1
Lifting Equipment	78	1
Capital Shaft Head	66	1
Road Transport Workshop	79	1
Main Substation	80	1
Central Boiler House	92	1
Pumping Station	73	1

Table 5.7.9: Open Pit and Underground Mining Operational Phase 2027 - Primary Source Sound Power Levels		
Source	**Sound Power Level L_W(dB)**	**Quantity of Sources**
Drill rig - Pit Viper 271 Atlas Copco	100	3
Drill rig - FlexiROC D65 Atlas Copco	100	3
Rope shovel - EKG-20	116	4
Hydraulic shovel - Komatsu PC-2000	111	2
Mix-pump truck - IVECO-AMT 693903	110	5
Bulldozer - Komatsu D 275A-5	112	7
Bulldozer - Komatsu D-375-A	113	5
Bulldozer - Komatsu D65EX-16	108	1
Dump truck - Komatsu HD 785-5	116	9
Western Ventilation Shaft (VO-30VKR)	89	1
Eastern Ventilation Shaft (VO-30VKR)	89	1
Capital Shaft (VO-40VKR)	89	1
Ore Preparation	95	1
Air Compressor	82	1
Main Fan	88	1
Lifting Equipment	78	1
Capital Shaft Head	66	1
Road Transport Workshop	79	1
Main Substation	80	1
Central Boiler House	92	1
Pumping Station	73	1

The nearest noise receptors to the Project are identified in Table 5.6. Within the affected communities, the sensitive receptors are residential properties and therefore the sensitivity of all the receptors is medium (see Table 5.7.1). Table 5.7.10 presents each receptor location and the corresponding approximate distance to the main operational areas of the Project.

Table 5.7.10: Distance from Source to Receptors

Community	Distance (m)			
	Open pit	Haulage Route	Waste Dump	Processing Plant
ESR 1 – Solnechnoye	1700	1100	2100	900
ESR 2 – North West Auezov	500	1700	1400	2300
ESR 3 – North East Auezov	400	600	1000	1200
ESR 4 – East Auezov	650	700	1200	1100
ESR 5 – North East Auezov	400	400	900	1000

The main factor affecting point-source noise transmittal is distance between noise source and receptor. For all receptors the distance identified is significant in terms of attenuating specific noise sources. For the noise prediction carried out using ISO9613-2:1996 [1], accuracy is defined as ±3dB for distances up to 1km. Estimates of accuracy for distances greater than 1km are less certain. It should be noted that all of the nearest communities are within 1km of the mining process. .

Air and ground adsorption also influence noise transmittal, as can seasonal climatic/atmospheric changes; however for the Project impact assessment these effects are considered to be insignificant, and distance between noise source and receptor remains the key pathway of interest. Therefore, it has been assumed that noise emanating from the Project will remain relatively consistent throughout the year.

Noise Prediction

To accurately model the land surrounding the operation, an AutoCAD drawing was produced, which included the layout of the proposed mining operations and land contour data for the assessment years, to define natural barrier attenuation between the source of noise and receptors.

Calculations were carried out using the computer modelling software SoundPLAN Version 7.4. The computer modelling methodology conforms to the calculation procedures set out in ISO9613-2:1996 (acoustic measurement standard procedures). ISO9613-2:1996 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 attenuation factors outlined above have been used in the model.

[1] Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation, ISO9613-2:1996

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

- Geometrical divergence accounts for the hemi-spherical spreading of noise in the free-field from a point source situated near the ground surface - geometrical divergence is the most important factor in the attenuation of noise, as its main component is distance.
- 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 0.2 in accordance with the guidance given in Section 7.3.1 of ISO9613-2:1996.
- Attenuation due to screening is a result of noise being reflected or absorbed by barriers during propagation from the source to the receiver. In this calculation process, barriers will be land contours encountered along the noise propagation path, as determined by the ground model used in the predictions.

In addition to the above, the calculation parameters of the acoustic model have been set to include the meteorological correction, Cmet, which is used to calculate the equivalent continuous long term sound press pressure level, as set out in Clause 8 of ISO9613-2:1996.

5.7.4 Operational Phase Prediction

The potential noise impact at existing receptors considered have been assessed by comparing the noise levels predicted for the operational phase of the project with the absolute noise level limits within IFC EHS Guidelines, which should not be exceeded during daytime (07:00-22:00) and night-time (22:00-07:00) periods. The predicted daytime noise values in the nearby communities during the 2016 (opening year), 2019 and 2027 operational phases are compared to these values in Table 5.7.11, Table 5.7.12, and Table 5.7.13 respectively.

Table 5.7.11: 2016 (Opening Year) Operational Phase Assessment Daytime Noise Impact

Receptor	Predicted Site Noise Level, L_{Aeq} (dB)	Daytime Noise Criteria, L_{Aeq} (dB)	Difference
ESR 1 – Solnechnoye	40	55	-15
ESR 2 – North West Auezov	54	55	-1
ESR 3 – North East Auezov	51	55	-4
ESR 4 – East Auezov	52	55	-3
ESR 5 – North East Auezov	52	55	-3

Table 5.7.12: 2019 Operational Phase Assessment Daytime Noise Impact			
Receptor	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Daytime Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	40	55	-15
ESR 2 – North West Auezov	49	55	-6
ESR 3 – North East Auezov	48	55	-7
ESR 4 – East Auezov	47	55	-8
ESR 5 – North East Auezov	49	55	-6

Table 5.7.13: 2027 Operational Phase Assessment Daytime Noise Impact			
Receptor	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Daytime Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	38	55	-17
ESR 2 – North West Auezov	43	55	-12
ESR 3 – North East Auezov	46	55	-9
ESR 4 – East Auezov	45	55	-10
ESR 5 – North East Auezov	48	55	-7

It can be seen that the daytime operational phases of 2016, 2019 and 2027 will be below the IFC Guidelines at all receptor locations. 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 would be less.

The output from the noise prediction model, showing noise emission from Project operational phase during the daytime are presented in Drawings 5.7.1, 5.7.2 and 5.7.3 for 2016, 2019 and 2027 respectively. It should be noted that the unshaded parts of the contour plots represent areas where the predicted site noise level is less than L_{Aeq}55dB (in compliance with IFC EHS daytime noise levels).

The significance of this impact in **None** when compared to the sensitivity of the receptor using Table 5.7.3.

The night-time noise levels arising from the operational phases of 2016, 2019 and 2027 have been assessed in Table 5.7.14, Table 5.7.15 and Table 5.7.16.

Table 5.7.14: 2016 (Opening Year) Operational Phase Assessment Night-time Noise Impact			
Receptor	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	40	45	-5
ESR 2 – North West Auezov	54	45	+9
ESR 3 – North East Auezov	51	45	+6
ESR 4 – East Auezov	52	45	+7
ESR 5 – North East Auezov	52	45	+7

Table 5.7.15: 2019 Operational Phase Assessment Night-time Noise Impact			
Receptor	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	40	45	-5
ESR 2 – North West Auezov	49	45	+4
ESR 3 – North East Auezov	48	45	+3
ESR 4 – East Auezov	47	45	+2
ESR 5 – North East Auezov	49	45	+4

Table 5.7.16: 2027 Operational Phase Assessment Night-time Noise Impact			
Receptor	**Predicted Site Noise Level, L_{Aeq} (dB)**	**Night-time Noise Criteria, L_{Aeq} (dB)**	**Difference**
ESR 1 – Solnechnoye	38	45	-7
ESR 2 – North West Auezov	43	45	-2
ESR 3 – North East Auezov	46	45	+1
ESR 4 – East Auezov	45	45	0
ESR 5 – North East Auezov	48	45	+3

It can be seen that the night-time operational phases occurring in 2016 and 2019 will be above the IFC Guidelines at all receptor locations within Auezov. Marginal exceedances are expected at two receptors in Auezov during the night-time periods of 2027. The receptor location at Solnechnoye will be below the IFC Guidelines during the operational phases of 2016, 2019 and 2027.

It should be noted that the noise model predictions assume down wind conditions for all sensitive receptor locations. It has been found, based on average wind rose data from the Shalabay weather station[2], located approximately 5km south-west of the Bakyrchik Deposit, for approximately 50% of the year sensitive receptors will be located up-wind from the mining operations. Therefore the predictions represent a "worst-case" scenario and the noise impact at sensitive receptors would be less.

Additional calculations have been undertaken to quantify the likely noise impact as sensitive receptors when considering the average meteorological conditions throughout the whole year. The results predict a reduced impact to those presented within this report at all receptor locations of between 2 to 3 dB(A).

The output from the noise prediction model, showing noise emission from operational phases during the night-time are presented in Drawings 5.7.1, 5.7.2 and 5.7.3 for 2016, 2019 and 2027 respectively. It should be noted that the unshaded parts of the contour plots represent areas where the predicted site noise level is less than L_{Aeq}45dB (in compliance with IFC EHS night time noise levels).

When comparing the predicted specific noise levels, at ESR 1 (Solnechnoy), from the operation phases of 2016, 2019 and 2027, with the IFC Guidelines, the magnitude of the noise impact of the operational

[2] Bakyrchik Mining Venture LLC , The Bakyrchik Gold Deposit, MINE AND PROCESS PLANT CONSTRUCTION, 34.01.06.00100 PZ3, St. Petersburg, 2015

phase is considered to be Negligible. The significance of this impact in **None** when compared to the sensitivity of the receptor using Table 5.3.

When comparing the predicted specific noise levels, at ESR's 2 to 5 (Auezov), from the operation phases of 2016, 2019 and 2027, with the IFC Guidelines, the magnitude of the noise impact of operational phase is considered to be Medium to Large at receptor locations in Auezov. The significance of this impact is **Substantial** in the short term and **Moderate** in the long term, when compared to the sensitivity of the receptor using Table 5.7.3.

The nearest affected community of Auezov is 400m from major Project facilities. Standard noise mitigation and best practices, presented within section 5.5, will be adopted from the health and safety management plan.

5.7.5 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

- Undertake noise monitoring to establish the current baseline noise levels at sensitive receptor location.
- Incorporate designed mitigation measures prior to start up, including housing for crushing plant 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.
- During detailed design, consider the use of noise barriers, baffles, or enclosures to provide abatement for noisy equipment such as generators, compressor, pumps, gearboxes; and maintain an adequate distance between the stationary noise sources from nearby communities.

Operational Plant Mitigation

- All mobile plant should undergo regular inspection and maintenance of to ensure that they have designed mufflers are perform to an adequate standard and that worn parts are replaced;
- Schedule noisy construction activities, so that when new activities commence, local communities can be made aware of the activity in advance, through existing stakeholder engagement mechanisms.
- Where practical, noisy activities should be undertaken during the "normal working" daytime period.
- Maintain the surface of haul roads in good condition and impose a speed limit.

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;
- Blast design will include face profiling and explosive packing to maintain high level of environmental performance for each blast;
- Employees and contractors involved in mining and blasting operations will be issued 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 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;
- Complaints related to noise related to mining 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; 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 population areas;

- Maintain access road surfaces in good repair to reduce tire noise; and
- Ensure continuous traffic flow to avoid prolonged idling.

5.7.6 Monitoring and Audit

The monitoring and audit planning required to validate the effectiveness of the mitigation strategies have been identified in Table 5.7.17.

Table 5.7.17: Noise and Vibration Monitoring and Audit

Noise - Monitoring Approach		
Standard Operating Procedures	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 procedures will be identified. Chain of custody documentation. • 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	
Monitoring strategy	**Equipment**	**Procedure**
Noise	Class 1 noise meters with environmental monitoring kits will be retained on site and maintained throughout the duration of the Project.	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.

5.7.7 Residual Impacts

Standard noise mitigation and best practices will be adopted by the Project to protect workers and community receptors. With appropriate mitigation measures applied, the noise levels at each nearby community will reduce the noise impact at each receptor location. The residual impact is therefore considered **Substantial** in the short and **Moderate** long term for community receptors.

Additional calculations have been undertaken to quantify the likely noise impact as sensitive receptors when considering the average meteorological conditions throughout the whole year. The results predict a reduced impact at all receptor location of approximately 2 to 3 dB(A).

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 5.7.18.

Table 5.7.18: Impact Summary - Noise

Impact	Source	Primary Receptor (1)	Phase (2)		Significance(3)		Mitigation Measures	Management Plan
			C	O	ST	LT		
Noise	2016 Operational Phase - Table 5.6 2019 Operational Phase - Table 5.7 2027 Operation Phase - Table 5.8	R	-	X	SU	M	• 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. • Position stationary noise sources away from residents.	Transport Management Plan
							• Schedule high noise-generating activities to daytime and/or normal work hours. • Post signage in appropriate languages denoting areas of high noise where hearing protection is mandatory. • Position containers for use as temporary noise barriers when possible.	Noise Management Plan
							• Monitor noise-related complaints through the Complaints and Grievances Process.	Stakeholder Engagement Plan

Notes:
(1) Primary Receptors: R = residents, E = employees, B = buildings
(2) Project Phase: C = Construction, O = Operations
(3) Expected Significance Rankings: ST = short-term with mitigation, LT = long-term with mitigation, VS = very substantial, SU = substantial, M = moderate, SL = slight, N = none

5.7.8 Conclusions

An impact assessment has been undertaken to assess the effects of the operational phases of the Project with regard to noise sensitive receptors. The findings of the impact assessment are summarised in Table 5.7.18.

The potential impact magnitude of noise generated by the Project has been assessed at identified sensitive receptors and appropriate mitigation measures recommended to ensure that significant noise impacts are reduced. In the absence of L_{Aeq} average national regulatory limits, the potential day and night-time noise impact has been assessed to the IFC EHS Guidelines.

To reduce the potential for noise impacts at existing receptor locations in the immediate vicinity of the site, standard mitigation measures and best practices will be adopted by the Project to protect community receptors. Additionally, the effectiveness of mitigated noise activities will be monitored via the Project's grievance mechanism.

The threshold between insignificant and significant lies between "Moderate" and "Substantial". Moderate impacts might be noticeable and intrusive but may only cause a small change in behaviour. Substantial impacts might be noticeable and disruptive, and might cause a material change in behaviour or attitude.

During operational phases, the residual impact is considered to be none during the day time. During the night-time the residual impact is considered **Substantial** in the short and **Moderate** long term for community receptors.

5.8 Soils and Land Use

5.8.1 Project Activities and Sources of Potential Impact

All project activities which will take new areas of land, such as creation of the WRD, TSF, and CSF, will have potential impact on soils. This is because soil will be stripped from those areas and stored for later use in restoration after mine closure. Undisturbed soils adjacent to the project activity areas may be also impacted through deposition of dry and wet materials, which may potentially contaminate them.

5.8.2 Receptor Sensitivity

The Project is situated within a mostly uncultivated steppe habitat. Herding practices currently take place in some parts of the area identified as the footprint for the future development of the mine and associated infrastructure, in particular the TSF facility and processing plant. Due to low intensity use and potential for local substitution, the land is considered to be of low importance to agriculture. As described in Section 4.7 soils over the majority of the Project footprint are low in organic matter (3.5% on average), shallow and stony (most of the WRD and process plant area), occurrences of deeper soils are confined to land depressions and stream valleys (parts of the TSF and east section of the WRD). The soils are therefore considered of local importance in terms of carbon storage. They are resilient to erosion in the current form. The soil types and ecosystems they support are extensive locally (see Section 4.9: Biodiversity baseline). They are therefore considered to have local importance and high potential for substitution within the local area.

Based on the above, using criteria from Table 5.8.1, the soils present within the Project footprint are considered to be a receptor of ***minor*** sensitivity.

5.8.3 Potential Impacts

Potential impacts of all project stages (construction, operational and decommissioning/restoration) include the following:

- disturbance and removal of soils;
- changes in soil quality during storage;
- change in soil chemistry and quality through soil contamination resulting from accidental spills or discharges; and
- loss of soil through wind and water erosion.

No sources of existing contamination within the areas of soils that will be disturbed were identified, therefore the risk of contaminant mobilisation due to soil disturbance in those areas is negligible.

Without appropriate mitigation the Project activities will cause such degree of change that total loss of soils from disturbed areas will occur. According to the criteria defined in Table 5.8.1, the magnitude of change will be ***high***.

According to the criteria set out in Table 5.8.1, without mitigation, the combination of minor receptor sensitivity and high magnitude of change gives a **moderate** impact, which will result in a *significant* effect.

5.8.4 Mitigation Measures

In order to reduce the level of significance of the residual impact appropriate mitigation measures are required. To minimise soil loss and disturbance the following measures have been incorporated into the layout and design of the Project facilities:

- Construction restricted to the area required to develop the mine.
- The footprint of temporary facilities, such as construction access roads and laydown areas aligned, if possible, with those required during the operational phase.
- The layout of the infrastructure optimised to maximise the use of already disturbed areas.
- Topsoil storage area located away from sources of potential historic contamination (Drawing 1.3)
- Installation of impervious liners in the TSF structures, ore buffer stockpile and carbon product storage to ensure protection of adjacent areas from contamination.
- Drainage water from the sites, such as the TSF, ore buffer stockpile and carbon product storage diverted and collected away from undisturbed areas and topsoil storage.
- Designated waste collection and temporary storage areas in order to prevent littering and soil contamination.
- Additionally the following good practice mitigation measures are recommended:
- Topsoil (biologically active, organic matter rich layer, varying depth, approx. 30cm – see Appendix 4.7.1 for detailed description of soil profiles) will be stripped from the WRD, TSF and CSF areas before they are operational.
- Vegetation (turf) layer from TSF, and other areas where thick vegetation cover exist, will be removed before topsoil stripping and should be used as a mulch for the topsoil storage stockpiles to minimise risk of erosion (see Appendix 5.8.1 Framework Soil Management Plan).
- Topsoil will not be mixed with subsoil.
- Subsoil (typically below 30cm depth, clayey or sandy layer poor in organic matter) will be used as base and cover of the TSF polyethylene protection liners. Topsoil will be used for this purpose only when there is no sufficient subsoil available locally.
- Soil from existing industrial and disturbed areas will not be mixed with topsoil from undisturbed areas.

- Vehicular traffic will be restricted to existing routes and proposed new routes.
- Stored topsoil will be used for restoration of disturbed land during mine closure and rehabilitation.

Good practice mitigation measures for soil management are described in Appendix 5.8.1: Framework Soil Management Plan.

Avoidance and Containment of Spills and Accidental Discharges

Training will be provided on and implementation of the accident response plan, emergency response plan, and oil spill response plan (as referenced in the Emergency Preparedness and Response Document – Management Plan 4) to mitigate the potential for adverse impacts to soil and water quality in the event of an accidental spill or release during normal construction or operating conditions. All employees and contractors will be bound by the procedures in the Plan.

Appropriate bunded containment will be provided around areas where spills could occur, such as storage tanks, and areas where chemicals, fuels, or lubricants are being handled or used will be underlain by a suitable liner or paved to prevent any accidental spills from reaching the underlying soils.

Sorptive materials for the materials stored or in use in a particular area will be provided and kept stocked in an easily accessible location, so that in the event of a spill or accidental discharge, the spill can be contained and wiped up immediately.

Mine Closure and Rehabilitation

There is the potential for land to be rehabilitated on mine closure to a steppe habitat capable to be used by herders. Details about the Project's mine closure and rehabilitation can be found in Polymetal's Feasibility Study (Volume 1, Section 13.3) as well as in the Mine Closure and Rehabilitation Plan (see Management Plan 5), which outlines the planned rehabilitation and re-vegetation activities which will be undertaken by the Project. The waste dump area will be graded, topsoil will be restored and revegetated.

After underground mining ceases, the open pit will be rehabilitated by treatment of slopes with ingress of groundwater to the deeper part of the void. Soil will be placed on shallower gradients and sown to grassland. The perimeter of the pit will be fenced to exclude animals.

5.8.5 Residual Impacts

The proposed mitigation will minimise soil loss and disturbance, and allow for majority of the Project footprint to be restored. Some loss and alteration will occur, however, the post development characteristics and quality of the soils will be changed only partially and reversibly. According to the

criteria in Table 5.8.1 the residual magnitude of change to soils and land capability is therefore considered to be **moderate**. The combination of minor receptor sensitivity and moderate magnitude of change, according to the criteria in Table 5.8.1, gives a **minor** impact, resulting in a **non-significant** residual effect.

5.8.6 Monitoring and Audit

Soil monitoring will continue in part of the existing monitoring points (M1-M18), points M1, M2, M8, M9, M12, M13 will be under areas of disturbance: pit, waste rock storage, and TSF areas, and as a result they will no longer be suitable for monitoring. Equivalent number of new soil monitoring points will be established (points N1–N6, Figure 4.7.2) in higher risk areas: stream valleys south west, north, and east of WRD, south east of CSF and south of TSF below the dam.

Topsoil storage areas will be monitored for signs of erosion and appropriate additional protection measures taken accordingly.

5.8.7 Summary

Soil disturbance in the form of stripping, handling, and storage will take place throughout the lifetime of the Project. It was identified that the soil resources present within the Project footprint are a receptor of minor sensitivity due to predominantly shallow profile and low organic matter (carbon) content, supporting habitat that is common in the region and having limited agricultural use. The assessment have shown that without the mitigation Project activities would have a significant effect. Mitigations measures included in the layout and design of the Project facilities and Framework Soil Management Plan (Management Plan 7) will reduce the impact to minor, resulting in a non-significant residual effect.

Table 5.8.1: Summary of Mitigation and Residual Impacts

Impact	Mining Stage	Impact before mitigation	Key Mitigations	Residual Impacts
Loss and degradation of soil	All	Moderate	Use of appropriate methods of soil handling, storage and restoration to preserve soil quality and minimise risk of erosion (see Management Plan 7). Restoration of disturbed areas after mine closure using stored soil resources.	Minor

5.9 Water Resources

5.9.1 Project Activities and Sources of Potential Impact

Construction Phase

The construction phase will occur in two stages:

- Stage 1 associated with the open pit mining and occurring between 2016 and 2024;
- Stage 2 associated with the underground mining and occurring between 2025 and 2039.

These two stages can each be sub-divided into the following key construction tasks:

Stage 1 – Open Pit Mining (2016 – 2024)

A. Demolition of buildings within the new pit blast zone and protection areas including the old processing plant facilities, the water tower serving the Auezov settlement and the settlements coal-fired boiler house;

B. Construction of the new processing plant, mine facilities including various infrastructure associated with the processing facility, the open pit, storage facilities, waste dumps, utilities network and roads;

C. Construction of public and community infrastructure including the Bakyrchik-Bursak by-pass road and, Aurezov utilities including power and lighting networks, a transformer substation, a replacement boiler house, a replacement water tower, a heat supply network, a water supply network and a sewer network;

D. Construction of a new Tailings Storage Facility (TSF).

Stage 2 - Underground Mining (2025 – 2039)

A. Refurbishment of the five existing shafts to the underground workings and construction of a ventilation fan and heat generating power unit at three of the shafts (The Western, Eastern and Capital shafts);

B. Construction of connecting infrastructure networks for the underground mine workings including sanitary and amenity buildings, a heat supply network, water storage tanks and sewage networks;

C. Construction of facilities in the Eastern area including underground mining facilities, pithead facilities and a paste backfill plant;

D. Construction of facilities in the Western and Central areas.

These key construction tasks have the following construction activities associated with them, which carry potential impacts which could affect the water environment (Table 5.9.1).

Table 5.9.1: Construction Activities of the Project Description Relevant To The Water Environment during Construction

Construction Activities	Potential Impacts
Soil Compaction	Compaction of soil by machinery reduces infiltration, increases runoff and shortens the rainfall–runoff response.
Soil Stripping	Soil stripping reduces soil moisture storage capacity and may increases runoff.
Vegetation Removal	Removal of vegetation reduces interception and evapotranspiration rates and increases runoff.
Construction / Removal of Impermeable Surfaces	Redirection of lateral flows in the soil (through flow) and surface runoff routes around impermeable structures and foundations.
Use Of Machinery	Pollution from spills or leakage of fuel and oil from use of machinery and storage onsite.
Use Of Concrete Or Equivalent	Pollution from spills or leakage.
Earthworks	Earthworks including re-profiling and regrading can generate runoff high in sediment or pollutants associated with previous land uses, which if not treated would have a polluting impact on the receiving waterbodies.
Demolition	Demolition can mobilise pollutants associated with the previous building uses which can be mobilised in surface runoff.
Modification of surface water catchments and channels	Redirection of surface water channels and removal of catchments may lead to alterations in the runoff-recharge relationship.
Construction activities over water bodies	Modification of water courses channels and banks may be required which could lead to potential alterations in flow regimes as well as mobilisation of sediment.

Table 5.9.2 summarises which construction activities and thus impacts are associated with the key construction tasks:

Table 5.9.2: Construction Activities Associated with the Key Construction Tasks

Key Construction Task	Construction Activity									
	Soil Compaction	Soil Stripping	Vegetation Removal	Construction of Impermeable Surfaces	Use of Machinery	Use of Concrete or Equivalent	Earthworks	Demolition	Modification of surface water catchments and channels	Construction activities over water bodies
1A	✓	✓		✓	✓	✓	✓	✓		
1B	✓	✓		✓	✓	✓	✓		✓	✓
1C	✓	✓		✓	✓	✓	✓			
1D	✓	✓	✓	✓	✓	✓	✓		✓	✓
2A				✓	✓	✓				
2B	✓	✓		✓	✓	✓	✓			
2C	✓	✓		✓	✓	✓				
2D	✓	✓		✓	✓	✓	✓			

Operational Phase

The operational phase (2016 – 2039) will have the following key tasks and activities which may potentially cause impacts to the water environment associated with them:

Table 5.9.3: Activities Associated with Each Potential Operational Tasks and their Potential Impact on the Water Environment		
Key Task	**Activity**	**Potential Impact**
Stage 1 (2016 – 2024)		
Open pit mining activities including blasting activities, dewatering and exposure of strata	Expansion of the open pit	Alteration in the recharge – runoff relationship by direct interception of rain and snow.
	Dewatering	Alteration in groundwater regime (level and flow direction) in superficial and bedrock aquifers
	Use of explosives	Introduction of nitrate into the groundwater within the aquifers.
	Use of machinery	Spills and leaks of oils, fuels and lubricants associated with machinery operating within the pit.
Processing activities including stockpiling, preparation and processing of ore	Presence of Impermeable Surfaces	Redirection of lateral flows in the soil (through flow) and surface runoff routes around impermeable structures and foundations.
	Storage and use of potential pollutants	Contamination of surface runoff
The operation of the TSF	Modification of surface water catchments and channels	Redirection of surface water channels and removal of catchments may lead to alterations in the runoff-recharge relationship.
	Emplacement of tails material	Leakage of tails water through base and side of TSF dam. Loss of tails and associated water during dam failure.
The operation of the waste dump	Presence of Impermeable Surfaces	Redirection of lateral flows in the soil (through flow) and surface runoff routes around impermeable structures and foundations.
	Storage of potential pollutants	Contamination of surface runoff
	Modification of surface water catchments and channels	Redirection of surface water channels and removal of catchments may lead to alterations in the runoff-recharge relationship.
External water supplies for the site operation	Abstraction of groundwater from the Kyzyltu borefield	Alteration in groundwater regime (level and flow direction) in the bedrock aquifer
External water supplies for Auezov	Abstraction of groundwater from the Kyzyltu borefield	Alteration in groundwater regime. Changing flow direction and depletion of groundwater storage in the bedrock aquifer

	Abstraction of surface water from the Kyzylsu Reservoir	Alteration in surface water flow and level
Generation, storage and disposal of other waste streams including carbon concentrate and domestic waste	Impermeable Surfaces	Redirection of lateral flows in the soil (through flow) and surface runoff routes around impermeable structures and foundations.
	Storage of potential pollutants	Surface runoff may potentially contain high concentrations of pollutants associated with stored materials.
Storage of reagent, fuel and lubricants	Storage and use of potential pollutants	Surface runoff may potentially contain high concentrations of pollutants associated with spills and leaks of stored materials.
Operation of plant and heavy vehicles as well as vehicle workshops and warehouses	Repair, washing and use of machinery	Leaks and spills of oils, lubricants and fuels as well as generation of dirty washdown water may enter surface runoff
Stage 2 (2025 – 2039)		
Underground mining activities including blasting activities and dewatering	Operation of dewatering activities associated with the underground mine	Alteration in groundwater regime (level and flow direction) in the bedrock aquifer
	Operation of dewatering activities associated with the open pit	Alteration in groundwater regime (level and flow direction) in superficial and bedrock aquifers
	Use of explosives	Introduction of nitrate into the groundwater within the bedrock aquifer
	Use of machinery	Spills and leaks of oils, fuels and lubricants associated with machinery operating within the underground mine
Generation and emplacement of paste backfill	Storage of backfill material in underground mine	Alteration in groundwater regime (level and flow direction) and quality in the bedrock aquifer

Note: Only activities additional to those identified in Phase 1 are listed in Phase 2. All Phase 1 activities are considered to continue into phase 2 with the exception of blasting activities associated with the open pit.

Closure Phase

The closure phase will consist of the following key activities:

Table 5.9.4: Activities Associated with Each Potential Operational Task and their Potential impact on the Water Environment

Key Task	Associated Activity	Potential Impact
General site rehabilitation	Demolition	Demolition can mobilise pollutants associated with the previous building uses which can be mobilised in surface runoff.
	Soil regrading	Alteration to rainfall-runoff response and recharge-runoff relationship.
Open Pit Rehabilitation	Formation of a pit lake	Alteration in groundwater regime (level and flow direction) in the shallow and deep aquifers.
Waste Dump Rehabilitation	Regrading and revegetation	Emplacement of vegetation increases interception and evapotranspiration rates and reduces runoff.
Tailings Storage Facility Rehabilitation	Removal of the settling pond, tailings pond and associated pipework	Discharge to the water environment may potentially lead to alteration in surface water flow and quality.
	Covering of the TSF and construction of a water diversion ditch	Discharge of water from within the TSF after closure into surface water bodies altering flow and quality characteristics.
	Modification of surface water catchments and channels	Redirection of surface water channels and removal of catchments may lead to alterations in the runoff-recharge relationship.

5.9.2 Impact Significance Criteria

The sensitivity criteria used to determine the sensitivity of the baseline environment is set out in Table 5.9.5. The criteria for sensitivity are based on a hierarchy of factors relating to the quality of the aquatic environment, including international and national designations, water quality information, waterbody status, consultations, site surveys and the professional judgement of the assessment team. Not all of these criteria may actually be present within, adjacent to or downstream of the project study area. These criteria are used to guide the analysis of the sensitivity of the baseline hydrological and hydrogeological environment.

Table 5.9.5: Water Receptor Sensitivity Value		
Sensitivity (value)	**Typical Descriptors**	**Hydrogeology / Hydrology Descriptors**
Minor	Low importance receptor; Abundant; Local importance or scale; Resilient to change; Potential for substitution within the local area.	• A water body or aquifer of local importance (villages or hamlets) for water supply, food production, income or amenity value; • A water body of moderate amenity value; • A water body of low amenity value with casual access, e.g. along roads; • An area of aquatic ecosystem of low sensitivity.
Medium	Low to medium importance receptor; Relatively abundant; Regional important or scale; Reasonably resilient to change; Potential for substitution.	• A water body of regional importance (towns, cities or nomadic communities) for water supply, food production, income or amenity value; • An aquatic ecosystem of regional importance; • A regionally important aquifer for water supply, surface water support, food production or amenity value; • An area of aquatic ecosystem of regional importance or moderate sensitivity.
High	Medium to high importance receptor; Relatively rare; National importance or scale; Fragile and susceptible to change; Limited potential for substitution.	• A water body of national importance in an area used for national water supply, national food production, national income or national amenity value; • An aquatic ecosystem of national importance or high sensitivity; • A nationally important aquifer in an area used for national water supply, national surface water support or national food production.
Very High	Very high importance receptor; Extremely rare; International importance or scale; Very fragile; Highly susceptible to change; Very limited potential for substitution.	• Any water body which forms a boundary between, or flows through, two or more countries; • Any water body that is bounded by two or more countries or within one country but provides a necessary channel between the open sea and other country; • A highly sensitive aquatic ecosystems of international importance; • A water dependent world heritage site or other water dependent site of international significance.

The magnitude of the effect has been based on the criteria identified in Table 5.9.6. In the absence of specific and documented guidance that relates to determining the magnitude of effect in relation to hydrology and the hydrogeological resource, the guideline criteria are based on professional experience, adopted in the assessment of water resources that take account of performance standards and industry best practice.

Table 5.9.6: Magnitude of Effects with Respect to the Water Environment	
Impact Magnitude	**Guideline Criteria**
Negligible	Minimal or few detectable changes in baseline resource, which are either of short duration or infrequent periodicity, such direct control or management is not required.
Low	Detectable change to the baseline resource, such that preconstruction and during operations there would be ongoing deterioration in underlying characteristics or quality of the baseline situation in the absence of standard good industry practice to protect the water environment.
Moderate	Loss of, or alteration to the baseline resource such that post development characteristics or quality would be partially changed during construction and operational phase. Sustained mitigation strategy required through to post closure phase.
High	Total loss of, or alteration to, the baseline resource such that post development characteristics or quality would be fundamentally and irreversibly changed. Detailed mitigation strategy combined with offsite compensation is required to reduce the magnitude of the effect.

5.9.3 Potential Receptors

Five primary potential receptors are identified:

1. Groundwater within the superficial alluvial aquifer;
2. Groundwater within the Lower Carboniferous bedrock aquifer;
3. Surface water within the Kyzylsu River, including the surface water reservoir;
4. Surface water within the brooks draining the project area. The main brooks are the Akbastaubulak, Kysyltu, Alaaigyr and Mayranbastau/Holodniy Klyuch Brooks;
5. Surface water within the Alaaigyr Lake.

Groundwater within the superficial alluvial aquifer is associated with recent fluvial deposits and proluvial deposits comprising sand and gravel. The groundwater table is unconfined and the flow direction is towards the Kyzylsu River. This aquifer has limited storage capacity and is not used for water supply but provides baseflow to the Kyzylsu River at certain times of the year. The groundwater within the superficial alluvial aquifer is therefore considered to have ***Minor*** sensitivity.

Groundwater within the Lower Carboniferous Bedrock aquifer is contained within fractures and fissures in the weathered zone which extends to c. 100m below the top of the unit. The groundwater is partially confined in places by the Pavlodar clay aquitard, and where it is not confined, there is a high degree of connectivity with the superficial alluvial aquifer. Locally groundwater is exploited to supply the village of Auezov however this will cease once the mine is developed and the groundwater will only supply the mine. The groundwater within this aquifer is therefore considered to have ***Medium*** sensitivity.

The Kyzylsu River is the main river within the area and derives its water from snowmelt run-off as well as groundwater baseflow at certain times of the year. The Kyzylsu Reservoir, located on the Kyzylsu

River, will be utilised by the town of Auezov for its water supply during operation of the mine. The Kyzylsu River flows through the town of Shalabay. It is unknown if the town, or other towns downstream, derives their water source from this river. The surface water within the Kyzylsu Reservoir is therefore considered to have ***Medium*** sensitivity.

The brooks located in the project area are generally small streams, which flow broadly in a northeast to southwest direction. Most of the mine infrastructure is located within the catchments of the Akbastaubulak and Kysyltu Brooks. A network of flow monitoring stations was installed on the brooks within the project area. Collection of flow data has been sporadic, but it was observed that the flow within the brooks is ephemeral between the months of August and March. The surface water within the brooks is therefore considered to have ***Minor*** sensitivity.

The Alaaigyr Reservoir, located on the Alaaigyr Brook downstream of the tributaries and the TSF, is used by the locals for fishing and other recreational activities. The surface water within the Alaaigyr Reservoir is therefore considered to have ***Minor*** sensitivity.

The significance of impacts is a product of receptor sensitivity and magnitude as described in the input significance matrix shown in Table 5.9.7.

Table 5.9.7: Impact Significance Matrix for Identified Water Resource Receptors

Receptor		Receptor Sensitivity	Magnitude of Change			
			Negligible	Low	Moderate	High
Groundwater within the superficial alluvial aquifer		Minor	Negligible	Negligible	Minor	Moderate
Groundwater within the Lower Carboniferous bedrock aquifer		Medium	Negligible	Minor	Moderate	Moderate
Surface Water within the Kyzylsu River, including the surface water reservoir		Medium	Negligible	Minor	Moderate	Moderate
Surface Water within the Brooks		Minor	Negligible	Negligible	Minor	Moderate
Surface Water within the Alaaigyr Lake		Minor	Negligible	Negligible	Minor	Moderate
Notes	(no colour)	No active or on-going mitigation required – delivered through design and industry best practice;				
	(light grey)	Active and ongoing mitigation required. Measures designed to reduce the level of significance on the water environment. Framework management plans have been developed to define the mitigation strategy and/or reduce the level of uncertainty associated with a specific impact;				
	(dark grey)	The sensitivity of the receptor is such that mitigation and/or offsite compensation would not be sufficient to reduce them to non-significant;				

Temporal changes have been considered as either short term (for the duration of a particular activity or operation) or long term (those that persist for the duration of the Project and potentially into post closure).

Within the matrix the effects that are defined as major and moderate are considered to be 'significant' in ESIA Terms (Table 5.9.7). Potential impacts (both pre and post mitigation) have been identified using a bold font in the following text.

5.9.4 Potential Impacts

Assessment of potential impacts to water resources is divided into four sections, as follows:

1. Surface water quantity;
2. Surface water quality.
3. Groundwater quantity;
4. Groundwater quality.

Surface Water Quantity

Potential Impacts to Surface Water Quantity

Construction Phase

During the construction process there will be an increase in vehicle access and machinery usage on Site which can cause compaction of overlying soils. In addition to this, activities including overburden stripping and removal of vegetation may result in a reduction in surface infiltration and consequent increase in surface water runoff during storm events or in response to snowmelt. However, the resulting additional runoff are likely to be limited as a proportion of existing catchment run-off. In consequence, there are unlikely to be any impacts on surface water flow during the construction phase of the development. The magnitude of impact of change is **negligible** and short term and therefore the overall significance is **negligible**.

Construction activities on Site (including the demolition of buildings, construction of infrastructure, formation of the tailings storage facility) will alter the surface characteristics and runoff coefficients of these areas. It is likely that surface runoff during storm events and in response to snowmelt will increase. However, this runoff will be intercepted by surrounding catchment ditches and discharged into the drainage network after settlement. In consequence, there are unlikely to be any impacts on surface water flow during the construction phase of the development. The magnitude of change is **negligible** and therefore the significance is **negligible**.

The Kysylsu River is considered to be the most sensitive surface water receptor, as it will be the source of surface water for the water supply of the Auezov settlement. The daily water intake from the Kyzylsu Reservoir will be about 1,300m^3/d. The Kysylsu river flow of 95% exceedance probability at the village of Ostrikovka is 3,197m^3/d (0.037m^3/s). Therefore the predicted reduction of the flows in the Kysylsu River during the construction phase of the TSF is less than half of predicted flows. The magnitude of change is **low** and leading to a **minor** impact significance.

The construction of the TSF and the Waste Rock Dump (WRD) will require the course of the Akbastaubulak Brook, of the Kyzyltu Brook and of some tributaries of the Alaaigyr Brook to be modified (Drawing 5.9.1). Activities within the vicinity of the stream will have the potential to increase compaction and alteration to the banks natural form, but the resulting alteration to the flow of the streams will be **low**. The diversion ditch around the TSF will have a **minor** impact on the surrounding water environment.

The TSF is designed with two containment dam walls, two upstream dams and one diversion ditch. The upstream Dam No.1 is constructed to redirect the flow in the unnamed stream around the eastern side of the TSF via the diversion ditch. The surface water flowing within the diversion ditch around the TSF will eventually find its way into the Alaaigyr Brook and then into the Kysylsu River and the alteration to the flow of the streams will therefore be **low**. The stream diversion will have a **minor** impact on the surrounding water environment.

The WRD footprint will intersect the Akbastaubulak and Kyzyltu Brooks. The design approach to managing the intersection of these streams is to construct two protections dikes (No 1 and 2) associated with two settling ponds north of the WRD. The water that collects in the settling ponds will be piped away to the west into the Kjholodny Klyuch Brook via a stream diversion channel. The channel will be designed to handle an estimated flow of $Q_{P=3\ \%}$ =2.96m³/s. In addition water diversion trenches and drainage ditches will be constructed to manage water flows through and around the WRD. As a result of the diversion of the flow from the Akbastaubulak and Kyzyltu Brooks to the west into the Kjholodny Klyuch Brook, the flow in the Akbastaubulak Brook dowsnstream of the WRD will be reduced. The results of the groundwater flow modelling carried out by SRK in 2015 indicates that the flow in the Akbastaubulak Brook will be reduced from 1,530m^3/d prior to start of operation to632 and 465m^3/d in the 5th and 10th year of mining, respectively. This reduction in flow is likely to result in a **High** magnitude of change and therefore a **Moderate** significance.

The construction of a new processing plant, mine facilities and associated infrastructure will also lead to a reduction in surface area of the catchment of the Kysylsu River and its associated tributaries. Within this area, open ground will be replaced with hardstanding with an associated drainage network which will capture water and re-direct it. The area of the process plant compared to the catchment area of the Kysylsu River is negligible. Therefore, these reductions in surface area and decrease in associated runoff into the Kysylsu catchment area are likely to result in a **negligible** magnitude of change and therefore a **negligible** significance.

Operational Phase

The continued operation of the areas of hardstanding, new WRD and TSF will mean the continuation of the alteration of surface and runoff characteristics. As discussed above, the magnitude of change is **negligible** and therefore there is **negligible** significance.

Where the surface water features have been diverted, the continued operation of the Site will maintain their previous impact and the significance will remain as **minor** for the TSF and **Moderate** for the WRD.

During open pit mining, rain and snowmelt will be intercepted by the open pit. The resulting water will be collected within the in-pit sump and transferred to the process plant to support mine water supply or the tailings storage. The area of the open pit represents only a small area of the Kysylsu River's catchment. Therefore there is unlikely to be any impact on surface flow during the open pit activities. The magnitude of change is **low** and the significance is **minor**.

The water pumped out as part of the open pit dewatering during operation will be composed of both surface water run-off and groundwater inflows. The results of the groundwater flow modelling carried out by SRK in 2015 indicate that a large proportion of the groundwater inflows originate from the nearby streams (Akbastaubulak, Kholodnyi Kliuch and Benzymiannyi brooks). This proportion is 45% (1,164m^3/d) after the 5th year of mining and 58% (1,603m^3/d) after the 10th year of mining. This corresponding loss of baseflow into the streams is likely to result in a **High** magnitude of change and therefore a **Moderate** significance.

The results of the groundwater flow modelling carried out by SRK in 2015 are for Stage 1 (open pit mining) up to the 10th year of mining. There is still a lack of information regarding the proposed dewatering activities for Stage 2 (underground mining) between 2025 to 2039. Undertaking a thorough impact assessment was therefore not feasible. The potential impact upon surface water features from loss of baseflow during Stage 2 is **unable to be assessed**.

Numerical modelling was used to predict the impact of open pit mining (2016-2024). Further work is required to understand the potential impacts of prolonged dewatering and expansion of underground mine on surface water quantity.

In the unlikely event of a failure of the TSF dam, an unexpected release of tails and tailings water could occur into the Bezymyanny Brook (Brook No 3), which flows into the Alaaigyr Brook and the Alaaigyr Lake. If this release were to occur, the resulting flows would be large but short-term as the tailings dam would empty causing alterations to the morphology of the stream and lake. The magnitude of impact would be **Moderate to High** and the significance is **Moderate**.

The operation of the Kyzylsu reservoir is likely to have the same effects on surface water flow as outlined in the construction phase. The magnitude of change is moderate and the significance is **minor**.

Sewerage water from areas of the site, excluding the process plant, are collected and transferred through an on-site treatment facility before being discharged into the TSF. Household effluents from the village is to be discharged of within the Auezov sewerage network. No sanitary wastewater will be

discharged to the environment from the Tailings storage and therefore the magnitude of change is **negligible** and therefore there is **negligible** significance.

Water from the open pit settling pond, will be collected and transferred to the TSF. The water used within these processes are won from the various on-site mine dewatering systems. The TSF will be lined and minor seepage from its base will occur, however these volumes will be minimum compared to the catchment of the River Kyzylsu. Therefore the overall magnitude of change is considered to be **Low** and the significance is **minor**.

Closure Phase

The Bakyrchik site will be decommissioned in accordance with Kazakh closure measures including demolition of surface structures, stripping of utilities, stabilisation of mining related structures, encapsulation of the TSF, soil regarding and revegetation. Decommissioning will be undertaken in a phased approach.

The process of soil regrading will alter the rainfall-runoff relationship at Site. As discussed within the construction phase the magnitude of change is **negligible** and therefore there is **negligible** significance.

Where the surface water features have been diverted, the continued operation of the Site will maintain their previous impact and the significance will remain as **minor** for the TSF and **Moderate** for the WRD.

As detailed within Kazakh closure measures, following decommissioning and reclamation, the land will have topsoil reapplied and ecological restoration will be undertaken. This will include the formation of an isolated pit lake. **Insufficient information** is currently available to undertake an impact assessment for the pit lake during closure.

Mitigation and Monitoring Measures for Impacts to Surface Water Quantity

The assessment of potential impacts has demonstrated that the significance of impacts on surface water quantity would be **negligible** to **moderately** adverse. Some impacts are therefore significant in ESIA terms and defined mitigation measures are therefore required.

During construction and operation activities, drainage ditches and storm water control measures should be constructed around the TSF to channel up-gradient runoff away from the lined TSF areas and enable clean water to drain into channels which mimic the natural morphology allowing the balance between runoff and infiltration maintained. No mitigation is possible for the area of catchment which will be lost within the TSF itself.

It is understood that all areas of the mine will be worked under Best Kazakh Practice. Best practice operating procedures including monitoring of the tailings dam to allow an early warning of any potential problems which can be mitigated against to prevent a dam failure.

Surface water monitoring has been carried out on a monthly basis since June 2015 at 16 stream locations at the mine site to measure stream stage. Monitoring of stream flow should be carried out at a number of locations on some of the protection ditches, the drainage ditches, the diversion channel and the diverted streams. The appropriate structures should be constructed for that purpose. Monitoring should be carried during the construction, operation and closure phases.

Surface Water Quality

Potential Impacts to Surface Water Quality

Construction Phase

Various construction activities occurring on site, including removal of topsoil, slope re-profiling of the open pit, expansion of waste dumps, removal of vegetation will lead to increased sediment load within the runoff. Within the site runoff will be collected by catchment drains, and diverted to the natural drainage system. Only minor seepages are expected through the base of the TSF. The magnitude of change is therefore **negligible** with a **negligible** significance.

The construction of a new TSF will include large scale excavations which will lead to alterations in the recharge-runoff environment. The Bezymyanny Brook (Brook No 3) and the canal diversion located east of the TSF are located in the vicinity of the TSF. However, the formation and location of the diverted channel streams will be such that limited amount of suspended solids enter the Bezymyanny Brook (Brook No 3). The potential increase in suspended solids is therefore considered **negligible** and therefore the significance of the risk is also **negligible**.

The construction of the plant area will include groundworks and the placement of hardstanding. Runoff from these areas will be channelled into a surface drainage system which discharges into the TSF via the treatment facility. This discharge would include sediments derived from the construction works. The magnitude of change is therefore **negligible** and there is **negligible** significance.

The use and storage of fuels (including in vehicles), chemicals and materials associated with the construction phase could potentially enter the surface water courses through runoff or from accidental spillages. The volumes of fuels and chemicals associated with these activities are unlikely to be large and the storage of fuel and chemical on store will be undertaken in line with Kazak and international Best Practices. The magnitude of impact is **negligible** with **negligible** significance.

The planned demolition of buildings include an old processing plant, water tower and boiler house. This activity have the potential to mobilise pollutants which may have previously been located in these

buildings and enter the surface water system. Any runoff from these areas will be directed, by drains, to the treatment facilities before being discharged into the TSF. From the TSF only minor seepages are expected, causing the potential magnitude of impact to be **negligible** with a **negligible** significance.

Operation Phase

As the pit is expanded, increasing amount of rainfall will be intercepted and collected in sumps. This water will dissolve from explosives and will be diluted by inflowing groundwater. This water collecting in the sump will be pumped to the open pit and further diluted before being used in the process. Surrounding streams which receive baseflow from groundwater may be **negligibly** affected by the mining activities with a **negligible** significance.

Vehicle activity on Site could release fuels or oils which may potentially enter the surface water courses through runoff or from accidental spillages. The volumes of fuels and chemicals associated with these activities are unlikely to be large and the storage of fuel and chemical on store will be undertaken in line with Kazak Best Practices. Follow this the magnitude of impact is **negligible** with **negligible** significance.

Sewerage water from areas of the site, excluding the process plant, are ultimately discharged either off site to the Auezov sewerage network via the on-site sewerage treatment facilities. The TFS will be lined to best practice and therefore the potential magnitude of change to the water quality of the Kyzylsu River, by contamination of the Bezymyanny Brook (Brook No 3), is **negligible** and there is **negligible** significance.

Solid waste, generated by the Process plant, will be disposed of as tails in the TSF. As the TSF is lined there will be limited seepage from its base but seepage could potentially enter groundwater and from there provide baseflow to the Bezymyanny Brook (Brook No 3) and the Kyzylsu River. The magnitude of change is considered **negligible** and there is **negligible** significance.

Contamination of the pumped out mine water (open pit and underground workings water) from exposure of arsenic-rich and sulphidic mineralogy in the pit walls and underground workings has been assessed in Chapter 5.5, as having a **moderate** impact. The water pumped out as part of the open pit dewatering during operation will be collected within the pit drainage water settling sump (open pit 2) and transferred to the process plant to support mine water supply or the tailings storage. Surface water may be discharged to the environment during storm event or when the pit drainage water settling sump (open pit 2) reaches capacity. This activity will be regulated by the relevant approval process. Therefore the significance is **minor**.

Some of the mine facilities (TSF, WRD, carbon concentrate storage facility, explosive storage facility and ore stockpiles) have the potential to generate runoff, which could potentially include metals, inorganics and be of poor quality, into the streams draining the project area, when water either infiltrate from the WRD or leaking from the TSF, carbon concentrate storage facility, explosive storage

facility or ore stockpiles. Groundwater may enter the stream system via baseflow and potentially affect the water quality of the streams.

The TSF will be lined and the system designed to minimize seepage however seepage will still occur from the base of the TSF through breaches in the liner or deterioration over time and reach the underlying groundwater. Best practice techniques will be utilised during the construction of the TSF. Best practice lining methodologies should minimise the seepage from the TSF. Monitoring and mitigation currently in place will be continued into the operational period.

The potential for water contamination from Acid Rock Drainage (ARD) is discussed in detail within Chapter 5.5. It was estimated that only the carbon cake storage facility and the ore stockpiles have a significant potential to contaminate water from ARD. The TSF and WRD potential impact is non-significant. However, once mitigation measures are implemented, the residual impacts are estimated to be **negligible** during construction and **minor** during operations.

The results of the groundwater flow modelling carried out by SRK in 2015 indicate that the chemical concentration in the streams of the contaminants released by these facilities is very small (less than 3% of the original concentration at the facility). It is not known whether the potential contamination from ARD has been considered as part of the groundwater flow modelling. It is likely that it will result in a **low** magnitude of change on stream water quality and therefore a **minor** significance.

Numerical modelling was used to predict the impact of open pit mining (2016-2024). Further work is required to understand the potential impacts of prolonged dewatering and expansion of underground mine on surface water quantity.

During operation there is the possibility of failure of the TSF dam which could lead to an unexpected release of tails and tailings water to the Bezymyanny Brook (Brook No 3) or the diverted channel, which runs to the east of the TSF. If this release were to occur, this would result in a sudden change in the water quality of the Bezymyanny Brook (Brook No 3) from the tails water but also a longer term alteration while the clean-up of the tails proceeded. The Bezymyanny Brook (Brook No 3) first joins the Alaaigyr Brook, which then flows into the Kyzylsu River. The magnitude of impact would be **high** and the significance is **Moderate**.

Closure Phase

The site will be decommissioned in accordance with Kazakh closure measures including demolition of surface structures, stripping of utilities, stabilisation of mining related structures, encapsulation of the TSF, earthworks and revegetation. Following decommissioning and reclamation, the land will have topsoil reapplied with an isolated lake being located within the pit.

To fully assess the impact of the closure of the Site upon the surface water environment additional restoration plans will be required.

Mitigation and Monitoring Measures for Impacts to Surface Water Quality

The assessment of potential impacts has demonstrated that the significance of impacts on surface water quality would be no significance to **moderately** adverse. Some impacts are therefore significant in ESIA terms and defined mitigation measures are therefore required.

It is understood that all areas of the mine will be worked under Best Kazakh Practice. Best practice operating procedures including monitoring of the tailings dam to allow an early warning of any potential problems which can be mitigated against to prevent a dam failure.

The runoff from the various mine facilities considered will be intercepted by surrounding catchment ditches or drain onto adjacent land from where it discharge into the TSF via the treatment facility.

If Kazakh standards for the storage and use of fuels, oils and chemicals (which are already adhered to on site) do not include the storage of these materials on hardstanding and with 110% bunded storage capacity below tanks, then implementation of these in line with international best practice should be considered.

Surface water quality monitoring has been carried out on a monthly basis since June 2015 at 16 stream locations at the mine site. Monitoring of surface water quality should be carried out at a number of locations on some of the protection ditches, the drainage ditches, the diversion channel and the diverted streams. Monitoring should be carried during the construction, operation and closure phases.

Groundwater Quantity

Potential Impacts to Groundwater Quantity

Construction Phase

Construction activities including top soil removal and soil compaction due to vehicle movement may lead to increased runoff volumes particularly during storm events. Although the topsoil is defined as being poorly developed, and therefore favorable for groundwater recharge, the re-direction of this increased runoff to catchment ditches will not majorly affect the overall runoff/infiltration balance. In addition the expansion of waste dumps and ore stockpiles, and the expansion of the existing plant area will also increase the recharge. In consequence, the magnitude is unlikely to be detectable and duration is short-term, therefore the significance is **minor**.

Vehicle activity on Site during the construction could release fuels or oils which may potentially enter the groundwater through runoff or from accidental spillages. The volumes of fuels and chemicals associated with these activities are unlikely to be large and the storage of fuel and chemical on store will be undertaken in line with Kazak and international Best Practices. The magnitude of impact is **negligible** with **negligible** significance.

The planned demolition of buildings include an old processing plant, water tower and boiler house. Any runoff from these areas will be directed to the natural drainage network and runoff is not expected to directly reach the water table. The potential magnitude of impact to be **negligible** with a **negligible** significance.

The construction of a new TSF will reduce the area available for infiltration into the underlying aquifer system. However, the TSF area is small in comparison to the groundwater catchment area and therefore the magnitude of change is considered to be **negligible** and the significance is **negligible**.

Operational Phase

During open pit mining, dewatering of the open pit will take place. The water pumped out will be composed of both surface water run-off and groundwater inflows. The results of the groundwater flow modelling carried out by SRK in 2015 indicate that a proportion of the groundwater inflows originate from storage in the bedrock aquifer. This proportion is 42% (1,096m^3/d) after the 5th year of mining and decreases to 27% (759m^3/d) after the 10th year of mining. This reduction in groundwater storage will result in the creation of a cone of depression, which will extend away from the open pit about 4 km to the south, and 2.8 km to the west and east. There are no water users present within the cone of depression and it is likely to result in a **Low** magnitude of change and therefore a **Minor** significance.

During operation, the Kyzyltu wellfield, located north of the project area, will be abstracted to supply the mine installations with household and potable water at a rate of 107 and 207m^3/d during the stages of open pit mining and underground mining, respectively. The current abstraction at the Kyzyltu wellfield is between 1,000 and 1,600 m3/d. The abstraction will be significantly reduced and it will result in a **moderate** magnitude of change and a **Positive** impact of **moderate** significance.

It is currently not possible to quantify the potential impacts on groundwater quantity during the phase of underground mining (2025 – 2039) as the numerical modelling was only used to predict the impact of open pit mining (2016-2024). However, it is likely that the magnitude and significance of the impact during the phase of underground mining will not be greater than those during the phase of open mining.

Numerical modelling was used to predict the impact of open pit mining (2016-2024). Further work is required to understand the potential impacts of prolonged dewatering and expansion of underground mine on surface water quantity.

Closure Phase

During closure, dewatering of the open pit and underground facilities and abstraction of the wellfield will cease. Therefore, there will be no potential impacts on groundwater quantity during the closure phase.

Mitigation and Monitoring Measures for Impacts to Groundwater Quantity

The assessment of potential impacts has demonstrated that the significance of impacts on groundwater quantity would be **moderately** positive to **moderately** adverse during the operation phase. Impacts are therefore not significant in ESIA terms and defined mitigation measures are therefore not required. There are no significant impacts during the construction and closure phases.

Monitoring for groundwater level has been carried out on a monthly basis since June 2015 at the58 boreholes of the mine monitoring network. Although adverse impacts significant in ESIA terms are not expected, the monitoring should be continued during construction, operation and closure phases.

The monitoring network should also be upgraded as new infrastructures will be constructed and existing boreholes will be lost.

Groundwater Quality

Potential Impacts to Groundwater Quality

Construction Phase

Various construction activities occurring on site, including removal of topsoil, slope re-profiling of the open pit, expansion of waste dumps, removal of vegetation will lead to increased sediment load within the runoff. Within the site runoff will be designed to run to the natural drainage network. Only minor seepages are expected to enter the underlying groundwater. The magnitude of change is therefore **negligible** with a **negligible** significance.

The construction of a new TSF will include large scale excavations which will lead to increased levels of suspended solids within the surface water runoff. Within the site runoff will be designed to run to the natural drainage network. Only minor seepages are expected to enter the underlying groundwater. The magnitude of change is therefore **negligible** with a **negligible** significance.

The construction of the plant area will include groundworks and the placement of hardstanding. Recharge within this area will be reduced as precipitation will be channelled to the natural drainage network. The magnitude of the reduction in recharge is therefore **negligible** and there is negligible significance.

The use and storage of fuels (including in vehicles), chemicals and materials associated with the construction phase could potentially enter the groundwater from accidental spillages. The volumes of fuels and chemicals associated with these activities are unlikely to be large and the storage of fuel and chemical on store will be undertaken in line with Kazak and international Best Practices. The magnitude of impact is **negligible** with **negligible** significance.

The planned demolition of buildings include an old processing plant, water tower and boiler house. This activity have the potential to mobilise pollutants which may have previously been located in these buildings and enter the groundwater system. Any runoff from these areas will be directed, by drains, to the treatment facilities before being discharged into the TSF. From the TSF only minor seepages are expected, causing the potential magnitude of impact to be **negligible** with a **negligible** significance.

Operational Phase

Some of the mine facilities (TSF, WRD, carbon concentrate storage facility and explosive storage facility) have the potential to release contaminants into the alluvial and bedrock aquifers, when water either infiltrating from the WRD or leaking from the TSF, carbon concentrate and explosive storage facilities reach the aquifer water table. The results of the groundwater flow modelling carried out by SRK in 2015 indicate that the contaminated water reaching the aquifer water table will be contained by the dewatering taking place at the open pit and the associated cone of depression. The contaminated groundwater will therefore not move away from the mine area. It is likely that it will result in a **low** magnitude of change and therefore a **minor** significance.

Closure Phase

During closure, the contaminants potentially released by some of the mine facilities (TSF, WRD, carbon concentrate storage facility, explosive storage facility and ore stockpiles) during operation into the alluvial and bedrock aquifers will not be contained anymore by the dewatering which will take place at the open pit during operation, as it will cease at the end of the operation phase. The potentially contaminated groundwater will therefore have the possibility to move away from the mine area under the natural hydraulic gradient.

However it is currently not possible to quantify the potential impacts on groundwater quality from the release of contaminants during the closure phase, as the numerical modelling was only used to predict the impact of open pit mining (2016-2024). At this stage, failing to have the relevant information, it will be considered that it may result in a **high** magnitude of change and therefore a **moderate** significance.

Mitigation and Monitoring Measures for Impacts to Groundwater Quality

Impact assessment has demonstrated that potential impacts on groundwater quality during the construction and operation phases of development range from no significance to minor significance and therefore no formal mitigation of effects is required. However, best practice should be followed during construction, as detailed below:

- Fuel and chemical stores will be bunded, with the bunded areas providing a minimum of 110% of tank capacity so that any spills are fully contained. Workers will be trained

in the safe handling of these substances, and strict protocols will be put in place to verify proper handling;

- Double-skinned tanker vehicles will be used for transport of these materials. Any vehicles used during construction will be maintained and inspected regularly for leaks; and
- Equipment will be made available on site to expeditiously deal with minor spills. The Emergency Response Plan will be put in place to deal with more significant events, and workers will be trained in spill prevention and emergency response and cleanup procedures.

The excavation, handling and stockpiling of soils and overburden during construction could lead to increased transport of suspended solids and adsorbed pollutants to groundwater. This impact will be decreased substantially by limiting or protecting the amount of exposed overburden during construction work, via:

- Phasing of construction to minimise exposure of unprotected soil;
- Appropriate location of topsoil stockpiles away from ephemeral stormwater channels;
- Covering (revegetating) topsoil stockpiles; and
- Designing flow paths to facilitate interception of silt-containing runoff in filter barriers and/or silt traps.

Additional modelling is required to assess the potential impacts on groundwater quality from the movement of potentially contaminated groundwater away from the mine area under the natural hydraulic gradient during the closure phase, as open pit dewatering is stopped.

Monitoring for groundwater quality has been carried out on a monthly basis since June 2015 at the 58 boreholes of the mine monitoring network. The monitoring should be continued during construction, operation and closure phases. The monitoring network should also be upgraded as new infrastructures will be constructed and existing boreholes will be lost.

5.9.5 Residual Impacts

Residual Impacts to Surface Water Quantity

The residual impacts to surface water quantity from the diversion of the flow from the Akbastaubulak and Kyzyltu Brooks round the WRD during the construction, operational and closure phases are reduced to **minor** with the implementation of proposed mitigation and monitoring. However, there may be associated potential ecological impacts resulting from the reduction in flows in the Akbastaubulak Brook. This potential impact is discussed in detail within Chapter 5.10.

The residual impacts to surface water quantity from the loss of flow from pit dewatering in some of the streams during the operational phase are reduced to **minor** with the implementation of proposed

mitigation and monitoring. However, there may be associated potential ecological impacts resulting from the loss of flows in the streams. This potential impact is discussed in detail within Chapter 5.10.

The residual impacts to surface water quantity from the possibility of failure of the TSF during the operational phase is reduced to **minor** with the implementation of proposed mitigation and monitoring.

Residual Impacts to Surface Water Quality

The residual impacts to surface water quality from the possibility of failure of the TSF during the operational phase is reduced to **minor** with the implementation of proposed mitigation and monitoring. There are no residual impacts arising from the construction and closure phases.

Residual Impacts to Groundwater Quantity

There are no residual impacts from the construction, operation and closure phases.

Residual Impacts to Groundwater Quality

The residual impacts to groundwater quality from the potential release of contaminants by some of the mine facilities (TSF, WRD, carbon concentrate storage facility and explosive storage facility) during operation into the alluvial and bedrock aquifers, once dewatering has ceased at the end of the operation phase **cannot be assessed**. Additional investigations (modelling) are required.

There are no residual impacts arising from the construction and operation phases.

Table 5.9.8 below presents a summary of the anticipated water resources impacts.

Table 5.9.8: Impact Assessment – Water Resources				
Impact	**Mining Stage**	**Impact Before Mitigation**	**Key Mitigation**	**Residual Impacts**
Diversion of flow from Akbastaubulak to Kjholodny Klyuch from Waste Rock Dump construction	Construction, Operational and Closure	Moderate	Carry out surface water monitoring and release water from mine dewatering into Akbastau brook. Ensure absence of blockage in downstream culverts.	Unknown
Loss of baseflow into streams due to open pit dewatering	Operational: Open pit mining	Moderate	Carry out surface water monitoring	Unknown
Loss of baseflow into streams due to open pit dewatering	Operational: Underground mining	Not assessed yet (likely to be moderate)	Groundwater modelling only simulates conditions up to the end of open pit mining stage. Carry out surface water monitoring and further modeling.	Unknown
Accidental release of tailings into Bezymyanny Brook (Brook No 3) causing short term increased flows	Operational	Moderate	Regular monitoring of TSF dam stability	Minor
Accidental release of tailings into Bezymyanny Brook (Brook No 3), causing sudden deterioration of water quality with long term effects	Operational	Moderate	Best Practice operating procedures, including geotechnical stability monitoring. Additional guidance in MP2: TSF Management Plan	Minor
Reduction in groundwater flows due to open pit dewatering	Operational: Underground mining	Unknown	Groundwater modelling only simulates conditions up to the end of open pit mining stage. Carry out further groundwater monitoring prior to commencing underground mining and carry out further modeling to assess potential impacts	Unknown
Release of contaminants from TSF, waste dump, carbon concentrate storage, explosive storage facilities leading to groundwater contamination at the open pit and downgradient when pit dewatering ceases.	Closure	Unknown	Groundwater modelling only simulates conditions up to the end of open pit mining stage. Carry out further groundwater monitoring prior to commencing underground mining and carry out further modeling to assess potential impacts, and conditions at mine closure.	Unknown

5.9.6 Monitoring and Audit

Surface water monitoring has been carried out on a monthly basis since June 2015 at 16 stream locations at the mine site for water quality and to measure stream stage. Additional information regarding surface water monitoring at the mine site is provided in Section 4.8.

Monitoring of stream flow and water quality should also be carried out at a number of locations on some of the protection ditches, the drainage ditches, the diversion channel and the diverted streams. The appropriate structures should be constructed for that purpose. Monitoring should be carried during the construction, operation and closure phases.

Monitoring for groundwater level and groundwater quality has been carried out on a monthly basis since June 2015 at the 58 boreholes of the mine monitoring network. Additional information regarding surface water monitoring at the mine site is provided in Section 4.8.

The monitoring should be continued during construction, operation and closure phases. The monitoring network should also be upgraded as new infrastructures will be constructed and existing boreholes will be lost.

5.10 Biodiversity

5.10.1 Introduction

This section assesses the potential impacts on flora and fauna within the Project study area, together with an assessment of offsite impacts which may result from the construction, operational and closure phases of the BMV project.

5.10.2 Sources of Information

This assessment is based on information provided in the Environmental and Social Baseline (Chapter 4, particularly Section 4.9).

5.10.3 Assessment Criteria

Qualitative risk assessment methodology has been applied in which the sensitivity of receptors has been assessed with respect to the magnitude of the potential impact, and has been used to determine significance.

This approach provides a mechanism for identifying the requirements for mitigation and for identifying appropriate measures to reduce the risk of unacceptable loss of biodiversity, taking account of flora and fauna and therefore reduce the significance of effects, as consequence of the construction, operation and closure of the mine.

The Project design aims to ensure that biodiversity and ecosystem functions are not systematically degraded or permanently lost from the landscape as a result of the Project.

The approach taken for this assessment is to predict whether any significant residual impacts i.e. those impacts which may remain after the mitigation measures built into the design and implementation of the Project are in place (these are delivered through site specific design and industry best or standard practice which remove or reduce the potential for adverse ecological impacts at source). And, where residual (unmitigated) significant impacts are identified, to develop further mitigation measures that will reduce their magnitude to an acceptable (non-significant) level.

Within this Chapter, Section 5.6.3 identifies the main Project activities or components predicted to give rise to ecological impacts. Section 5.6.4 then identifies key ecological receptors or "important" biodiversity components which form the focus of the impact assessment.

The sensitivity criteria used to determine the sensitivity of receptors and/or the baseline environment is set out in Table 5.10.1. This is based upon the characteristics of the affected receptor and the extent of change it can tolerate.

Table 5.10.1: Sensitivity of Receptor		
Sensitivity	**Characteristics of biotopes / species assemblage (ecological receptors)**	**Examples and extent of change that defines sensitivity**
Negligible	Any losses of individuals from a species population are within bounds of normal variation. The receptor is likely to be ubiquitous or represented on many sites (i.e. to have low irreplaceability), e.g. Habitats might be widespread so that losses are insignificant when compared with overall extent and do not affect the viability or functioning of the habitat.	Not applicable
Minor	Biotopes are sufficiently adaptable and resilient to recover from the impact spontaneously Species are able to avoid impacts by relocating to alternative suitable habitat Habitats / species are generally insensitive or able to tolerate potential impacts	Species with habitats characterised by high mobility, high tolerance of disturbance and / or rapid regeneration times. Highly mobile species Species receptors are able to recover from the impact without intervention within one breeding season.
Medium	Biotope is sensitive to potential impact. Impacts result in measurable decline in population or extent at a district or regional level. Decline in species population is outside bounds of normal variation Biotopes have properties that make spontaneously recovery unlikely.	Species within habitats have a low mobility, low tolerance related to slow regeneration / short growing season. Biotope or species not able to recover from a potential impact without intervention, through use of mitigation Recovery is possible with appropriate mitigation measures. For example restricted distributions, lower mobility, less rapid breeding cycles.
High	The proportion of the biotopes distribution is lost or affected. A significant proportion of the total known distribution or extent of the biotope is adversely affected The integrity of an area protected for biological diversity or sensitivity is adversely affected	Long term or permanent decline in the viability of remaining habitats. Depends on the relevant geographic scale of consideration. The ability of the designation to support the designated characteristics or species is impaired.
Very High	Impacts affect a large proportion of a population of an endemic species.	Impacts are on a population of a single site endemic species.

Table 5.10.1: Sensitivity of Receptor		
Sensitivity	**Characteristics of biotopes / species assemblage (ecological receptors)**	**Examples and extent of change that defines sensitivity**
	Sites or ecosystems essential to maintain the population of any critically endangered species. Entire global population potentially exposed.	Affected population unlikely to recover from Project impacts, with possible risk of extinction at national or global levels.
Note: Biotope = Habitat Biological community = Population of a particular species and associated flora and fauna		

The magnitude of the impact upon receptors due to the Project has been based on predicted change from baseline conditions.

Table 5.10.2: Magnitude of Potential Impacts	
Magnitude	**Magnitude of Potential Impacts**
Negligible	Minimal or few detectable changes in baseline resource, which are either of short duration or infrequent periodicity, such direct control or management is not required.
Low	Detectable change in baseline conditions such that post construction and during operations habitats or individual species have the capacity to adapt without active or on going mitigation
Moderate	Partial loss or alteration, such that post construction or operation phase characteristics have a measurable change from the baseline condition of a sensitive receptor
High	Total loss or major alteration to baseline conditions for highly sensitive receptor

The significance of effects is determined in relation to the sensitivity of the receptor (Table 5.10.1) and magnitude of potential impacts (change from the baseline condition) (Table 5.10.2), using the matrix shown in Table 5.10.3 below. Significant effect are those where the impact is moderate or greater, whereas minor and negligible are not significant. Positive changes are identified as a benefit to the receptor.

Table 5.10.3: Impact Significance Matrix				
Receptor Sensitivity	**Magnitude of Change**			
	Negligible	**Low**	**Moderate**	**High**
Minor	Negligible	Negligible	Minor	Moderate
Medium	Negligible	Minor	Moderate	Moderate
High	Minor	Moderate	Major	Major
Very High	Minor	Moderate	Major	Very High

5.10.4 Project Affected Biodiversity and Ecosystems

The Project has the potential to generate adverse impacts during all phases, including decommissioning and post-closure management. The physical components and activities will have a degree of potential impact on biodiversity and the supporting ecosystems.

The physical footprint of the Project that comprises the mine pit, waste storage areas, access, haulage roads and conveyors, processing plant, tailings facility and a number of other components of supporting infrastructure would be developed during the construction phase and to a lesser extent during the operational phase.

The Project's physical footprint will include temporary and some permanent components. The total footprint of disturbed land (including both existing and proposed facilities/infrastructure) is approximately 816 ha. The principal habitat identified within the baseline environment is lowland dry steppe, although parts are situated in the foothill steppe belt. A detailed habitat map of the area is included as Appendix 4.9.2, this shows that the existing and proposed development associated with BMV is located in areas of undisturbed pasture and disturbed pasture (lowland dry steppe belt); low hill terrain, river valleys and the existing industrial zone.

In addition, there will be fenced areas which may constitute barriers to movement of animals though the Project affected area.

Project activities will also cause biophysical changes in a wider area which have the potential to alter ecosystems and affect the distribution and condition of associated biodiversity components.

Bakyrchik mine has been worked intermittently since the 1950's, and is currently non-operational. Therefore the Project study area contains existing infrastructure. The construction of additional site infrastructure and the expansion of mining operations will introduce a source of disturbance and human activity in areas where levels of such activity have recently been absent.

The presence of the Project with the construction of additional infrastructure and renewed and expanded operations will potentially affect natural land use over a wider area than that directly influenced by mining operations, with a resultant effect on both floral and faunal communities.

The main sources of biophysical change which are expected to have consequences for biodiversity and ecosystems in the Project area are summarised in Table 5.10.4, together with an indication of potential ecological impacts.

As stated above, the potential impacts discussed are those residual impacts which remain after mitigation measures brought forward through good design and best practice measures are in place; for instance the new Tailings Facility, ore buffer stockpile and carbon product storage areas will have impermeable liners installed to mitigate impacts to ground and surface water; channels will be created

to divert existing watercourses away from areas of potential contamination; water treatments facilities will be in place (settling ponds, protection dykes); dust suppression will be in place for in work areas, dumps and mine roads; use of flotation processing so that no harmful chemicals are required; *etc.* A full list of the Environmental Design Criteria are contained in Appendix 5.10.1.

Residual impacts which are rated as moderate or above; i.e. where good design and best practice measures are not sufficient to reduce the environmental impact to acceptable (non-significant) levels; and considered unmitigated residual impacts and further additional mitigation measures are required.

In addition to the sources and impacts outlined in Table 5.10.4, induced effects on biodiversity and ecosystems could occur due to social and demographic changes associated with mining in the area.

Table 5.10.4: Potential Impacts on Flora and Fauna

Project Component	Associated activities or drivers of biophysical change expected to give rise to ecological impacts	Summary of Potential Ecological Impacts
Construction		
Earthworks, site clearance and construction	Land clearance, removal of vegetation	Permanently reduction in the extent of some biotopes, which are however, extensive both locally and regionally. Resultant slight reduction in the distribution and population size for certain plant species including those that are rare/endemic, reduction in extent of habitat for associated fauna, within the surrounding biotope which extends over a very large area in comparison to the Project.
	Additional temporary footprint	Includes haul road, crushing plant, mine camp and topsoil storage, all temporary in duration, reinstatement dependent on the restoration programme.
	Dust generated by truck movements and earth moving.	Dust can smother vegetation and reduce suitability of habitat for associated animal populations within the deposition zone (small mammals, reptiles and amphibians). Dust suppression – damping of surfaces in place.
	Vehicle exhaust emissions: • NO_x, SO_x, CO, CO_2 , and diesel particulates.	Can cause permanent changes in plant species composition adjacent to roads due to nutrient enrichment.
	Soil exposure	Cleared areas with exposed soil, prone to erosion and scour during snow-melt or rain.
	Loss of soil resource	Topsoils removed and stockpiled in designated areas on Site for future reuse.
Diversion of the Brook Akbastaubulak to facilitate the creation of the Waste Dump.	Reduction in water level within the lower reaches due to reduced (and potentially sporadic) input of flows. Change of source from the natural flows of the upper reaches to clean run off from the Waste Dump.	Brook Akbastaubulak no longer being able to support fish populations due to reduced water levels. Changes to flow regime leading to habitat changes. Potential for the entire water column to freeze leading to catastrophic loss of life.
Import of materials and machinery	Heavy goods traffic on access roads and public highways.	Disturbance to animal populations.

Table 5.10.4: Potential Impacts on Flora and Fauna

Project Component	Associated activities or drivers of biophysical change expected to give rise to ecological impacts	Summary of Potential Ecological Impacts
	Emissions of dust, exhaust etc.	As above
Fencing of Mine	Contain and delineate the mining operations.	Fenced areas which will constitute barriers to movement of certain mammals.
Mining		
Drilling and blasting	Dust from blasting and drilling.	May alter vegetation and suitability of habitat for small mammals in the deposition zone.
	Noise and disturbance	Potential to disturb and deter migratory species from breeding and feeding within existing habitat adjacent to the proposed mine pit.
	Altered substrate	Soil removal may result in new areas of exposed rock. These could provide habitat for some plants which are rare, relic or endemic.
Loading and hauling	Dust	May alter vegetation and suitability of habitat for small mammals in the deposition zone. Dust suppression or control measures in place.
	Vehicle exhaust emissions	NOx, SOx, CO, $CO_{2'}$ and particulate emissions will cause localised changes in soils and plant communities.
	Noise and disturbance	Potential for some birds and small mammals will be displaced.
Waste Dump	Dust	Fugitive dust particles. Dust suppression through watering etc.
	Physical footprint	Spatially specific impacts depending on biodiversity components in proposed location.
Tailings Facility /Open pit	Possible seepage to groundwater	Seepage of water to groundwater from the open pit and tailings facility should this be of poor quality, containing acid and toxic metals from Acid Rock Drainage (ARD) there would be potential for impact on the fish populations downstream. Tailings facility fitted with impermeable liner to prevent seepage to groundwater.
	Surface water runoff	Runoff from the TMF and waste dumps during rainfall may contain sediment, leached metals and increased acidity, potential impact on ephemeral streams and surrounding vegetation. Surface water management and, where required, treatment in place.
Crushing and ore preparation		
Stockpiles	Dust from tipping	Fugitive dust from wind blow. Localised pollution of soil.
	Footprint	Forms part of physical footprint and removes biotope/habitat.
Crushing	Crusher and transfer points	Fugitive dust escaping at crusher building and transfer points; controlled with water sprays and enclosure (dust extraction).
Processing		
Process plant and supporting infrastructure	Dust Vehicle exhaust fumes	Dust generated from demolition activities, earthworks. Controlled with water sprays

Table 5.10.4: Potential Impacts on Flora and Fauna		
Project Component	**Associated activities or drivers of biophysical change expected to give rise to ecological impacts**	**Summary of Potential Ecological Impacts**
Storage and reagent handling	Lime: outdoor stockpile	Assumed that reagents will be stored and handled only under contained, controlled conditions and there will be no emissions.
Heap Leach Facility	Dust with heavy metals	Small mammals, birds feeding on small ., aquatic species.
	Disturbance associated with operation	Birds and animals sensitive to disturbance.
Process plant and supporting infrastructure	Physical footprint	Loss of biotope/ habitat.
Supporting Infrastructure		
Domestic wastewater treatment	Physical footprint of works,	Loss of biotope/ habitat
Electrical power supply	Power lines	Potential risk of collision with power lines by birds.
Employment	Presence of people and associated traffic	Disturbance of animal and bird populations.
Security measures	Lighting	Disturbs nocturnal species including, some small mammals and birds.

Potential impacts during decommissioning and post-closure may be positive compared to the operational phase, as land within the Project study area will be reinstated, including access and haulage roads that are not retained post-mining. These areas will be reinstated with a soil profile and grassland established. Other potentially positive ecological effects may be realised, for example, exposed rock face within the mine pit could provide an alternate nesting sites for certain birds of prey species, creation of gentle rocky south facing slopes could create habitat for reptiles.

5.10.5 Potential Ecological Receptors

The complex nature of biodiversity is such that it is difficult to model the precise changes that will occur in relation to flora and fauna, in all dimensions, including at the genetic level. For this reason, the important biodiversity components or receptors have been considered, for which the aim to ensure that biodiversity and ecosystem functions are not degraded or lost, through the development of appropriate mitigation measures. These components may be adopted in accordance with:

- legal or policy requirements to demonstrate that they will be safeguarded;
- valued by local people; and
- good indicators of ecological "health" for other, associated biodiversity components.

Table 5.10.5 summarises the sensitivity attributed to receptors which have been identified for the Project, based on the results of the baseline assessment presented in Chapter 4 and taking into account the following considerations:

The presence of:

- species which are protected in the RoK (listed in Kazakhstan Red Data Books);
- species which have been identified as threatened or declining either in the RoK or in the region;
- areas of natural habitat according to the definition in IFC Performance Standard 6 or EBRD's PR6;
- species which might suggest or trigger the presence of critical habitat according to PS6/ PR6. This includes species where are listed by IUCN as being Endangered or Critically Endangered at a global and European level as well as species meeting other criteria listed in the Performance Standards; and
- habitats or ecosystems which might be considered "critical" according to IFC Performance Standard 6.

Note that impacts and the need for mitigation have been considered for all affected biodiversity. In some cases generic or standard good practice measures are considered likely to be effective in reducing impacts to acceptable levels. However specific implications for the receptors identified in Table 5.10.5 have been considered to ensure that no damage or loss of biodiversity and ecosystem functions can be clearly demonstrated for biodiversity components that are considered to be important.

Table 5.10.5: Important Ecological Receptors		
Importance Criteria	**Important Receptors Affected by the Project in this Category**	**Sensitivity**
Globally important or critical: biodiversity which is important at a global level or which potentially triggers "critical" habitat. Biodiversity prioritised for conservation action through Regional Conservation or Action Plans		
Species which are endangered at a global level listed by IUCN or in the RoK Red Book. Globally significant concentrations of migratory species.	Large Heath or Common Ringlet Butterfly (*Coenonympha tullia*) is classed at Category III (rare) in Red Book of Kazakhstan and 'Vulnerable' in the "Red Book of European butterflies".	High
	Eight plant species listed within the Red Book of Kazakhstan were identified within the Study Area: Steppe peony; Spring asphodel, *Hyssopus macranthus Boriss*, Prairie Crocus, Bent tulip, Wild Rosemary, *Euphorbia macrorrhiza* and Ludwig's iris. The precise location of these species (in terms of whether they were found in areas which are to be lost to development) and their conservation status with in the Red Book (Category I – critically endangered to Category V – out of danger) are not known and therefore as a worst case scenario it must be assumed that they are endangered at a global level. *Euphorbia macrorrhiza* is also endemic to Altai region.	High
	Golden eagle is a migratory species through the region and a single individual was observed circling at very high altitude over the area planned for the new tailings facility on 1st October 2011. This species is listed in the Red Book of Kazakhstan as rare (Category III), but is considered a species of Last Concern in the IUCN Red List.	High
Endemic species or species with highly restricted range. Assemblages with high proportion of endemic, endangered or declining species.	Not present	N/A
Internationally/nationally recognised sites for nature protection; some nationally designated sites for nature protection. Highly threatened and/or unique ecosystems.	The Project lies within the 'Western and northern foothills of the Kalba Range' International Bird Area (IBA), however the 816ha BMV site (including the existing industrial areas) only accounts for 0.1% of the 657,170 ha IBA.	High
Biodiversity which is important at a national level or which is "natural" according to IFC PS6 (2012).		
Nationally designated sites for nature protection, national parks.	None in the Project Area or within close proximity.	N/A

Table 5.10.5: Important Ecological Receptors		
Importance Criteria	**Important Receptors Affected by the Project in this Category**	**Sensitivity**
Biotopes which are declining or under-protected in the region or country.	None	N/A
Extensive areas of natural habitat (terrestrial).	Much of the Project areas comprises the existing mine site and is therefore disturbed or modified habitat. However some areas of natural habitat, for example the locations of the proposed Waste Dump and the proposed tailings dam would be disturbed as a result of the proposals.	Medium
Areas of natural habitat (aquatic).	The ponds and reservoirs within the Project area are anthropogenic, but mostly function as natural habitats. The rivers and streams are all considered natural; although the Brook Akbastaubulak has been modified through the creation of dams for irrigation, this has created a more diverse range of habitats within the Brook.	Medium
Species listed by IUCN or on RoK Red Book as being Near Threatened or Vulnerable.	The Pallid Harrier and Eurasian Curlew are listed as 'Near Threatened' on the IUCN Red List, but are not listed within the Red Book of Kazakhstan. Red-footed falcon is not listed within the Red Book of Kazakhstan, but is considered to be 'Near Threatened' by the IUCN The Pond bat (*Myotis dasycneme*) is identified as 'Near Threatened' on the IUCN Red List, but is not listed within the Red Book of Kazakhstan.	Medium
Species which are declining regionally, nationally, globally.	Rare relic and endemic plants -there are 3 plant species in the Project Affected Area which are considered to be rare or endemic. *Euphorbia macrorrhiza* is endemic to Altai region; whilst *Iris ludwigii* and *Hyssopus macranthusare both* endemic to Kazakhstan. However these three species are also all listed in the Red Book of Kazakhstan and so are considered in category above.	Medium
Key sites for sustaining nationally protected species or globally threatened species (at levels below "Endangered").	Not present	N/A
Biodiversity which is widespread and has high capacity for spontaneous recovery		
• Biotopes which are extensive and have characteristically low biodiversity. • Assemblages/ populations of species which have wide ranges and distributions.	Mesotrophic steppe grassland which is very extensive in the region. Xerophytic vegetation of the low-hill terrains and foothills is very extensive in the region.	Minor Minor

Table 5.10.5: Important Ecological Receptors		
Importance Criteria	**Important Receptors Affected by the Project in this Category**	**Sensitivity**
• Assemblages/ populations of species which are not considered to be under threat at any geographic scale (global to local). • Areas used relatively intensively for farming.	Aquatic vegetation is extensive in the region	Minor
	Common bird species such as Pied wheatear (*Oenanthe pleschanka*), Barn swallow (*Hirundo rustica),* African Stonechat *(Saxicola torquata),* Magpie (Pica pica) and Tree sparrow (Passer montanus)	Minor
	13 species of birds of prey were observed in the study area	Minor
	Mammal populations.	Minor
	Reptiles and amphibians	Minor
	Aquatic and terrestrial invertebrates	Minor
	Fish, including species which may be fished commercially or for sport.	Minor
	Benthic fauna.	Minor
	Plankton, Phytoplankton and Periphyton.	Minor

The significance of effects is determined in relation to the sensitivity of the receptors defined through baseline studies and magnitude of potential impacts, using the matrix shown in Table 5.10.6.

Table 5.10.6: Significance Matrix for Identified Biological Resource Receptors

Receptor	Sensitivity	Magnitude of Potential Impact			
		Negligible	Low	Moderate	High
Mesotrophic Steppe Grassland	Minor	None	Minor	Minor	Moderate
Xerophytic steppe bush formations of the low-hill terrains and foothills	Minor	None	Minor	Minor	Moderate
Aquatic vegetation	Minor	None	Minor	Minor	Moderate
Bird populations	Minor	None	Minor	Minor	Moderate
Birds of Prey	Minor	None	Minor	Minor	Moderate
Mammal populations	Minor	None	Minor	Minor	Moderate
Amphibian and reptile populations	Minor	None	Minor	Minor	Moderate
Aquatic and terrestrial Invertebrate	Minor	None	Minor	Minor	Moderate
Benthic fauna	Minor	None	Minor	Minor	Moderate
Fish populations	Minor	None	Minor	Minor	Moderate
Plankton, Phytoplankton and Periphyton	Minor	None	Minor	Minor	Moderate
Areas of natural habitat lost to development.	Medium	Minor	Minor	Moderate	Moderate
Species listed by IUCN or on RoK Red Book as being Near Threatened or Vulnerable	Medium	Minor	Minor	Moderate	Moderate
Species which are declining regionally, nationally, globally - Rare relic and endemic plants	Medium	Minor	Minor	Moderate	Moderate
Species which are endangered at a global level: Large Heath Butterfly; 8 plant species; Golden eagle	High	Minor	Moderate	Moderate	Major
Internationally/nationally recognised	High	Minor	Moderate	Moderate	Major

sites for nature protection 'Western and northern foothills of the Kalba Range' IBA				
Notes:	Not significant:	Minor or negligible potential impact (pre or post mitigation)		
	Significant:	Moderate or Major impact (post mitigation)		
	Pre mitigation	(no colour)	No active or ongoing mitigation required, mitigation delivered through combination of design and industry best practice.	
		(light grey)	Active and ongoing mitigation through management plans, with policies and procedures designed to reduce the level of significance or, alternatively there is potential for compensation to reduce significance of potential impact through offsite enhancement of habitats of flora and fauna.	
		(dark grey)	The sensitivity of the receptor is such that mitigation and / or offsite compensation would not be sufficient to reduce the non-significant	

5.10.6 Potential Impacts to Biodiversity

There will be a physical footprint on some areas which are important because of the ecosystems and biodiversity they support. The locations of listed, rare and endemic plant populations was not noted in the survey data; however the survey report only specifically identified Wild Rosemary as potentially being directly impacted by the development. It is therefore assumed that all other plant species of conservation note are not located within areas within the physical footprint of the development. The following areas support important biodiversity components identified in Table 5.10.6 which are affected by specific Project infrastructure:

- Wild rosemary was discovered in an area close to the new mine near the river Kyzyl Su.
- The Large Heath Butterfly was recorded in 'natural habitats' of the sanitary protection zones (1.5 to 5.0km from the industrial area (Appendix 4.9.16)), which includes areas within the project footprint; however no further information on the location of sightings was given, it is therefore it is possible that this species could be present in the areas which will be developed as the Waste Dump and Tailings Facility.
- Pallid harrier was observed on hunting flights over the proposed Waste Dump and Tailings Facility sites.
- Golden eagle was observed on a hunting flight over the proposed Tailings Facility site.
- Infrastructure/activity within the Industrial Zone will impact on species of bird of prey including Black kite (scavenger species) and Common kestrel which was recorded nesting around the existing industrial facilities.
- Pond bat was recorded within residential areas and technical facilities.

Further detail on these potential impacts has been considered in Table 5.10.7.

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
Land clearance; loss of land to mining and construction footprint including TMF facility and processing plant, removal of vegetation, deposition of waste rock and storage of top soil.	Loss of lowland mesotrophic grassland.	Loss of mesotrophic lowland steppe grassland with regional endemic plant Wild Rosemary.	Low – Mesotrophic grassland Moderate – Wild Rosemary.	Minor **Moderate**	 Minor
	Loss of Xerophytic steppe bush formations of the low-hill terrains and foothills	Loss of Xerophytic vegetation	Low	Minor	
	Loss of natural habitats within the Western and northern foothills of the Kalba Range IBA	Loss of potential habitat for qualifying species of the IBA identified during field surveys - Demoiselle Crane and Pallid harrier. The 816ha BMV site (including the existing industrial areas) only accounts for 0.1% of the 657,170 ha IBA. Demoiselle Crane observed well away from footprint areas; Pallid Harrier has large hunting territory and was only observed at height on hunting flight.	Negligible	Minor	
	Loss of areas of suitable foraging or hunting territory for a range of bird, mammal, reptile and invertebrate species.	Loss of foraging or hunting territory for common species, easily displaced to other areas. Loss of foraging or hunting territory for birds of prey including Golden Eagle. These species including Golden eagle have a large range.	Low Low Low – Golden eagle	Minor Loss of suitable Loss Minor **Moderate**	 Minor
	Loss of areas of habitat and breeding territory for range of species	Loss of habitat for common species, easily displaced to other areas.	Low	Minor	

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
		Loss of habitat for endangered species: Large Heath Butterfly.	Moderate	**Moderate**	Minor
Natural riparian habitat lost to development.	Loss of areas of habitat and breeding territory for range of aquatic species	Diversion of the headwaters of the Brook Akbastaubulak to facilitate the creation of the Waste Dump. Will remove the potential for contamination from the Waste Dump entering the surface water environment. Lowering of water levels in lower reaches of the Brook Akbastaubulak leading to potential habitat changes and loss of biodiversity. Potential for drying out in summer and freezing in winter leading to large scale loss of individuals. Reduction of average flows to less than 10cm may make the watercourse unsuitable for some existing fish species. Reduction in water volume will decrease the dilution effect should pollutants enter the Brook. Therefore increasing the risk of degradation of water and habitat quality and/ or adverse impacts to aquatic life.	Moderate to High	**Moderate**	Cannot be assessed at this time as further studies will be required to fully assess the scale of the impact and to help devise appropriate mitigation measures – see MP8. Therefore assessed as **Moderate** at this time.
Reduced quality of remaining	Habitat degradation: reduced	Loss of steppe habitats and reduced populations of	Low – Steppe habitats	Minor	

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
habitat caused by a variety of Project-related impacts e.g. by soil erosion, pollution, disturbance, noise, lighting or other human activity.	populations of rare/endemic plant species.	rare/endemic plant species.	Moderate – rare/endemic species.	**Moderate**	Minor
	Habitat degradation	Lower quality habitat for breeding and migrating birds (including birds of prey), easily displaced to other areas. Large territories of bird of prey. Lower quality habitat reducing the availability of prey species for predatory and insectivorous species.	Low – common and Near Threatened species	Minor	
			Low – Golden eagle	**Moderate**	Minor
		Bird species of conservation concern which are not birds of prey (Eurasian Curlew), easily displaced to other areas.	Low	Minor	
		Lower quality habitat for breeding and foraging mammals, reptiles, amphibians and invertebrates.	Low – common species	Minor	
		Animals of conservation concern (Large Heath Butterfly). Degradation of potential habitat for qualifying species of the IBA (see above)	Moderate	**Moderate**	Minor
		Some foraging will continue within fenced areas (but see below).	Negligible	Minor	

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
Influx of people and activity – noise and light and activity.	Disturbance.	Disturbs fauna and disrupts breeding, foraging and/or hunting patters (daytime and night time). Pond bat was recorded in residential and industrial areas and therefore assumed tConhat disturbance would not deter this species. Causes displacement of fauna and avian species to alternative areas. Large availability of alternative habitat.	Low – common fauna Low – Pond bat Low	Minor Minor Minor	
Construction of high structures such as power lines and use of existing powerlines.	Threat to migration flight paths.	Hazard is posed by overhead transmission lines which are difficult navigate for migrating and feeding bird flight paths.	Low	Minor	
	Electrocution risk to bird species.	Hazard is posed by overhead transmission lines which: 1) are difficult navigate for migrating and feeding bird flight paths; and 2) provide insufficient separation between energised phase conductors (also called 'phases') and between phases and grounded hardware.	Low Low - Golden eagle	Minor **Moderate**	Minor
Tailings Facility	Pulp (mixture of water and rock) will be stored after treatment. Flotation processing so that no harmful chemicals are required, however	Once established the Tailings facility may attract birds, with potential for poisoning. However, in the short term birds would be displaced due to construction works; additionally there is an abundance of better quality	Low	Minor	

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
	there remains the possibility of build-up of naturally occurring contaminants such as sulphate, cadmium, and arsenic which are found in concentrations in excess of the maximum permissible level in groundwater surrounding the site as a result of the local geology. (See Section 4.8).	wetland, riparian and lacustrine habitats in the vicinity, which would be used preferentially.			
Introduction of physical barriers into the landscape – fencing of Industrial Zone	Barrier effects caused by infrastructure, fencing or frequent disturbances which interrupt or prevent movements of animals across the landscape. Also habitat fragmentation.	Second hand recording of Moose during the surveys, however this was outside of the areas to be fenced. Some impact on small (rodents etc.) and medium (e.g. wolf and red fox) mammal movements and use of area depending on the type of fencing used and whether it allows animal passage.	Negligible	None	
Pollution	Deposition of toxic or harmful elements & substances (via air or water runoff, ground water, transport), including heavy metals, hydrocarbons, acid rock drainage; e.g. ore dust, fuel spillage, process chemicals.	Pollution by toxic substances could reduce the viability of some plants, possibly including rare/endemic plants. However tight emissions controls and monitoring programmes will be in place.	Low-steppe habitats Low – rare, relic and endemic plant species Low - aquatic ecology	Minor **Moderate** Minor	Minor

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
		Pollution of surface or ground waters could reduce the viability of aquatic plants and animals. Developmental abnormalities in fish species. However detailed mitigation measures are in place through the project design process and working practices. Additionally the Project would stop the uncontrolled drainage of ARD into the Brook Akbastaubulak (current situation) providing a positive environmental improvement. Animals may ingest toxic substances from vegetation or pick them up later in the food chain (biomagnification of pollutants) e.g. birds of prey which hunt could pick up toxic substances in small mammals. Toxic effects may reduce viability, cause mortality of some individuals or cause longer term declines in population due to e.g. reduced breeding success.	Low – common and Near Threatened species - Low Golden eagle and Large Heath Butterfly - Low	Minor **Moderate**	Minor
Pollution	Deposition of dust particles	Smothering or reduction in photosynthesis of vegetation possibly including rare/endemic plants. Dust suppression measures in place throughout operations including roads, to mitigate dust nuisance to humans. Research by Farmer (1993) suggests that the most sensitive species appear to be affected by dust deposition at levels above 1000mgm^{-2}day^{-1}, which is five	Negligible-steppe habitats Negligible – rare, relic and endemic plant species	Negligible Minor	

Table 5.10.7: Ecological Impacts

Project Component/ Activity	General Ecological Impacts	Specific Impacts	Magnitude	Residual Significance	Significance with additional mitigation (where required)
		times greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. Most species appear to be unaffected until dust deposition rates are at levels considerably higher than this.			
Deposition of substances (via air/ dust) containing N, P, K, Ca, Mg, S); e.g. explosive residues, cement, deposition of vehicle exhaust gases containing NOx and SOx.	Changes in soil fertility/pH.	Dominance of plant communities by competitive ruderal species and potential decline in endemic plant species in mesotrophic grassland within the Project study area.	Low	Minor	
Accidental import of alien species on machinery. Use of soil from elsewhere containing seed bank of non-local species.	Invasive alien species out-compete slower growing native species and may dominate vegetation.	Steppe vegetation within the Project study area.	Low	Minor	
Accidental transfer of disease or pathogens on machinery	Infection of healthy populations	Steppe vegetation (movement of contaminated soil), aquatic fauna.	Low	Minor	

As identified in Table 5.10.7, significant potential impacts due to the renewed activity and disturbance in the Project area have been identified in relation to the rare, relic and endangered plant species; the Kazakhstan Redbook listed species Golden Eagle and Large Heath Butterfly; and the loss of or damage to the natural riparian habitats of the Brook Akbastaubulak due to the diversion of its headwaters.

Eight species of plant listed within the Red Book of Kazakhstan were recorded during the 2010 survey; their conservation status (level of endangerment) on the list is however not known. The location(s) and general abundance of these species within the study areas was also not noted; however specific mention of Wild rosemary being within an area close to mine operations near the River Kyzylsu was made. It is therefore assumed that this is the only one of the eight species which could be impacted during the development of the main project footprint; however it is possible that new and / or temporary access and haul roads may also coincide with rare plant locations, however these are not shown on the main project footprint in Drawing 4.9.1.

Wild rosemary is not internationally designated as an endangered species (IUCN Red list as 'Least concern') due to the large range of the species (widespread across the Russian Altai) and its stable population trend. The conservation status of the remaining seven species have not been assessed by the IUCN.

As per Table 5.10.7, potential significant impacts in relation to rare or endemic plant species include:

- impact to Wild rosemary population within the project footprint;
- habitat degradation in areas surrounding the BMV, leading to a decrease in population size; and
- pollution effects through contamination of soils and water.

The Golden Eagle (*Aquila chrysaetos*) is a relatively common species of eagle and it is not internationally designated as an endangered species (IUCN Red list as 'Least concern') due to the large range of the species and its stable population trend. It is however a migratory species through the Altai region and has a wide, but sporadic, distribution within the RoK as a whole. It is listed in the Red Book of Kazakhstan as rare (Category III) as it exhibits a decreasing in population trend within RoK.

A single individual was observed circling at very high altitude over the area planned for the new tailings facility during the migratory bird survey (1st October 2011) on a hunting or searching flight. It generally inhabits steppe-covered hills, rocky mountains, eroded mountains ridges, pine and other forest lands, wetlands and sauxhaul tree deserts; it does not nest in the vicinity of the BMV and it is likely that the site forms part of its wide hunting territory.

As per Table 5.10.7, potential significant impacts in relation to the Golden Eagle include:

- loss of hunting territory within the project footprint;

- habitat degradation in areas surrounding the BMV leading to a reduction in the population sizes of prey species;
- electrocution through contact with uninsulated or inappropriately designed overhead power lines; and
- the biomagnification of contaminants through the food chain.

The 2013 field study only recorded Lepidoptera (butterflies) as being present within sanitary zones 1 and 2 (1.5 to 5.0km from the industrial zone) (Appendix 4.9.16). It therefore follows that the Large Heath or Common Ringlet Butterfly (*Coenonympha tullia*) was also only recorded in these areas. The report also states that Large Heath Butterfly was only found in 'natural habitats', however the precise location(s) and number of sightings is not provided in the survey data, it is therefore possible that the species is present within the proposed development footprint. The species was not recorded during the 2011 preliminary survey. This species has yet to be assessed for the IUCN red list, but is listed in the Red of Kazakhstan at Category III (rare). The species is also classed as 'Vulnerable' in the "Red Book of European butterflies. The caterpillars feed on cotton grass (Eriophorum), sedges (Carex), rhynchospora (Rhynchospora); ovsyannitsa (Festuca), meadow grass (Poa), feather grass (Stipa) etc. some of which are common across the study area.

As per Table 5.10.7, potential significant impacts in relation to the Large Heath butterfly include:

- loss of habitat within the project footprint;
- habitat degradation in areas surrounding the BMV, which would also impact any individuals displaced from the project footprint; and
- the biomagnification of contaminants through the food chain.

The construction of the Waste Dump will require the diversion of the Brook Akbastaubulak (and its tributary the Zhumataybastau) into the River Mayranbastau to the west. The diversion will be to the North of the Waste Dump and is designed to prevent any potential contamination from the Dump entering the surface water system. The lower reaches of the Brook Akbastaubulak will therefore no longer be fed by the headwaters and instead flow will be provided by specifically diverted clean surface water runoff from the Waste Dump, which is likely to be a sporadic rather than a continuous flow. There is a paucity of data in relation to current water levels and flow rates within the Brook Akbastaubulak and therefore the impact of the diversion on flow characteristics cannot be accurately quantified at this time, although it is predicted that under the above scenario flow rates will be reduced by approximately two-thirds and there is the potential for water levels within the Brook to be reduced to less than 10cm even if continuous flow is maintained.

The Brook Akbastaubulak is known to support a range of aquatic fauna, including fish and invertebrate species, although none of these are listed within the Kazakhstan Redbook nor are they unique to the Brook Akbastaubulak, being found in other waterbodies investigated during the 2013 survey within the local area.

Although the Brook Akbastaubulak has been modified at various points by damming structures (to facilitate agricultural irrigation), this has increased the range of habitat types available along the watercourse and may have increased its overall biodiversity (for example it supports both limnophillic and rheophilic species); therefore the Brook Akbastaubulak is considered to be a natural habitat. Due to the paucity of data, the the potential scale of the impact to the ecology and biodiversity of the Brook Akbastaubulak cannot be accurately predicted at this time and therefore the impacts have been assessed as a considered worst case. Further detailed survey, as outlined in MP8, is required pre-construction to better inform the impact assessment and to help devise appropriate mitigation measures.

As per Table 5.10.7, potential significant impacts in relation to the diversion of the Brook Akbastaubulak are:

- Diversion of the headwaters of the Brook Akbastaubulak to facilitate the creation of the Waste Dump will remove the potential for contamination from the Waste Dump entering the surface water environment;
- Lowering of water levels in lower reaches of the Brook Akbastaubulak leading to potential habitat changes and loss of biodiversity;
- Potential for drying out in summer and freezing in winter leading to large scale loss of individuals;
- Reduction of average flows to less than 10cm may make the watercourse unsuitable for some existing fish species; and
- Reduction in water volume will decrease the dilution effect should pollutants enter the Brook, therefore increasing the risk of degradation of water and habitat quality and/ or adverse impacts to aquatic life.

5.10.7 Mitigation for Impacts on Biodiversity and Ecosystems

The Project mitigation strategy for biodiversity is based on the objective of ensuring that biodiversity and ecosystem functions are not systematically degraded or lost from the landscape as a result of the development and operation of the Project. This will be achieved through application of the mitigation hierarchy as summarised in Table 5.10.8.

Table 5.10.8: Biodiversity Mitigation Measures	
Step in mitigation hierarchy	**Typical Measures and Commitments**
Avoid	Impacts on highly irreplaceable biodiversity should be avoided unless it can be proved that effective mitigation or an effective offset is possible without compromising viability. Impacts should be avoided (e.g. by relocating infrastructure or carrying out activities at a more suitable time) if: • There is a risk of losing biodiversity with very high irreplaceability. • Biodiversity affected is threatened and declining throughout its remaining area of occupancy. • Impact will result in remaining portion of the resource becoming non-viable because critical viability thresholds have been exceeded (remaining habitat too small or fragmented, population unable to recover). • Recovery from impact is uncertain and no proven mitigation measures are known.
Minimise	Improve measures/design to minimize ecological impacts e.g. by reducing proportion affected, reducing magnitude or intensity of impact. Other measures include covering leachate ponds to prevent mortality of small mammals, amphibians, reptiles and birds.
Restore or repair	Post-impact measures to restore the condition of biodiversity in its current location, e.g. diversification of vegetation that has become disturbed during construction and restoring its pre-impact species composition. This is necessary for all areas where vegetation has been cleared, e.g. for haul roads or for temporary storage of materials or components. It will also be necessary for the temporary camp.
Offset	Possible offset opportunities

5.10.8 General Mitigation Measures for Biodiversity and Ecosystems

Several measures are proposed for impacts on soil, water and air which will also reduce some impacts on biodiversity and ecosystems. These include measures to minimise footprint, suppression of dust etc.

5.10.9 Mitigation for Impacts on Natural Vegetation and Plants

Avoidance of impacts on Vegetation

Populations of the eight plant species recorded within the study area and listed within the Kazakhstan Red Book will be confirmed prior to construction and, where important populations coincide with or are close to the development footprint they will be avoided where possible. It is known that Wild rosemary is present in the vicinity of the River Kyzylsu close to the proposed mine site.
Disturbance of identified rare species can be avoided by:

- clearly marking the location of the species;
- educating employees/contractors regarding occurrence of important species in the area and the importance of their protection;
- erect temporary fencing around the species to exclude workers and construction equipment and vehicles; and

- maintaining a protective buffer around the species to exclude unintentional disturbance.

Minimising Impacts on Vegetation

The Project's footprint is located on steppe grassland and steppe bush habitats which are widespread within the area and wider region. However eight plant species which are listed within the Red Book of Kazakhstan have been identified within the Project study area. Therefore, efforts are needed to minimise the impact on these species, including all site clearance works to minimise disturbance of habitats and flora. This can be achieved by:

- use of construction methods to minimise excavation works;
- restricting site and private vehicles (mine personnel) to designated access roads, haul routes and working areas to prevent disturbance;
- restricting foot traffic in areas to prevent disturbance; and
- Suppressing pollution which could degrade vegetation and habitats in adjacent zones. The pollution prevention measures identified in the environmental design criteria should be effective in reducing localised deposition and pollution affecting vegetation; as well as reducing the potential for contamination of surface and ground water which may be taken up by these species

Restoration

Research work would be needed in partnership with the RoK botanical specialists to establish effective techniques for restoring the vegetation types affected by the Project.

Upon closure disturbed areas will be regraded to create a slope angle suitable for recultivation and will be reinstated with topsoil and reseeded with perennial grasses. The selection of appropriate native plant species to be used during interim and final reclamation should be guided by the field trials and undertaken as early as possible on disturbed areas. Consideration should also be given to reintroducing rare, relic and endemic species which have been identified during the biodiversity baseline studies. Restoration should also include suitable habitats/vegetation for small mammals which make up the a main component of the food source for birds of prey and other mammal species; and should provide suitable materials for nest building.

All revegetation carried out for the Project would be reviewed annually to avoid accidental introduction of invasive alien (non-native or invasive) species and include management practices to avoid the spread of alien species to surrounding areas.

An essential part of the biological reclamation process is aftercare, to ensure that the vegetation develops and is sustained for the required afteruse. Aftercare is generally required for about 5 years,

but may be shorter or longer depending on how monitoring shows that the reclaimed areas have achieved the necessary condition.

The aftercare programme will be developed to include activities such as:

- Re-seeding and re-planting of the swards where there have been failures to establish or grow;
- Addition of fertiliser or other ameliorants to re-build soil fertility;
- Maintenance of wind and water erosion control measures; and
- Management of grazing on agricultural pasture areas.

Offset

Where the impact to an identified population of a plant listed within the Red Book of Kazakhstan cannot be avoided or minimised with the population in situ, some or all of the population (including the underlying soil resource containing the seed bank) should be translocated to a suitable receptor area(s) away from the zone of influence of the mine. Initial research would be required to establish effective techniques for translocation and to identify suitable alternative locations; this will be required in advance of disturbing these habitats during the construction phase.

Translocation areas should be clearly marked and appropriately fenced to prevent damage to or loss of the translocated individuals whilst they establish.

5.10.10 Mitigation for Impacts on Fauna Species Populations

Avoidance and Mitigation of impacts on Golden Eagle

As identified in Table 5.10.7 significant potential impacts due to the renewed activity and disturbance in the Project area have been identified in relation to the Golden Eagle, which is a migratory visitor to the site and has only been observed as a single individual circling at very high altitude above the study area. It was not observed to be hunting within the area. These impacts relate to the loss and degradation of hunting habitat; the potential for biomagnification of pollutants; and the potential of electrocution due to overhead transmission lines.

Since only one individual was observed and the duration of seasonal migrations differs significantly in this area, (autumn migration is long, and spring migration is short) it is recommended that further field work is conducted in the second half of April or September-October, this will further inform the status and activity (actively hunting or passing through) of this species in the vicinity of BMV. However, as Golden Eagle does not breed within the area there is no requirement to survey for active nesting sites within the landtake and area of influence of the mine.

Additional monitoring should be taken every 2 or 3 years in order to monitor the condition of populations of bird species and to add corrections to the environmental protection measures, if required.

Impact to Golden eagle in terms of the loss of suitable hunting territory / habitat to the project footprint cannot be avoided. However this species has a very large range and suitable hunting territory is widespread.

Degradation of the habitats surrounding the mine could lead to a reduction in the availability of prey species within the area. However as Golden eagle has a very large range, better quality feeding habitat would be widespread in the area and the birds could easily move to areas of higher prey species density.

Additionally there is the potential for biomagnification of contaminants (pollution) through the food chain to this end predator due to the potential for contamination of habitats (air, soil and ground/surface water).

Large birds such a Golden eagle are also at risk of electrocution when power transmission lines are difficult to navigate and cross migrating and feeding bird flight paths; and where there is insufficient separation between energised phase conductors (also called 'phases') and between phases and grounded hardware.

Mitigation measures should include:

- use of construction methods to minimise excavation works;
- restricting site and private vehicles (mine personnel) to designated access roads, haul routes and working areas to prevent disturbance to prey species or degradation of prey species habitat;
- restricting foot traffic in areas to prevent disturbance to prey species or degradation of prey species habitat;
- Suppressing pollution which could degrade vegetation and habitats in adjacent zones (making them less attractive to prey species) or which could accumulate through the food chain. The pollution prevention measures identified in the environmental design criteria should be effective in reducing localised deposition and pollution affecting vegetation; as well as reducing the potential for contamination of surface and ground water which may be taken up by vegetation and / or prey; and
- Installation or retrofit of "avian-safe" power transmission lines (see below).

An "avian-safe" power transmission line is a configuration designed to minimise bird electrocution risk by providing sufficient separation between energised phase conductors (also called 'phases') and between phases and grounded hardware to accommodate at least the wrist-to-wrist or head-to-foot distance of a bird. If such separation (isolation) cannot be provided, exposed parts should be covered

(insulated) to reduce electrocution risk. It is possible to mitigate for electrocution on an already operational network, through retrofitting.
Mitigation measures can include:

1) line design or configuration – combination of two approaches: either to ensure that the likely preferred perching space for a bird on the pole top is well clear of dangerous components; or to ensure that the dangerous components are sufficiently separated by space to ensure that the bird cannot touch them;
2) Insulation: covering energised parts and/or covering grounded parts with materials appropriate for providing incidental contact protection to birds. It is best to use suspended insulators and vertical disconnectors, if upright insulators or horizontal disconnectors are present, these should be covered. By insulating the wires altogether, the insulators will no longer be required, and the wires can be directly attached to the poles.
3) Protective perches or applying perch management techniques – e.g. providing artificial bird safe perches.

Restoration

The restoration details described above for the reinstatement of soils and vegetation would return the BMV site to natural habitat and reinstate the area of 'lost' hunting territory.

Off-set

There is no requirement to offset mitigation for this species.

Avoidance of impacts on Large Heath Butterfly

Populations of the Large heath butterfly (Red Book of Kazakhstan and the Red book of European butterflies) were recorded in the sanitary protection zone and therefore could be located within or close to the Project footprint (for example the Waste Dump or Tailings facility). The exact locations of populations will be confirmed prior to construction and, where important populations coincide with or are close to the development footprint they will be avoided where possible.
Disturbance can be avoided by:

- clearly marking the location of the species;
- educating employees/contractors regarding occurrence of important species in the area and the importance of their protection;
- erecting temporary fencing around the species to exclude workers; construction equipment and vehicles; and
- maintaining a protective buffer around the species to exclude unintentional disturbance.

Minimising Impacts on Large Heath Butterfly

Populations of the Large heath butterfly were recorded in the sanitary protection zone and therefore could be located within areas outside of the Project footprint which could potentially be subject to habitat degradation (for example a decrease in the abundance or vitality / nutrient content of the plant species no which it lives, reproduces and feeds) or disturbance. There is also for the potential for the biomagnification of pollutants should the host plants become contaminated by air, soil or waterborne pollutants.

Therefore, efforts are needed to minimise the impact on these species, including all site clearance works to minimise disturbance of habitats and flora. This can be achieved by:

- use of construction methods to minimise excavation works;
- restricting site and private vehicles (mine personnel) to designated access roads, haul routes and working areas to prevent disturbance;
- restricting foot traffic in areas to prevent disturbance; and
- Suppressing pollution which could degrade vegetation and habitats in adjacent zones, making them less suitable for Large heath butterfly; or cause a reduction in population size; or biomagnify through the food chain. The pollution prevention measures identified in the environmental design criteria should be effective in reducing localised deposition and pollution affecting the host vegetation; as well as reducing the potential for contamination of surface and ground water which may be taken up by the host plants.

Restoration

As part of the research into establishing effective techniques for restoring the habitats and vegetation types affected by the Project, the creation of areas of habitat offering optimal conditions for the Large heath butterfly should be investigated. This may require inputs from RoK entomological specialists.

These areas should be surveyed annually (at least for the five year aftercare period) to establish whether Large heath butterfly has established in these areas and, if it has, the health and size of the population(s) established.

Offset

Where the impact to an identified population of Large heath butterfly cannot be avoided or minimised with the population in situ, some or all of the population (including the live host vegetation) should be translocated to a suitable receptor area(s) away from the zone of influence of the mine. Initial research would be required to establish effective techniques for translocation and to identify suitable alternative locations; this will be required in advance of disturbing these habitats during the construction phase.

Translocation areas should be clearly marked and appropriately fenced to prevent damage to the habitat; or disturbance / loss of the translocated individuals.

Avoidance and Mitigation of impacts on Brook Akbastaubulak

As identified in Table 5.10.7 significant potential impacts due to the diversion of the headwaters of the Brook Akbastaubulak have been identified. These impacts relate to the reduction in flow rate leading to the degradation of habitat quality and potential for adverse impacts to aquatic life.

The diversion of the Brook Akbastaubulak cannot be avoided as it is essential for ensuring that potential contamination from the Waste Dump does not enter the surface water environment.

Due to the paucity of data in relation to the current hydrological condition within the Brook, the potential impacts of the diversion in terms of changes to flow rates and reduction in water levels cannot be accurately quantified at this time. Consequently, the potential impacts to aquatic life are also difficult to accurately establish; although it can be assumed (as a worst case) that the reduction in flow could potentially lead to periodic losses of all aquatic life in some (or all) sections of the Brook due to drying out or freezing; although the latter is considered more likely. Changes in flow rate; and a potential change from continuous to sporadic flow may also alter the suitability of (sections of) the Brook to sustain certain species; for example the lowering of the flow rate may make the Brook less suitable for some rheophilic (living in flowing water) species. There is also the potential for increased pollutant concentrations due to the reduced dilution effect.

Therefore baseline studies will be required to accurately assess the potential scale of the impacts and to help devise appropriate mitigation measures. As set out in MP8, it is suggested that monthly monitoring of water levels and flows be undertaken at different points along the Brook for at least one year prior to construction of the diversion to allow an accurate account of current conditions to be determined. This will allow the impact of the diversion to be better assessed in terms of the impact on water levels and flow; and hence on the habitats available within the Brook Akbastaubulak.

It is also suggested that additional pre-construction aquatic ecology surveys are undertaken within the lower reaches of the Brook Akbastaubulak, during appropriate survey windows, to better establish the baseline; for example to identify the locations of different habitat types and further examine populations of key species. These data will help to formulate targeted mitigation measures for the Brook, which cannot be formally identified at this time.

On-going hydrological (water levels and flow rates) and ecological monitoring (key indicator habitats / species to be defined as a result of the baseline surveys), during the construction and operation phases should also form part of the mitigation measures, as set out in MP8. It is currently suggested that initially hydrological monitoring be monthly and that ecological monitoring be designed to fit with appropriate survey windows, depending upon the indicators chosen. Monitoring frequency should be reviewed depending upon the data gathered.

As previously discussed, targeted mitigation measures cannot be formally identified at this time due to lack of data, however there is a possibility that post-diversion flows to the Brook Akbastaubulak could be increased by the introduction of clean, treated, process water. This would increase the flow and volume of water into the Brook and potentially would be continuous rather than sporadic in nature. This potential mitigation measure will be investigated further should the baseline studies and revised impact assessment show a need to increase post-diversion flows.

Restoration

The Waste Dump would remain *in situ* post-operation / upon mine closure and therefore no restoration details can be put forward.

Off-set

Depending upon the results of the additional baseline surveys and the revised assessment of potential ecological impacts, it may be considered that some degree of off-setting is required. If so, it is recommended that the potential for habitat improvements to the River Mayranbastau (the receiving water course of the diversion) be considered. This will require baseline studies to identify potential areas for improvement; as the River Mayranbastau was not included in the 2013 Aquatic Survey.

Biodiversity Action Plan

A Biodiversity Action Plan should be developed for the Project to include the following recommended measures:

1) Management of populations of Red Book listed plant species including, but not limited to:
    - Details of future monitoring;
    - Details of pollution prevention measures; and
    - Details of how identified populations will be protected in situ and through translocation; and details of aftercare management.

2) Protection of Golden eagle including, but not limited to:
    - Details of Mitigation measures required to protect the Golden eagle (and other medium to large birds) from possible electrocution on existing and new power transmission lines;
    - Details of any further survey work; and
    - Details of pollution and disturbance prevention measures to maximise availability of prey species.

3) Management of populations of Large heath butterfly including, but not limited to:
    - Details of future monitoring / survey;
    - Details of pollution prevention measures; and

- Details of how identified populations will be protected in situ and through translocation; and details of aftercare management.

Mitigation measures are required in order to protect the Golden Eagle and other medium to large birds from possible electrocution on existing power lines (when they are reenergized for the Project) and from new transmission lines.

5.10.11 Residual Impacts on Biodiversity and Ecosystems

This section considers the impacts that may remain following mitigation and assesses their likely significance for important biodiversity receptors.

Rare, relic and endemic plant species: The baseline survey predicts a moderate potential impact prior to mitigation. Subject to the implementation of suitable avoidance measures (where possible) and undertaking research and investigation into the potential for translocation of target species the residual impact would be reduced to **minor and not significant**.

With respect to the Golden Eagle, taking account of the baseline survey, moderate potential impact prior to mitigation have been predicted. However with the described mitigation measures in place the residual impacts would be **minor and not significant**.

The impacts to Large heath butterfly predicted from the baseline survey were moderate. However with the described mitigation measures in place the residual impacts would be **minor and not significant**.

The predicted impacts to Brook Akbastaubulak were moderate, however these were based on limited baseline data. As the impacts of the diversion cannot be fully quantified at this time, this has restricted the formulation of mitigation measures and therefore, as a worst case it has been assumed that the flow will be reduced to a level whereby the current ecology of the Brook is irreversibly changed and cannot support existing populations / species. The residual impacts therefore must at this time be assessed as **moderate and significant**. However, following further baseline surveys, both the impacts and suitable mitigation measures will be further defined to reduce the impact to **minor and non-significant**, either through mitigation to the Brook or via off sett measures

5.10.12 Ecosystem Services

Introduction

Ecosystem services are the benefits that people, including businesses, derive from ecosystems.

Ecosystem services are organised into four types:

(i) provisioning services, which are the products people obtain from ecosystems;
(ii) regulating services, which are the benefits people obtain from the regulation of ecosystem processes;
(iii) cultural services, which are the non-material benefits people obtain from ecosystems; and
(iv) supporting services, which are the natural processes that maintain the other services[1]"

This assessment considers each of these in relation to the Project. The ecosystem services impact assessment is interlinked with a number of topics from other Sections of the ESIA including those listed below:

- topography, land coverage and landscape;
- archaeology and cultural heritage;
- biodiversity;
- soils and land use;
- socio economic, public consultation and disclosure; and
- water resources.

Sources of Information

This assessment is based on information provided in the Environmental and Social Baseline (Chapter 4) of this report. Particular emphasis has been placed on information available from Auezov, Solnyechni and Shalabay household surveys, described in Sections 4.13-4.15.

Project Activities and Sources of Potential Impact

Ecosystem services may be affected by all Project activities.

Impact Significance Criteria

The sensitivity criteria used to determine the sensitivity of the baseline environment is set out in Table 5.10.9. The importance of the ecosystem services to beneficiaries and the availability of alternatives i.e. its replaceability, is used to assess and determine the sensitivity of the receptor.

[1] IFC, (2012), IFC Performance Standards on Environmental and Social Sustainability, www.ifc.org

Table 5.10.9: Receptor Sensitivity (Value)	
Sensitivity (value)	**Ecosystem Service Descriptors**
None (not sensitive)	The ecosystem service is of little to no importance to beneficiaries in terms of natural products and services.
Minor	The ecosystem service is of low importance to beneficiaries (local, regional and global) or is of moderate importance but with spatial alternatives available.
Medium	The ecosystem service is of medium importance to beneficiaries and has medium replaceability (some spatial alternatives), high importance to beneficiaries and many spatial alternatives, or low importance and few to no spatial alternatives.
High	The ecosystem service is of high importance to beneficiaries and has medium replaceability (some spatial alternatives); is of medium importance to beneficiaries and has few or no alternatives; or is essential to beneficiaries but has many spatial alternatives.
Very High	The ecosystem service is of high importance to beneficiaries and has few to no spatial alternatives; or the service is of high to essential importance and has moderate to low replaceability.

The magnitude of the effect was based on the criteria identified in Table 5.10.10. In the absence of specific and documented guidance that relates to determining the magnitude of effect in relation to ecosystem services, the criteria are based on professional experience and take account of performance standards and industry best practice.

Table 5.10.10: Magnitude of Effects with Respect to the Ecosystem Services	
Impact Magnitude	**Guideline Criteria**
Nil	No measurable change to the baseline condition of ecosystem services.
Negligible	Minimal or few detectable changes in baseline resource, which are either of short duration or infrequent periodicity, such direct control or management is not required. Within the normal range of natural variation.
Low	The impact results in a small reduction in the availability or functionality of the ecosystem service and/or has implications for a small number of people relative to the population within the Project study area. There is a perceptible difference from baseline conditions.
Moderate	The impact results in a moderate reduction in the availability or functionality of the ecosystem service and/or has implications for a substantial number of people relative to the population within the Project study area. Does not threaten the long-term viability of the service.
High	The impact results in the loss of all or a significant proportion of the availability or functionality of an ecosystem service and/or has implications for the majority of people within the project study area. The long term viability of the ecosystem service is threatened. Detailed mitigation strategy combined with offsite compensation is required to reduce the magnitude of the effect.

Potential Impacts

The assessment has been presented in Table 5.10.11, with identification of potential impacts. Ecosystem services can be assessed in terms of importance of the service to beneficiaries and replaceability of the ecosystem service.

A **low** to **essential** rating is given to the importance of ecosystem services to beneficiaries and is assessed in relation to the following areas:

- intensity of use;
- scope of use;
- geographic proximity; and
- degree of dependence.

Whilst the replaceability of the ecosystem service in relation to spatial alternatives is given a low to **high** rating according to the following areas:

- the existence of spatial alternatives (other sites where the same ecosystem service is also provided and that are close enough to be utilised by affected communities); and
- the sustainability of spatial alternatives given the potential for increased resource use, including a consideration of other users and the existing status and threats to the resource.

A rating of low replaceability indicates that there are no or few spatial alternatives, whereas a rating of high replaceability indicates that many alternatives are available in the area.

When considering ecosystem services, the receptor is the service itself, as provided by the underlying ecosystem. However, as the ultimate beneficiaries of ecosystem services are the human users of this service, the assessment takes into consideration both the magnitude of an impact on an ecosystem service and the resulting magnitude of impact on the human beneficiaries of that service.

Table 5.10.11: Assessment of the Potential Impacts of the Project on Ecosystem Services

Ecosystem Service	In Project Area of Influence	Within Project Footprint	Potential Project Impacts	Importance to beneficiary	Replaceability (alternatives)
Provisioning					
Food from: • crops, • livestock, • wild foods (animals, plants),	The surrounding area is not used to grow crops and fruit. Pastures outside the Project boundary would remain unaffected. The surrounding area may be used for non-commercial hunting and foraging.	No crops are grown within the Project footprint. Some areas within the Project boundary are used by herders. Non-commercial hunting and foraging may take place, the location not reported as particularly popular for such activities.	Minor.	Moderate – it constitutes a fragment of wider area used for grazing. No permanent pastures located within the Project footprint. Few users of wild food (3 out of 63 Auezov and Solnechni households)	High – there are many spatial alternatives. The Project area is of a common type within the wider area, which is extensive in terms of its ecosystem.
Food from: • fisheries, • aquaculture.	Fishing in Kyzylsu river and reservoir.	No fishing or aquaculture.	No significant impacts (impacts on water resources are assessed in Section 5.9).	Moderate	Low – few rivers and reservoirs are present in the area.
Biological raw material from timber and other wood products, fibres and resins, animal skin, sand, ornamental resources.	There are no significant woodlands/forests in the area. Small scale hunting takes place in the region. No evidence of use of fibres, resins and ornamental resources.	No significant sources of timber and other biological raw material within the Project footprint.	Minor beneficial impact possible as sand and ornamental resources may be released as a result of mining operations.	Low	High
Biomass fuel	No significant sources of biomass fuel (e.g. wood, crop residues).	No sources of biomass fuel within the Project footprint.	No impact.	N/A	N/A
Freshwater	The steppe grassland enables temporary surface water	The steppe grassland enables temporary surface	No impact as any additional runoff would	Low	High – most of surrounding land

Table 5.10.11: Assessment of the Potential Impacts of the Project on Ecosystem Services					
Ecosystem Service	**In Project Area of Influence**	**Within Project Footprint**	**Potential Project Impacts**	**Importance to beneficiary**	**Replaceability (alternatives)**
	storage and filtration.	water storage and filtration.	be draining into the surrounding catchment ditches or onto adjacent land without change in the net quantity of surface water generated from the Project area (see Section 5.9 for details).		fulfils the same function.
Genetic resources	No examples of current use.	No examples of current use.	No impact.	N/A	N/A
Biochemicals, natural medicines, and pharmaceuticals	No examples of current use.	Edible plants with medicinal properties grow sporadically within the project area but do not form commercial scale thickets and are not collected by local communities.	No impact	N/A	N/A
Regulating					
The role of ecosystems in regulating air quality	Minor regulating function in terms of Project induced emissions.	No regulating function in terms of Project induced emissions.	No specific or related impacts.	N/A	N/A
The role of ecosystems in regulating climate	Steppe grasslands provide biogenic carbon stores.	Not significant, as the Project study area represent a very small proportion of the local and national ecosystem coverage.	No specific or related impacts.	N/A	N/A

Table 5.10.11: Assessment of the Potential Impacts of the Project on Ecosystem Services					
Ecosystem Service	**In Project Area of Influence**	**Within Project Footprint**	**Potential Project Impacts**	**Importance to beneficiary**	**Replaceability (alternatives)**
The role of ecosystems in regulating water flows	It may play a part in regulating water runoff, water recharge and maintaining the water storage potential of the landscape.	Few watercourses within the Project study area, minor role in balancing flow during snow melt and storm conditions.	No major changes to runoff etc. anticipated.	N/A	N/A
The role of ecosystems in controlling soil erosion	Steppe grassland is vegetative climatic climax and is a stable system with low rates of soil erosion.	Removal of vegetative cover could result in increased soil erosion rates particularly during snow melt.	Topsoil removal and storage required for project development potentially leading to increased erosion. Impacts are minor with mitigation in place (see Section 5.8)	Low	High
The role of ecosystems in purifying water and treating waste	The ecosystem is a steppe with few anthropogenic sources of pollution other than the Project, within the locality.	No significant water purifying function other than for diffuse pollution from dust deposits.	No impact	N/A	N/A
The role of ecosystems in regulating diseases	No current examples.	No current examples.	No impact	N/A	N/A
The role of ecosystems in soil creation	Soil formation is taking place under the steppe grassland.	Soil formation is taking place under the steppe grassland.	Soil forming temporarily suspended where vegetation will be removed. Soil restoration upon mine closure would result in these processes taking place in the longer term depending on the geology (see Section 5.8) the impact is minor.	N/A	N/A
The role of ecosystems in	No current examples	No current examples	No impact	N/A	N/A

Table 5.10.11: Assessment of the Potential Impacts of the Project on Ecosystem Services					
Ecosystem Service	**In Project Area of Influence**	**Within Project Footprint**	**Potential Project Impacts**	**Importance to beneficiary**	**Replaceability (alternatives)**
regulating pests					
The role of ecosystems in pollination	Diverse population of pollinating insects present (see Section 5.10)	The same species present as in surrounding areas.	Minor impact due to relatively small area affected.	Low, relatively small contribution of the Project area compared to the extent of this type of ecosystem.	High – there are many spatial alternatives. The Project area is of a common type within the wider area, which is extensive in terms of its ecosystem.
The role of ecosystems in regulating natural hazards	No current examples	No current examples	No impact	N/A	N/A
Cultural					
Recreation and ecotourism: pleasure people derive from natural or cultivated ecosystems	No current examples	No current examples	No impact	N/A	N/A
Ethical and spiritual values including belief that all species are worth protecting regardless of their utility to people	No current examples	No current examples.	No impact	N/A	N/A
Aesthetic and religious value	No current examples	Cultural and religious value placed on graves located within the project footprint.	Minor (see Sections 4.10 and 5.11)	High (see Sections 4.10 and 5.11)	Low
Educational and inspirational	No current examples	No current examples.	No impact	N/A	N/A
Supporting					
The role of ecosystems in	The Project study area forms	The Industrial Zone	The habitat impacts	Moderate	High – there are

Table 5.10.11: Assessment of the Potential Impacts of the Project on Ecosystem Services					
Ecosystem Service	**In Project Area of Influence**	**Within Project Footprint**	**Potential Project Impacts**	**Importance to beneficiary**	**Replaceability (alternatives)**
supporting biodiversity	a very small part of steppe grassland that is prevalent both locally and nationally. There are numerous streams; ponds and reservoirs offering important habitat to aquatic assemblages, as well as providing habitat of bird and other species.	contains areas of existing infrastructure, therefore the habitat in the Industrial Zone is partly disturbed. The Project footprint does form a habitat for a number of species including those listed in the RoK Red Book. It provides a breeding habitat and also feeding habitat for birds including birds of prey.	generated by the project are addressed in Section 5.10.		many spatial alternatives. The Project area is of a common type within the wider area, which is extensive in terms of its ecosystem.
The role of ecosystems in nutrient cycling	Steppe grassland is important at a local and national level, as mesotrophic grassland.	The area performs this role but it is not critical for nutrient cycling in the region.	No impact	N/A	N/A
The role of ecosystems in primary production	Surrounding area of low to moderate grassland productivity.	Limited area of moderate productivity within the Project footprint (stream valleys).	No impact	N/A	N/A
The role of ecosystems in water cycling	Steppe grassland is important at national level as it temporarily stores water making it available to plants which transpire it locally.	The area performs this role but its contribution to water cycling in the region is not significant due to relatively small size.	No impact	N/A	N/A

5.11 Archaeology and Cultural Heritage

This chapter evaluates and assesses the potential impacts to cultural heritage and archaeology attributable to the construction, operation and closure of the Kyzyl Project. The chapter has been prepared in accordance with the International Finance Corporation (IFC) 2012 Performance Standards[1] (PSs) (see Table 5.11.1).

Table 5.11.1: IFC Performance Standards and EBRD Performance Requirements Key Relevant Requirements

Cultural Heritage and Archaeology
PS7 applies to communities or groups of Indigenous Peoples who maintain collective attachment. According to the IFC's definition, the Indigenous community around Kyzyl are the Kazakhs. Where a project may significantly impact on critical cultural heritage that is essential to identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, priority will be given to the avoidance of such impacts.
PS8 recognises the need of cultural heritage for current and future generations. This PS aims to ensure that clients protect cultural heritage in the course of their project activities from the adverse impacts of project activities and support its preservation. In addition, the PS aims to promote equitable sharing of benefits from the use of cultural heritage. Central to PS8 is the implementation of Chance Find Procedures, whereby the client is responsible for siting and designing a project to avoid significant adverse impacts to cultural heritage.

5.11.1 Impact Assessment Criteria

The magnitude of direct physical impacts to cultural heritage sites is determined by the physical extent of the damage. Such impacts are immediate and permanent: once an archaeological site has been damaged or modified, any value lost cannot be recovered or restored.

The potential consequence of impacts to archaeological heritage is the loss of scientific information about the history or prehistory of Kazakhstan and the legal consequence from the destruction of cultural property, as defined by the Law of RoK 1488-X11 (July 1992, amended Jan 2014) on the Protection and Use of Objects of Historical and Cultural Heritage. This law defines the goals, objectives and legal basis for the protection and use of historical and cultural heritage. In particular, Article 2 covers the definition of cultural and historical monuments, including those of architectural and archaeological value, as well as their protection and use.

All of the potential cultural heritage sites identified during the ESIA baseline surveys were identified by professional archaeologists during archaeological reconnaissance surveys. However, the non-intrusive, rapid reconnaissance methods employed during the baseline study did not allow for the determination of site sensitivity at every potential cultural heritage site.

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

5.11.2 Baseline and Conclusion

Site visit reconnaissance as well as surveys carried out by the independent contractor JSC Avalon in 2013 indicate that there are no identified objects of historical and cultural value within the Kyzyl Project site. The cultural heritage and archaeology baseline for the Project site as well as the wider region can be found in Chapter 4.10 of this report.

A full cultural heritage and archaeology impact assessment is not necessary. Nevertheless, Polymetal will continue to work according to the 'Archaeological Chance Finds Procedure' report, which they published in 2015. The report outlines the legal basis for archaeological chance finds and sets out the sequence of actions to take if a relevant object is discovered.

5.12 Infrastructure

The Project area has a rather well developed infrastructure. There are roads, the workers' community with skilled labour force, power lines with power reserves and potable and process water supply sufficient to meet the needs of the Project site facilities and the population.

The transport system, existing in the district, is represented by blacktop and broken-stone roads. There is a network of dirt side roads, heavy going in spring slush and winter snow drift seasons.

The BMV site is accessed via the existing road from Almaty-Semey national highway, and further Charsk railroad junction in the west, and from Almaty- Ust-Kamenogorsk road in the east.

The nearest railhead of the new Ust-Kamenogorsk - Almaty-Charsk railroad line is at Shalabay settlement and the Charsk junction station - 50km from Auezov settlement.

Figure 5.12.1: Bakyrchik Gold Project Location Map (legend below)

Legend for Figure 5.12.1	
Districts:	Territories, subordinated to maslikhats (regional executive committee)
2 – Borodulikhinsky 3- Shemonaikhinsky 4 – Glubokovsky 5 – Ulansky 6 – Zyryanovsky 8 – Zharminsky 10 - Koklektinsky	I Semey City II Ust-Kamenogorsk City BMV LLC geological allotment

Residential areas and production facilities are supplied with power from Ust-Kamenogorsk hydroelectric power plant, located 90 km north-east from the Bakyrchik deposit, via the electricity transmission line network of the East Kazakhstan region.

A water reservoir on the Kyzyl-Su River, as well as groundwater of the operated Kyzyl-Su water intake with the yearly average yield of 1000-1300m³/day, is the source of process and potable water supply.

The Bakyrchik mine is located 500-800m from the north end of Auezov settlement. The core business of the company is mining and processing of gold ores from the Bakyrchik deposit, which is confined to the Kyzyl Shear Zone (KSZ).

The Bakyrchik Project area is characterized by low-bald mountain terrain with absolute elevations, ranging from 350m to 488m, and relative elevation - from 20-39m to 50m. The climate is sharply continental. The depth of soil and subsoil freezing varies from 1.65m to 2.0m. Prevailing wind directions are south-east (38%) and north-west (15%). The annual average wind velocity is 2.7m/sec.

The Bakyrchik mine is located 500-800m from the north end of Auezov settlement. The core business of the company is mining and processing of gold ores from the Bakyrchik deposit, which is confined to the Kyzyl Shear Zone (KSZ).

5.12.1 Characteristics and Technical Properties of Transportation Lines

All external transportation will be by railway and vehicles.

The main cargoes for external transportation are coal, inert materials, cement, oil and lubricants, various materials and goods.

Coal, oil and lubricants and some other goods will be transported by railway in mainline locomotives to the Shar station, according to the existing scheme, and then by vehicles to the Bakyrchik deposit using access roads.

Some external and all internal transportation will be by vehicles. External cargoes will be carried by vehicles from Ust-Kamenogorsk and then to the Bakyrchik deposit using access roads. Komatsu HD-

785 dump trucks (91t capacity) and BelAZ 7518 dump trucks (80t capacity) are used for internal haulage of ore and rock, and leased KamAZ 6520 trucks are used for transporting coal, slag, etc..

In addition to transportation required for the production process, vehicles will be used for infrastructure facilities maintenance, such as auxiliary or special vehicles.

An access road scheme is arranged based on the primary access to the deposit, its stripping/development scheme, location of the open pit, dump site and ore stockpiles. Overburden is hauled by dump trucks from the open pit via entry trenches and then to the waste dump site by access roads. Overburden is also used for filling the tailing storage facility embankment. Excavated ore is hauled in dump trucks using access roads from the open pit to the ore preparation facility for further processing or to the buffer ore stockpile near the ore preparation facility. Komatsu WA800-3 front loader and Komatsu D65EX-16 dozer will be used at the buffer ore stockpile.

Access road parameters depend on the type of dump trucks, their capacity, haulage volumes, soil and climate of the project area and long spells of cold weather in particular. Parameters of access roads and other site roads are given in the table below (Table 5.12.1).

Table 5.12.1: Access Roads Parameters

Parameter	Eastern exit - waste rock dump	Eastern exit - ore preparation facility	Ore preparation facility - repair shops	Secondary roads
Access road category	I-K	III-K	IV-K One-lane with two-way traffic	IV-B One-lane with two-way traffic
Road earthwork width, m	38.00	30.60	24.50	9.00
Carriageway width, m	27.50	21.00	9.5	4.5
Roadside width (with a guard wall), m	2.50 (8.00)	2.50 (7.10)	4.75 (10.25)	2.25
Turn radius, m	30	30	30	30
Design speed, km/h	30	30	30	30

Road earthwork structure is assumed conditionally, on the basis of requirements to hauling and operation and the road category, taking into consideration the traffic intensity and vehicle characteristics, climate and availability of local construction materials. For the «Eastern exit - waste rock dump» access road it is 195cm (Type A) of crushed rock, and for «Eastern exit - ore preparation facility» roads and «Ore preparation facility - repair and mounting shops» roads it is 80cm (Type B) of crushed rock. Road paving structure is given in the Tables below (Table 5.12.2 and Table 5.12.3).

Table 5.12.2: Road Layer Parameters for Road type A

Road structure layers	Layer material	Layer thickness, cm
Paving	Crushed rock M1200, 20-40 mm fraction with gutting Kcompaction=0.98	155
Base	Gravel mix, C6 Kcompaction=0.98	40

Table 5.12.3: Road Layer Parameters for Road Type B		
Road structure layers	**Layer material**	**Layer thickness, cm**
Paving	Crushed rock M1200, 20-40 mm fraction with gutting Kcompaction=0.98	50
Base	Gravel mix, C6 Kcompaction=0.98	30

The intermediate type paving is made of hard rock using the choking method without any binders. All filled material should be compacted layer by layer to increase the stability and avoid subsidence. Parameters of entry trenches to dump sites and ore stockpiles are determined in accordance with the access roads to the relevant facilities. In the winter, the road should be cleared from snow and ice, and sprinkled with sand or gravel. In the summer roads are sprinkled with water for dust control. Roads are equipped with road signs and guiding devices to ensure safe traffic and orientation for drivers.

5.12.2 Transport

Impacts relating to traffic associated with this project include:

- direct increase in traffic on the local road network, potentially affecting journeys, junction capacity and safety; and
- Secondary potential impacts include increased wear and tear of road surfaces as a consequence of increased HGV traffic to and from the Project and a potential increase in environmental impacts such as noise and air quality resulting from increased traffic.

The Project site is served by the A350 which is located c. 30km to the East of Auezov and the M38 c. 40km to the West. During the site visit, WAI observed that roads in and around Auezov, as well as the A350, which connects Ust-Kamenogorsk and Kalbatau, are generally dusty, potholed, and lacking of maintenance. Details of the Railways, roads, air and waterway travel were discussed in Chapter 4.

In this assessment, the main access roads through Auezov and Shalabay have been considered and traffic counts were undertaken at the locations listed in Table 5.12.4:

Table 5.12.4: Traffic Survey Junction Coordinates				
	Geographical coordinates		Projected coordinates Pulkovo 1942, GK Zone14	
junction	**Easting**	**Northing**	**X**	**Y**
shalabay1	81.48804	49.68260	14535257	5505703
auezov1	81.56789	49.71033	14540996	5508827
auezov2	81.56789	49.71033	14540996	5508827

An aerial view of each junction is also shown in Photo 5.12.1 to Photo 5.12.3. Survey for one day at each identified junction on a Tuesday, Wednesday, or Thursday [neutral days] between the times of 6am and 8pm. All three junctions were surveyed on the same day at the same time.

Figure 5.12.2: All Junctions

Photo 5.12.1: Auezov – Site 1

Photo 5.12.2: Auezov – Site 2

Photo 5.12.3: Shalabay – Site 3

Traffic Count Method

A methodology was provided based on the fact that all traffic counts will be undertaken manually.

Timing

Survey for one day at each identified junction on a Tuesday, Wednesday, or Thursday [neutral days]. Surveys to take place between the times of 6am and 8pm and all three junctions must be surveyed on the same day at the same time.

Rationale

Traffic counts across junctions should be carried out on a day that is considered representative of the traffic network on a normal working day. For this reason weekends, and the days before and after weekends, should be avoided as these days have different traffic flow characteristics to normal working days. Traffic counts should not be conducted during holiday periods, as this will likely not be representative of a typical day.

The survey can be carried out for 12, 16, or 24 hours. 12 hour surveys usually run from 7am to 7pm, while 16 hour surveys run from 6am to 10pm. However, it is known that vehicle traffic is minimal [if not existent] between 10pm and 6am, hence, there was no need to survey during those hours.

Vehicle Categories

The categories of vehicles to be recorded are:

- **Light Vehicles**: Cars and Light Good Vehicles (LGV).
- **Heavy Vehicles**: Heavy Goods Vehicles (HGV) and Buses.

Motorcycles and bicycles can be ignored.

An example of an LGV and HGV is shown below in Photos 5.12.4 and 5.12.5. Buses should also be categorised as HGVs.

Photo 5.12.4: Example of an LGV

Photo 5.12.5: Example of an HGV

Results

The traffic count data, added up in 15 minute intervals, were provided in a spreadsheet format and attached in Appendix 4.12.1.

5.12.3 Project Activities and Sources of Potential Impact

The project involves Open Pit followed by underground mining; Open Pit mining operations are ongoing and the mined volumes would peak before decreasing as the life of the mines end. The same principle would apply for the underground mining.

The specific impacts associated with the mine are:

- Construction Phase
  - employee movements;
  - transport of construction materials, mine equipment and fleet vehicles;
  - transport of materials sourced internationally;
  - import and disposal of construction materials; and
  - mine servicing, e.g. food deliveries, fuel deliveries, etc.
- Operational Phase
  - employee movements;
  - exporting of mined materials;
  - transport of materials, equipment parts and fuel;
  - transport of materials sourced internationally;
  - export of products, by convoy; and
  - mine servicing, e.g. food deliveries, fuel deliveries, etc.
- Closure Phase
  - Employee movements;
  - Transport of materials, equipment parts and fuel required for mine closure works;
  - Export of redundant plant and equipment;
  - Export of oversize plant and materials, generally by low loaders; and
  - Mine servicing, e.g. food deliveries, fuel deliveries, etc.

Manpower

For all phases, staff will be sourced locally from Auezov or Shalabay. Those living further afield will be houses in either / both of these villages on two weeks on / two weeks off basis.

Staff living further away from Auezov and Shalabay will be transported to and from their place of residence by bus and similarly, all staff will be transported to the mine by bus.
Manpower of the repair and storage facilities for the period of the open-pit mining is given in the Table below (Table 5.12.5).

Table 5.12.5: Manpower of Repair and Storage Facilities for the Period of Open-Pit Mining

Position	People per 1st shift	People per 2nd shift	Total per day	Production processes group
Ammonium nitrate storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	2	-	2	2g
Storage guards	1	1	2	2g
Total without guards	3		3	
Reagent storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	3	-	3	2g
Fork lift driver	1	-	1	2g
Total	4	-	4	
Repair shops with an outdoor area, mode of operation 365x2x12				
Head of shops	1	-	1	1a
Foreman	2	2	4	1a
General mechanic	6	6	12	1b
Repairman	4	4	8	1b
Electrical fitter	2	2	4	1b
Fuel system fitter	2	2	4	1b
Machine tool operator	2	2	4	1b
Welder	2	2	4	2b
Store keeper/tool maker	2	1	3	1b
Total	23	21	44	
Materials and equipment storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Store keeper	1	-	1	1a
Loader	2	-	2	2g
Total	4	-	4	
Fuel and lubricants storage, mode of operation 365x2x12				
Head of storage	1	-	1	1a
Operator	1	1	2	1a
Warehouseman	2	1	3	2g
Total	4	2	6	
Concentrate storage, mode of operation 365x2x12				
Warehouseman	2	2	4	2g
Total	2	2	4	
Explosives storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	2	-	2	2g
Technician	1	-	1	1a
Watchman	3	3	6	2g
Total without guards	4	-	4	

Manpower of the repair and storage facilities for the period of underground mining is given in the Table below (Table 5.12.6).

Table 5.12.6: Manpower of Repair and Storage Facilities for the Period of Underground Mining				
Position	**People per 1st shift**	**People per 2nd shift**	**Total per day**	**Process Group**
Ammonium nitrate storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	2	-	2	2g
Storage guards	1	1	2	2g
Total without guards	3		3	
Reagent storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Warehouseman	3	-	3	2g
Fork lift driver	1	-	1	2g
Total	4	-	4	
Repair shops with an outdoor area, mode of operation 365x2x12				
Head of shops	1	-	1	1a
Foreman	1	1	2	1a
General mechanic	3	3	6	1b
Repairman	2	2	4	1b
Electrical fitter	1	1	2	1b
Fuel system fitter	1	1	2	1b
Machine tool operator	2	2	4	1b
Welder	1	1	2	2b
Store keeper/tool maker	2	1	3	1b
Total	14	12	26	
Materials and equipment storage, mode of operation 365x1x12				
Head of storage	1	-	1	1a
Store keeper	1	-	1	1a
Loader	2	-	2	2g
Total	4	-	4	
Fuel and lubricants storage, mode of operation 365x2x12				
Head of storage	1	-	1	1a
Operator	1	1	2	1a
Warehouseman	2	1	3	2g
Total	4	2	6	
Concentrate storage, mode of operation 365x2x12				
Warehouseman	2	2	4	2g
Total	2	2	4	
Explosives storage, mode of operation 365x1x12 - accounted in underground minemanpower				
Lamp house, mode of operations 365x3x7.2 - accounted in underground mine manpower				

Comparison of the manpower depending on the mining method – open pit or underground - is given in the Table below (Table 5.12.7).

Table 5.12.7: Manpower Comparison

Facility	Manpower, men/day	
	open-pit mining	underground mining
Repair shops with an outdoor area	44	26
Ammonium nitrate storage without guards	3	3
Reagent storage	4	4
Materials and equipment storage	4	4
Fuel and lubricants storage site	6	6
Concentrate storage	4	4
Explosives storage without guards	4	accounted in underground mine manpower
Storage guards	8	2
Lamp house	-	accounted in underground mine manpower

Construction Phase

As discussed earlier, the mine is operational and there will be no construction associated with the mines.

However, a bypass road around Auezov is proposed; the plant required, materials and staff are all be available locally (Figure 5.12.3).

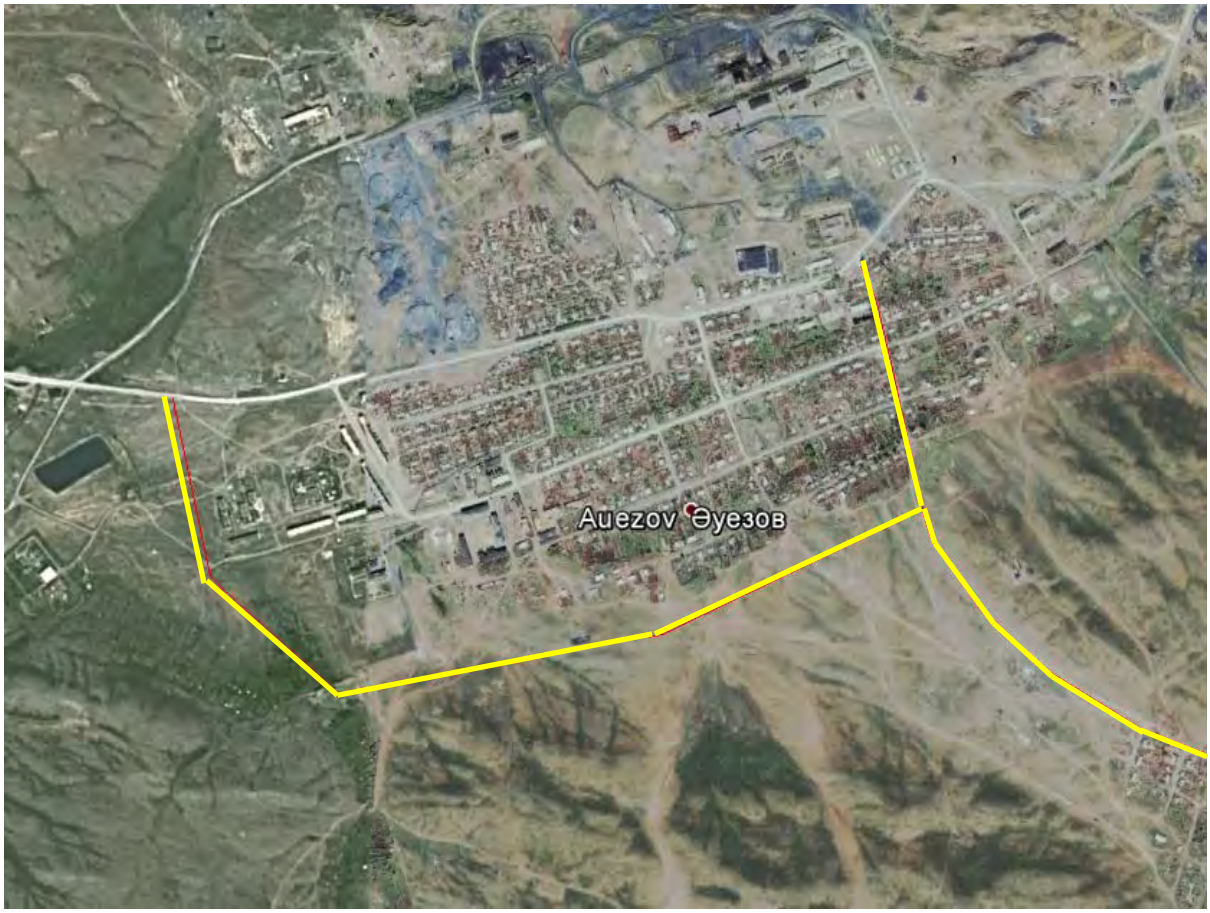


Figure 5.12.3: Proposed Route of Bypass

Operational Phase

As discussed earlier, the mine is operational; detailed analysis of the expected mined volumes to 2039 are included in the Project Description (Chapter 3).

Mined materials will be transported by land from Auezov to Shalabay where it will be loaded on trains towards their ultimate destination.

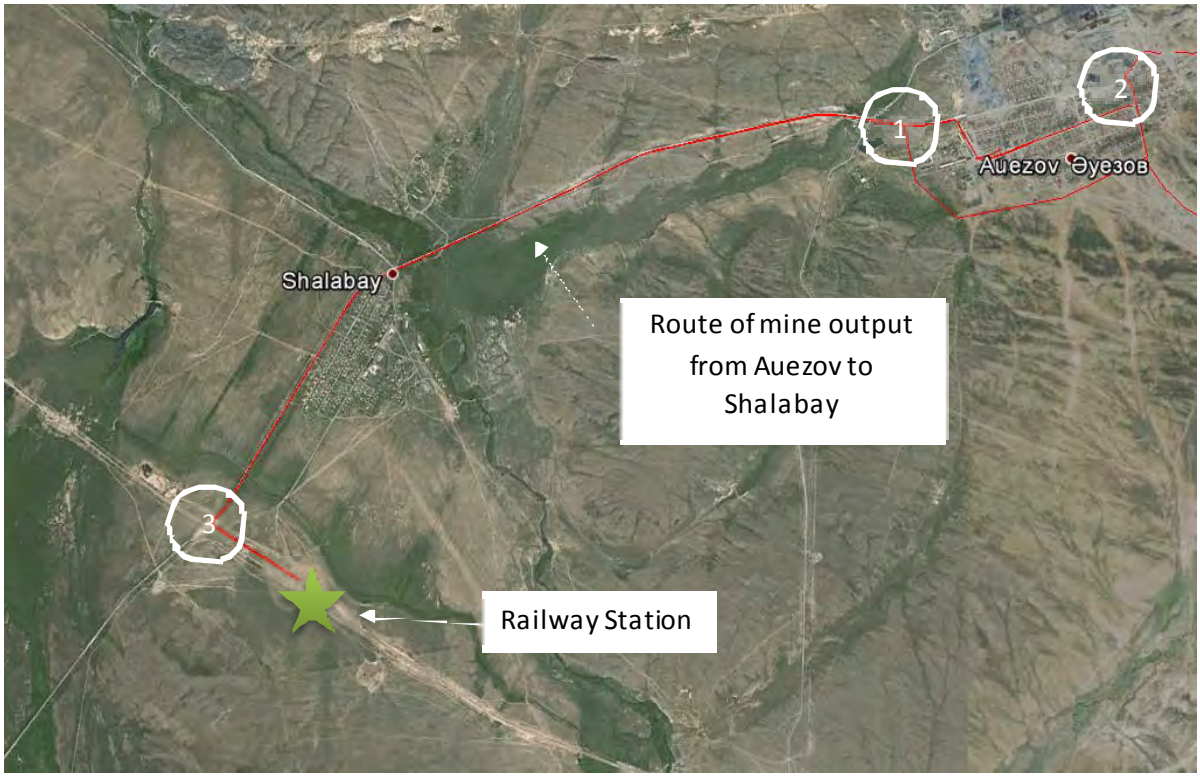


Figure 5.12.4: Mine Output Route from Auezov to Shalabay

Equipment Maintenance and Repair

The repair shop will be located in a heated building equipped with an overhead traveling supported electric crane (16t capacity).

Based on the number of points for maintenance of mining and conveyor equipment and vehicles, list and approximate size of areas for basic work sites and considering the type of equipment and its maximum size, the dimensions and height of the building were determined.

The repair shop will comprise all work sites necessary for the complete scope of technical inspection (TI) and regular maintenance (RM) of mining and conveyor equipment.

Work sites will be equipped in order to fulfil the following TI and RM operations:

- washing;
- diagnostics;
- fitting and assembling;
- tyre fitting;
- welding;
- repair of hydraulic and electrical equipment; and
- replacement of lubricating & cooling fluids.

All operations shall be performed at special sites of TI and RM. The repair shop will operate 365 days a year, two 12 hour shifts per day.

Closure Phase

The closure workforce would reduce to a maximum of approximately 20% of that during operations; the majority [if not all] of this work force are likely to live locally.

Heavy vehicle deliveries are anticipated throughout the closure phase of the Project. Deliveries will be required for equipment spare parts, miscellaneous materials for closure works, general supplies and fuel. Maintenance and service vehicles can also be expected; in addition, a variety of HGVs will remove plant and equipment from the mine, for resale or reuse on another project and waste materials for recycling or disposal.

Traffic generation has been predicted to be 20% of that experienced during the operational phase calculations and would therefore be equivalent to 14 light and heavy goods vehicles in the peak hour.

5.12.4 Impact Significance Criteria

A critical feature of an assessment of traffic impacts is determining whether a given impact is significant. Having identified the magnitude of the impact there are various ways of interpreting whether or not this is considered significant.

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 where traffic flows will increase by 10% or more."

In considering thresholds for significance, it is important to recognise 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 (Table 5.12.8).

A key characteristic for this assessment is that for many effects there are no simple rules or formulae which define thresholds of significance within an environmental impact assessment. Whether an impact is considered significant will depend on the level of development traffic activity, the level 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, qualified by appropriate data, secondary information and expert opinion.

The methodology to make judgements has been developed with due cognisance to the thresholds set out in IEMA guidance (1993) (Ref 11-3) and (see 5), provides a summary of the attributes that have been considered in order to assess significance.

Table 5.12.8: Classification of Transport Impacts			
Criteria	**Scale**	**General definition**	**Application to transport assessment for the Project**
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 roads
Magnitude	Negligible	No noticeable change anticipated.	No net change in traffic; or the change would not be significant given the nature of the roads.
	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 impair or substantially improve quality of life.	Inability of junctions to cope with level of 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.

5.12.5 Potential Impacts

Potential impacts to the three highways links [sites 1-3] were assessed and summarised in Table 5.12.9 – Table 5.12.11. The assessment identifies the significance of the impact of traffic volumes and assumes a worst case scenario where traffic is modelled for shift changeovers. This assumption has been applied for both the construction and operational phases.

As discussed in earlier sections, the mine is existing and the only change would be the introduction of a new bypass. All mining output will be transported by road from Auezov to Shalabay and by rail from Shalabay to their ultimate destination.

The closure phase is estimated to be 20% of the intensity of the activities during the operational phase.

As such, the impact of the Base conditions, construction of the bypass stage and the operational phase of the mine will be considered:

Base Conditions

As discussed earlier, three junctions turning counts were surveyed for the purpose of collecting baseline data for the traffic impact assessment for the Kyzyl Project ESIA. Under the baseline conditions, i.e. as existing without the bypass or underground mine phases being considered, the junctions Capacity and Ratio of Flow to Capacity [RFC] were determined:

Table 5.12.9: Baseline Capacity and RFC

Link	Baseline	Baseline HGV	Baseline pcu	HGV %	Baseline Capacity	Baseline RFC
1 EB	114	51	165	44.7	904	18.3
1 WB	115	50	165	43.5	923	17.9
1 SB	107	47	154	43.9	916	16.8
2 EB	65	16	81	24.6	1206	6.7
2 WB	56	14	70	25.0	1200	5.8
2 SB	19	2	21	10.5	1417	1.5
3 EB	58	16	74	27.6	1161	6.4
3 WB	41	17	58	41.5	953	6.1
3 SB	5	1	6	20.0	1275	0.5

Bypass Construction

The following volumes are assumed to be required for the construction of the bypass:

- Aggregates and construction fill – 30,000 cubic metres assuming:
  - All materials are mined locally and used in the construction of the bypass, i.e. no imported materials;
  - Length of the bypass is 5km;
  - Width 6m;

  - Depth of constructions 1m;
  - 1.8tonnes per cubic meter;
  - Delivery by 20 tonne trucks

    This will generate a total of 5,400 trips [arrival + departure] over the construction phase (estimated to last approximately 30 weeks) = 30 trips per day [6 days week] which is estimated at 2.5 trips per hour [all locally mined]

- Staff – assume 30 staff, arriving 30 per bus = 1 bus = 2 movements per shift;
- Food delivery – assume 4 trips per day;
- Fuel delivery – assume 1 delivery per day = 2 trips;
- Miscellaneous – assume 2 trips per day
- Assuming mine output is exported daily, the Open Pit mining is estimate to require 2 vehicular trips per day throughout the life of the Open Pit mine. The underground mining will not commence until 2025. All waste products are disposed-off within the grounds of the mine or its immediate vicinity without impacting on the roads network.

Assuming staff vehicular arrival and departure will occur within one hour and coincide with other trips [food, fuel, miscellaneous and Open Pit output], at a worst case scenario, the hourly movements during the bypass construction phase would be:

- 2 staff trips [bus arrives and departs] + 2 trips food delivery + 2 fuel delivery trips + 2 miscellaneous trips + 2 trips mine output = 10 trips

Table 5.12.10: Summary of Impact on Each Link / Arm of a Site Construction Phase

Construction Phase																		
Link	**Baseline**	**Baseline HGV**	**Baseline pcu**	**HGV %**	**Baseline Capacity**	**Baseline RFC**	**Dev Bus**	**Dev HGV**	**Total Con**	**Total Con pcu**	**Network Total**	**HGV %**	**Link Cap**	**Impact**	**RFC**	**D**	**M**	**G**	**DU**
1 EB	114	51	165	44.7	904	18.3	1	3	4	8	173	46.6	876	4.8	19.8	Neutral	Low	Local	Short
1 WB	115	50	165	43.5	923	17.9	1	3	4	8	173	45.4	894	4.8	19.3	Neutral	Low	Local	Short
1 SB	107	47	154	43.9	916	16.8	1	3	4	8	162	45.9	886	5.2	18.3	Neutral	Low	Local	Short
2 EB	65	16	81	24.6	1,206	6.7	1	3	4	8	89	29.0	1,140	9.9	7.8	Neutral	Low	Local	Short
2 WB	56	14	70	25.0	1,200	5.8	1	3	4	8	78	30.0	1,125	11.4	6.9	Neutral	Low	Local	Short
2 SB	19	2	21	10.5	1,417	1.5	1	3	4	8	29	26.1	1,184	38.1	2.4	Neutral	Low	Local	Short
3 EB	58	16	74	27.6	1,161	6.4	1	3	4	8	82	32.3	1,091	10.8	7.5	Neutral	Low	Local	Short
3 WB	41	17	58	41.5	953	6.1	1	3	4	8	66	46.7	875	13.8	7.5	Neutral	Low	Local	Short
3 SB	5	1	6	20.0	1,275	0.5	1	3	4	8	14	55.6	742	133.3	1.9	Neutral	Low	Local	Short

D = Direction M = Magnitude G = Geographic Extent Du = Duration Link = arm of junction

Notes:

The Link capacity was calculated based on DMRB TA 46/97 which identifies that capacity for existing links not currently experiencing congestion can be estimated from the following relationship:

CAPACITY – [A - B * Pk%H]

Where: A = 1800 two way flows (for single lane carriageway), UAP3 [Table 2] then reduced by 225 due to high HGV %age [Table 4]

B = 15 (for single lane carriageway)

Pk%H is the percentage of heavy vehicles in the hour

Operational Phase

Assuming the maximum Open Pit and the underground mining outputs coincide, these are equivalent to 32 trips per hour [30 trips for the underground mining and 2 trips for the Open Pit]. It is further assumed that:

- Staff –maximum 82 staff per shift [49 for the Open Pit and 33 for the underground mine], arriving 30 per bus = 3 buses = 6 movements per shift;
- Food delivery – assume 4 trips per day;
- Fuel delivery – assume 1 delivery per day = 2 trips;
- Miscellaneous – assume 2 trips per day

Assuming staff vehicular arrival and departure will occur within one hour and coincide with other trips [food, fuel, miscellaneous, Open Pit and underground mine output], at a worst case scenario, the hourly movements during the bypass construction phase would be:

- 32 trips for mines output + 6 staff trips [bus arrives and departs] + 2 trips food delivery + 2 fuel delivery trips + 2 miscellaneous trips =44 trips.

Table 5.12.11: Summary of Impact on Each Link / Arm of a Site Operational Phase

Operational Phase																			
Link	Baseline	Baseline HGV	Baseline pcu	HGV %	Baseline Capacity	Baseline RFC	Dev Bus	Dev HGV	Total Op	Total OP pcu	Network Total	HGV %	Link Cap	Impact	RFC	D	M	G	DU
1 EB	114	51	165	44.7	904	18.3	3	38	41	82	247	59.4	685	49.7	36.1	Neutral	Moderate	Local	Medium
1 WB	115	50	165	43.5	923	17.9	3	38	41	82	247	58.3	700	49.7	35.3	Neutral	Moderate	Local	Medium
1 SB	107	47	154	43.9	916	16.8	3	38	41	82	236	59.5	683	53.2	34.5	Neutral	Moderate	Local	Medium
2 EB	65	16	81	24.6	1,206	6.7	3	38	41	82	163	53.8	768	101.2	21.2	Neutral	Low	Local	Medium
2 WB	56	14	70	25.0	1,200	5.8	3	38	41	82	152	56.7	724	117.1	21.0	Neutral	Moderate	Local	Medium
2 SB	19	2	21	10.5	1,417	1.5	3	38	41	82	103	71.7	500	390.5	20.6	Neutral	Moderate	Local	Medium
3 EB	58	16	74	27.6	1,161	6.4	3	38	41	82	156	57.6	711	110.8	21.9	Neutral	Moderate	Local	Medium
3 WB	41	17	58	41.5	953	6.1	3	38	41	82	140	70.7	514	414.4	27.2	Neutral	Low	Local	Medium
3 SB	5	1	6	20.0	1,275	0.5	3	38	41	82	88	91.3	205	1,366.7	42.8	Neutral	Low	Local	Medium

D = Direction M = Magnitude G = Geographic Extent Du = Duration Link = arm of junction

Explanatory Notes:

Link 1EB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the north of Auezov

Link 1SB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the west, south and east Auezov

Link 1WB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the west and north of Shalabay

Link 2WB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the north of Auezov

Link 2SB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the east, south and west Auezov

Link 3EB Moderate Impact – this is due to the fact that, although remote and highly unlikely, it was assumed all HGVs will be traveling to the west and north of Shalabay

The summary data in Table 5.12.9 – Table 5.12.11 should be considered in context;

- Generally speaking, all links of each site would remain well within their operational capacity [RFC] with the exception of link 3SB [will be discussed below].
- To create a worst case scenario for each link, it was assumed that all vehicular movements would travel on that link and that there is no directional split, i.e. all vehicles from the mine would arrive to site 1 and then all travel to the east or all travel to the west, etc. Naturally, this would not be the case be it best demonstrates that even under these assumed conditions, the junctions / links would remain within their operational capacity.
- Link 3SB requires special consideration; at present, there are only 5 vehicles using that arm [in all directions] one of which is an HGV hence, the HGV %age is 20%. During the operational phase, 38 HGVs plus 3 buses will be introduced which would result in the HGV percentage rising to 91.3%, reducing the link capacity to 205 which would in turn result in an impact of 1366.7% and an RFC of 42.8. This is simply a mathematical anomaly which is clear when all the other links are considered whereby although the Baseline flows and HGV %ages are higher yet, they are well within their RFC capacity. In this particular instance, although the mathematical impact is substantial, the Magnitude is low as the junction will in reality operate well within its capacity and not impact on any community or sensitive receptors.

5.12.6 Mitigation Measures

A number of survey and engineering related infrastructure measures are recommended to mitigate the impact of increased HGV use as a consequence of the Project. These mitigation measures may include.

- A formal review of the roads network leading to the mine access points is to be reviewed to assess the ability of HGV and low loaders to negotiate the bends and the roads network safely.
- Formal road signage and potentially speed restrictions will be implemented in order to alert general traffic to the possibility of vehicles turning into and out of the mine.
- During deliveries of oversize HGVs or convoys, other traffic can be diverted; road diversions would be signed and if necessary staffed to ensure that reasons for the diversion were communicated appropriately.

A Transport Management Plan (TMP) is recommended and should include formal arrangements to minimise and mitigate the impact on the residents of Auezov and Shalabay.

The TMP should describe the measures that the company would undertake so as to cause as little disruption, inconvenience and delay to road users, without compromising safety. The TMP should

include the details required for temporary traffic management and the period over which they will be in place. The Framework TMP is attached as Management Plan 9.

5.12.7 Mining Haulage Management

Open pit haulage flow (haulage traffic) will be managed automatically.

Dispatch, a ready-made solution by Modular, will be used for this purpose. The Dispatch system hardware consists of devices, collecting telemetry of mobile equipment, servers (main and backup) for data processing, control station and graphics consoles on the equipment. MasterLink wireless network is used for data transmission.

Dispatch software has a modular structure, which allows adding new modules to extend functionality (at extra cost).

The system has the following functions:

- fixing GPS data on the location of equipment on the open pit/mine plan; tracking travel time for each road segment and using the moving average to predict travel time in the future; calculating the best route between all points;
- tracking condition and operational cycles of equipment; estimating equipment performance on the basis of repeated operations;
- creating a complete picture of the mine haulage system, counting time of a bucket hanging in the air, truck downtimes, chronological TMPH data and other KPI of the fleet, specific equipment and operators;
- controlling volumes of loaded materials to measure the volume of mined out ore;
- maintaining records of the employees, defining regular interruptions in production, such as lunch breaks; and
- reporting.

Analysis of the mining equipment and vehicles performance allows to optimize the open pit mining.

5.12.8 Residual Impacts

The combined impact of the transport requirements of the construction phase will be Low to moderate depending on the Link. The key mitigating measures will be those which lessen the impact of transporting the construction materials, staff and equipment, and particularly the oversized loads that require access to the Project during the construction phase.

Measures to reduce the traffic impact of transporting workers off site or on shift change over and staggering deliveries will also assist with lessening the impact on the roads network

The combined residual impact of most of the transport requirements of the operational phase will be Moderate for the residents of Shalabay and in practice reducing to Low for the residents of Auezov. The key mitigating measures would be those which lessen the impact of transporting the operational workforce, materials and equipment such as staggering vehicular movements and maximising the payload of HGVs.

5.12.9 Monitoring and Audit

Table 5.12.12 outlines a monitoring and audit approach for transport at and around the Kyzyl deposit, including a recommendation for the Management Plan 9 of this report; the Traffic Management Plan.

Table 5.12.12: Monitoring and audit approach for transport

Transport		
Monitoring approach	Baseline	• A programme of traffic counts at junctions 1-3; • A programme of speed, payload road condition monitoring; • Minimising the number of trips generated by the proposed development particularly where staff movement is involved and minimising the impact of all development traffic on community, heritage and environmental receptors; • A programme of drivers / staff training, fatigue management and driver behaviour monitoring; and • Journey Management Plans.
Level 2 Management Plan	A Traffic Management Plan (TMP) is recommended to provide details of mitigation measures to control (a) impact to the highway infrastructure and (b) emissions from Project vehicles using the local and national highway network. This includes driver awareness for all company employees.	
Level 3 SOPs	Four SOPs underpin specific guidance on monitoring for maintenance of the highway network and traffic counts: • Pre-construction road survey to establish the condition of the roads within and around Auezov and Shalabay and identify those areas of the road(s) where specific improvements may be required; • Annual roads survey and traffic counts at sites 1-3 selected for baseline surveys to audit capacity of links and record any variation in road use in comparison to baseline – report back and update TMP, as necessary. • Driver awareness surveys, to update all employees on the requirements of the TMP. All new employees and contractors and annually for all staff. • Random audit of Project related traffic, routing, vehicle speed and safety, inform TMP and driver awareness surveys	

5.13 Demography, Culture, and Governance

5.13.1 Introduction

The Project's impact on demography and culture is the focus of IFC Performance Standards 1 (Assessment and Management of Environmental and Social Risks and Impacts) and 8 (Cultural Heritage) (Table 5.13.1). Taken together, these recommendations aim to preserve the most manifest elements of the existing local culture which, as a result of the social impact of the Project, may otherwise be incrementally re-evaluated, deconstructed and weakened.

Table 5.13.1: IFC Performance Standards Key Relevant Requirements

Governance, Demography and Culture
PS1 refers to the assessment and management of environmental and social risks and impacts. This standard underscores the importance of managing environmental and social performance throughout the life of a project, with the aim of promoting sound and sustainable environmental and social performance, leading to improved financial, social, and environmental outcomes.
PS8 recognises the need of cultural heritage for current and future generations. This PS aims to ensure that clients protect cultural heritage in the course of their project activities from the adverse impacts of project activities and support its preservation. In addition, the PS aims to promote equitable sharing of benefits from the use of cultural heritage. Central to PS8 is the implementation of Chance Find Procedures, whereby the client is responsible for siting and designing a project to avoid significant adverse impacts to cultural heritage.

5.13.2 Demographic and Cultural Shift

Construction and operational phases of the Project development will attract an influx of workers seeking and undertaking employment at the mine and its associated facilities. The Project will also promote the expansion of services and contractors either directly or indirectly associated with the development of the mine, such as the development of a proposed rail depot in Shalabay. These trends will reverse the demographic shift from rural to urban experienced in recent years across Zharminsky District, including in Auezov and Shalabay, which has resulted in significantly reduced populations within rural communities. Of the out-migrants from rural areas, younger people have been more likely to leave, seeking educational and professional opportunities elsewhere.

While Auezov and Shalabay populations are predicted to grow during Project construction and operation, this process will present cultural challenges; while much of urban Kazakh society has transitioned to the cultural modernity that accompanies market liberalisation and industrial development, the cultural foundations of rural settlements have been less influenced by such phenomena by virtue of their geographic isolation. In the absence of measures to manage a potential population influx, there is a risk that Project-induced in-migration could result in a high number of settlers in Zharminsky District who have little or no affiliation to the area or its people and have different cultural customs, norms and values.

To that end, Auezov settlement is ethnically diverse but remains traditional in its observance of behavioural customs and codes. As a result, since 1998 and throughout the Project's Care &

Maintenance era, the settlement has not been easily adaptive to the less traditional behavioural norms introduced by returning settlers seeking Project employment or introduced by outsiders seeking Project 'spin-off' employment.

Behavioural differences exhibited by returning or temporary settlers and a limited number of outsiders of more diverse ethnicity will increase the potential for community and familial tension, discord, and even conflict. Polymetal's local recruitment and on-site accommodation strategy will help to reduce the likelihood of imbalanced and inappropriate rapid large-scale in-migration and any significant corresponding cultural challenges to small rural communities like Auezov and Shalabay. Existing cultural stability and values are likely to be more significantly challenged.

5.13.3 Project Expenditure and Perceived Financial Inequality

Project expenditure may create tensions across the community, including most notably by raising perceived unfairness in employment opportunities and by accentuating gender or age disparities as a result of the employment of a predominantly young and male workforce. Project workers will have higher disposable income compared to other members of the community, and this may lead to more materialistic and individualistic behaviour with a reduction in general levels of perceived community and family cohesion.

To minimise the impact of perceived financial inequality, Polymetal will continue to respect and assist in the observance of local cultural customs, maintain accessible grievance mechanisms, and attend community meetings at the local Akimats, with particular emphasis on inclusion of individuals with traditionally prominent leadership roles, such as village elders, Women's Union representatives, religious leaders, and herders. In addition, procurement of goods and services, including both for the technical Project itself and for the broader workforce, will create a more balanced positive local impact, broadening the range of the Project's impact to create indirect benefits, and will continue to require close management by Polymetal.

5.13.4 Governance and Crime

From a governance perspective, changes to the cultural and social fabric of the community as a result of in-migration are typically associated with increased levels of anti-social, deviant and criminal behaviour, and manifest in phenomena like alcoholism, prostitution (associated with a rise in STDs), theft and violent assault. Recommendations relating to these phenomena are outlined in IFC Performance Standard 4 on Community Health, Safety, and Security.

Some of the adverse impacts of Project in-migration would disproportionately affect women and girls within local communities, either directly or indirectly. Polymetal's local recruitment strategy mitigates significant increases in the level of these associated behaviours and their manifest phenomena; however, incoming workers to the mine camp located on site may require an increased need for policing and security forces given the proximity of the camp to the village of Auezov.

The mine camp will be located within the Project's licence area, with a total capacity yet to be determined. Facilities at the mine camp include a canteen, bathrooms and toilets, car parking, and several social areas. At present, it is also expected that a small proportion of employees may rent properties in Auezov and Shalabay, as well as lodge shorter-term at the two hotels (Kazakhstan and California) adjacent to the Project area, which are owned by Polymetal. Locating the mine camp within the licence area helps mitigate against potential increases on the housing rental market in Auezov and Shalabay, although it is still understood that some rental accommodation will be required in these local settlements.

The location of the workers' camp, given its proximity to Auezov, will create potentially adverse impacts associated with mine workers utilising the facilities and services of the settlement. These include issues relating to pressures on access to water, food and entertainment, pressure on existing services and utilities in Auezov (including the provision of utilities and services, such as healthcare), and health and safety implications for employees and the local community. At the same time, this influx of workers will also have a positive impact in Auezov, generating beneficial local economic gains to entertainment facilities, including non-essentials shops such as toy or clothing shops, restaurants, cafés, and bars, from increased spending capacity of employees.

Influx that creates increased spending capacity can also in turn have an adverse impact, leading to jealousy and compounded by either real or perceived injustices in recruitment policy. Vulnerable households with the most limited finances are most at risk in these instances, particularly across the smaller settlements in Zharminsky District and most notably the nearest hamlets of Zhanaaul and Solnyechni.

5.13.5 Closure

IFC PS emphasise the importance of adhering to closure and post-closure mitigation measures. Specifically, PS1 (Section 4) defines the term "project" as including aspects from the early developmental stages through the entire life cycle of the project, including closure and post-closure.

In the absence of measures aimed at diversifying the local economy and the skills base of workers, they would become livelihood-dependent on the Project. This dependency will become especially entrenched in Auezov, since Shalabay offers a wider diversity of other employment opportunities. Under these circumstances, the Project's closure will catalyse out-migration from the area following the cessation of Project employment provision, as has been observed in the past when the Kyzyl mine ceased active operations and moved into Care & Maintenance. This out-migration will be even more significant than what has previously been experienced in Auezov due to the interim development of transferable skills from the mining Project and the likely decline of traditional skills and a subsistence base among a large proportion of the working population as a result of Project-derived incomes.

Cumulative impacts are unlikely but may occur associated with influences from the wider area's industry, including Shalabay LLP farm and operations at Shalabay railway station which, based on the status of these industries at that point in time, could either enhance or reduce the effects associated

with closure. The impact of increased out-migration at closure would produce pronounced consequences, including resulting in an ageing demographic profile, community fragmentation, and reduced family support. Increases in criminal and anti-social behaviour may also be experienced in the years following closure, as a result of temporal, psychological, and economic consequences of transitional unemployment. Although a closure date is yet to be determined, administrative and police authorities, with support from Polymetal, will continue to plan for the broad social impacts of closure.

5.13.6 Mitigation and Enhancement

Polymetal continue to prioritise recruitment of local workers in accordance with the company's 'Personnel Recruitment Regulation'. In addition, the mine camp facility will help to reduce deleterious growth and demographic imbalances in the settlements of Auezov, Shalabay and the wider Zharminsky District during construction and operation.

The beneficial enhancement of Auezov's demographic base, however, is contingent on the ability of the Project to attract younger returning residents to the village and to help promote the attachment of existing residents to the settlement through employment provision. This is particularly the case given that both settlements of Auezov and Shalabay, like much of rural Kazakhstan, have experienced rapid depopulation since the Soviet era. It is therefore important that Polymetal's local recruitment policy continues to be affirmative, incorporating a sufficient quota for those originating from or living in Auezov and attempts to prioritise candidates by proximity.

Polymetal's local recruitment policy continues to be disseminated by way of local media and verbally to Project stakeholders. This includes using notice boards in local settlements, including at Auezov and Shalabay Akimats, and administered through a Community liaison Officer (CLO), who works closely with Polymetal's HR department. To that end, it is recommended that the company's local recruitment intent continues to be clearly articulated using language that comprises geographical boundaries. To manage local expectations and allow prospective employees time to improve their employability, local recruitment policy should continue to comprise clear and transparent criteria and procedures made available to the local population in a timely manner, and to include realistic estimates of local employment possibilities and timeframes. To avoid social discord, it is recommended that these, whenever possible, include the overt promotion of equality of opportunity for women and senior citizens across unskilled as well as more skilled managerial, administrative and technical roles.

To help avoid cultural conflict and promote understanding, a short cultural awareness course should also be included as part of the induction programme for new non-local employees. All employees should also be issued with 'Codes of Conduct' addressing company expectations with regard to employee behaviour when interacting with local residents. Disciplinary measures should be imposed should these not be met. The community grievance process currently being implemented and developed by Polymetal will complement this process and help address concerns arising from the community in relation to the Project. The employee Code of Conduct will include the following aspects:

- it will adhere to all applicable Kazakh legislations;
- Polymetal will operate a zero tolerance of employees being under the influence of or consuming or selling drugs and alcohol whilst at work;
- employment conditions will be free from discrimination as outlined in under the ILO; and
- human rights will be protected, both of employees and the local communities, under the United Nations Guiding Principles.

The aforementioned company strategies and mitigation measures will help to enhance community demographics, maintain community cohesion, and keep criminal and anti-social activity minimal. Nevertheless, Project dynamics will unavoidably elevate anti-social and deviant activity. Therefore, Polymetal should continue to work with district and rural authorities to agree a complementary strategy for addressing these issues and for the authorities, as beneficiaries of Project tax revenue, to strengthen the capacity of existing legal justice and enforcement bodies.

With these mitigation measures complementing and extending existing company policies and design measures, the demographic impact of the Project during the construction and operation phases will be positive, encouraging the retention of existing community members and the return of former community members. The influx of non-local workers will be moderated and largely limited to those seeking 'spin off' employment opportunities that are typically less likely to cause competitive resentment over job opportunities and more likely to be accompanied by familial or clan affiliated relations that facilitate cultural and social integration. Although the Project will also require a range of more skilled and specialist mine managers and workers, a proportion of whom will reside in but not originate from the locality, these employees will be accommodated at site for the duration of their working stays.

In the same way that the Project's recruitment and mine design accommodation strategies and measures will help to reduce any significant deleterious increase and imbalance on the existing local population base during operation, they will also help to reduce any negative or rapid reduction or imbalance to the local population base following decommissioning and closure. However, this will be dependent on the implementation of beneficial economic and livelihood related closure mitigation, with enhancement mitigation measures and strategies outlined later in further socio-economic impact assessment sections.

Recruitment of personnel and contractors from outside the local area requires Polymetal to provide accommodation of a suitable standard that meets the IFC PS accommodation criteria[1], including implementing the following considerations and mitigation measures:

[1] Workers' accommodation|: processes and standards: A guidance note by IFC and EBRD (2009)

- Provision of mine workers' accommodation that considers the availability of workforce locally and the availability of existing housing and subsequent monitoring of impacts on the local rental market – including availability and cost of housing;
- Provision of accommodation services in a manner consistent with the principles of non-discrimination and equal opportunities; and
- Provision of workers accommodation that does not restrict workers' freedom of movement or association.

5.13.7 Summary of Impacts: Demography, Culture, and Governance

To adequately enable socio-economic impacts to be determined, the calculation outlined in the impact methodology section (Section 5.2) factors in both the magnitude of impact (duration of impact and scope of impact) which for socio-economic impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity and communities and considers whether vulnerable people are affected).

The summary of impacts can be found in Table 5.13.2 below, which shows that, using this methodology, no significant adverse impacts are expected as a result of employment, population fluctuations, social issues, or the accentuation of gender and generational disparities. Post-mitigation, only retrenchment effects as a result of closure are predicted to have a moderate negative impacton local communities.

Table 5.13.2: Impact Assessment, Summary of Key Impacts – Demography, Culture and Governance

Project phase	Sub-category	Direction	Scope	Duration	Impact (prior to mitigation)	Impact (post mitigation)
Construction	Direct employment	Positive	Local, Regional	Medium-term	Low (positive)	Moderate (positive)
Construction	Indirect employment and procurement	Positive	National	Medium-term	Low (positive)	Moderate (positive)
Operation	Direct employment and procurement	Positive	National	Long-term	Moderate (positive)	High (positive)
Operation	Indirect employment and procurement	Positive	National	Long-term	Moderate (positive)	High (positive)
Construction and Operation	Influx and movement of population	Negative	Local, Regional	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Influx – increased spending leading to salary disparities, reduced social cohesion	Negative	Local, Regional	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Influx – increased spending	Positive	Local, Regional	Long-term	Low (negative)	Low (negative)
Construction and Operation	Social Issues	Negative	Local, Regional	Long-term	Moderate (negative)	Low (negative)
Construction, Operation and Closure	Influences on local culture	Negative	Local	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Accentuation of gender and generational disparities	Negative	Local, Regional	Long-term	Moderate (negative)	Negligible (negative)
Closure	Retrenchment	Negative	Local, Regional	Long-term	High (negative)	Moderate (negative)

5.14 Social Infrastructure

5.14.1 Introduction

The Project's impact on social infrastructure, health and education is the focus of IFC Performance Standards 1 (Assessment and Management of Environmental and Social Risks and Impacts) and 4 (Community Health, Safety, and Security) (Table 5.14.1). A key factor within this section is stakeholder engagement which, according to the IFC, is the basis for building strong, constructive and responsive relationships that are essential for the successful management of the Project's environmental and social impacts. A full Stakeholder Engagement Plan can be found in Management Plan 10.

The anticipated population growth in Auezov and Shalabay as a result of the in-migration of people seeking and undertaking employment at the Project or at enterprises to meet the Project's demand will increase the burden on the settlement's social infrastructure. In the absence of Project or local authority actions to enhance existing infrastructure, key aspects of the social infrastructure – including the reliable supply of domestic electricity, availability of healthcare and heating fuels, and the sanitary condition of water supplies and waste facilities – may be compromised.

Table 5.14.1: IFC Performance Standards Key Relevant Requirements

Social infrastructure
PS1 refers to the assessment and management of environmental and social risks and impacts. This standard underscores the importance of managing environmental and social performance throughout the life of a project, with the aim of promoting sound and sustainable environmental and social performance, leading to improved financial, social, and environmental outcomes.
PS4 on Community, Health, Safety, and Security recognises that Project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main objectives are, a) to anticipate and avoid adverse impacts on the health and safety of Affected Communities during Project life from both routine and non-routine circumstances, and, b) to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.

5.14.2 Social Infrastructure

Construction and operational phases of the Project will attract an influx of workers and those indirectly benefitting from the economic consequences of the Project's activity. The result of population increases is additional pressure on social infrastructure in Auezov and Shalabay municipalities, including at healthcare centres and schools. Shops and other local businesses will also be affected, for the most part benefitting from increased business opportunities.

The local healthcare centres in Auezov and Shalabay will experience increases in patient numbers for both longer-term and emergency treatment. As a result, these facilities may need to hire additional staff both locally and from elsewhere, if the desired professional qualifications are not available locally. Healthcare centres will also need improved equipment and provisions of medicines from regional providers, many of whom are based in Charsk.

Schools will also experience greater volumes of students, as they did during the Project's last operational phase in the years preceding 1998. During peak years, both Auezov and Shalabay schools doubled their capacity by accommodating two daily shifts of students running identical curricula. Facilities today are better than they were during those years and heads of schools are confident that their institutions would benefit from greater pupil numbers.

Administrative and entertainment facilities will also come under increased pressure as a result of a Project-driven population influx. For example, Auezov Akimat may require additional staff to process the administration required of a larger population in the settlement. At the same time, state-owned entertainment facilities, such as Auezov library, should expect more visitors and increased pressure on a wider array of books and periodicals.

Most of the roads in and around Auezov are gravel tracks or unpaved roads, and the road quality is generally poor. The main access road to Auezov from the east is also unpaved. The exception is the main access route into Auezov from the west, which is paved but in need of maintenance. Traffic volumes along these roads are presently low.

As the construction and operational phases begin, increased heavy goods vehicle traffic is expected to travel into Auezov towards the mining infrastructure. This traffic will originate from the railway stations at Charsk and Shalabay, where most of the goods and materials deliveries for the project will be dispatched. Increased traffic flows in to the settlement may generate increased noise levels and fugitive dust emissions along unpaved routes.

5.14.3 Closure

The public highway haulage requirements during the construction and operation of the Project will decline and disappear during Project closure, but so too will the operator's road maintenance regimes. Assuming that the local authority does not take over extended road maintenance and snow and ice clearance during the winter months, Project closure will revert community road users back to pre-Project transport conditions and negatively impact their access local business opportunities, social and familial networks, markets, medical supplies, education services and foodstuffs. Given that construction and operational traffic pose a relatively higher road accident risk to community road users than current risks without the Project, the cessation of the mining Project will reduce the accident risk to road users. The risk will not, however, be reduced to pre-project levels, because Project income generation will have increased the level of private vehicle ownership locally, even allowing for post-Project out-migration.

Out-migration following Project closure will, however, reduce the burden on community health services and administrative units to pre-project levels. The health impacts associated with closure of any major productive health unit can be serious and have been well documented by medics and behavioural scientists.

5.14.4 Mitigation and Enhancement

Polymetal continues to collaborate with local authorities to provide significant enhancements to the social infrastructure in order to mitigate potential Project-related impacts. Polymetal also have medical facilities at the mine site and provide basic and emergency healthcare programmes for mine employees, including villagers. This includes a general health assessment at the commencement of employment and regularly thereafter. This service will help to offset some of the increased burden on the already limited and basic healthcare provision at Auezov, although the use of Project medical facilities is limited to Project employees. This will not impact the basic healthcare provision at Shalabay, and should have a limited effect on health care provision in Auezov.

Much of the social and physical infrastructure of Auezov is poorly developed and in need of investment, repair, enhancement and maintenance. The facilities are not adequate for the anticipated increase in the population of the Project communities during mine construction and operation. Regional and local governments will receive the direct financial benefits from taxation and indirect local taxes from in-migration. Polymetal will liaise with the regional and local authorities and community stakeholders and to take measures to ensure that the regional and local authorities execute their obligations accordingly by utilising a significant proportion of the tax revenues from the Project for investment in the maintenance and enhancement of local social infrastructure.

Procedures might be defined to follow the precedent set during the 1990s, when Auezov healthcare centre possessed a stomach scanner and other more complex medical equipment, transferred away from the community due to net out-migration to Charsk and Kalbatau hospitals after operations ceased at the mine. In addition, during the Project's operational periods, schools in Auezov and Shalabay adopted daily double shift patterns, where they were able to double the number of students in attendance.

Notwithstanding the above, Polymetal will continue to help maintain and improve community relations by identifying and implementing low-cost avenues to enable Project community members to benefit from the transport, power, water supply and other technical requirements required for Project development and operation.

In the interest of managing local expectations and ensuring financial transparency, it is recommended that Polymetal becomes an active participant in the Extractive Industries Transparency Initiative (EITI), which was established in Kazakhstan as a mechanism for publicly disclosing extractive company payments to government. The initiative is primarily aimed at combating corruption, but importantly it also helps to manage stakeholder expectations because once aware of the Project's financial contribution to government, they shift the focus of their expectations and demands from the Project to the recipient authorities.

Given the distance of the Project from the nearest larger community settlement, the risk to community safety of a major mining accident remains low. Nevertheless, the potential for major accidents from mining operations are difficult to exhaustively or accurately assess, being contingent

on a multitude of variables. It is therefore prudent for the operator to apply the precautionary principle in planning for community safety by undertaking a community risk assessment and by involving the community when developing and implementing an Emergency Preparedness and Response Plan appropriate to its findings [2].

To safeguard the physical safety of Project community members it will be necessary to carefully monitor road traffic accident rates across the Auezov and Shalabay municipalities and across Zharminsky District as a whole, and to introduce comprehensive traffic safety controls, including: driver safety guidelines, vehicle speed limits, and pedestrian and livestock crossings near site access points. These controls should be based on, and extend to, the recommendations of a Traffic Management Plan which Polymetal continues to develop based on the findings of the traffic assessment. Road safety and community access will be further improved if the Project road works include snow and ice clearance in winter and maintenance regimes that are sufficient to offset Project traffic road degradation.

Project closure will result in the retrenchment of a large number of employees. To reduce the impact of mine closure, Polymetal will develop a retrenchment plan prior to the project closing. This plan will be aimed at diversifying the transferable skills of employees to enable them to more easily seek alternate employment options. At closure it is important that retrenched workers and their families receive some psychological support to cope with the stresses of unemployment or transitional employment and the negative reactions that can result. This should form an integral part of a retrenchment plan. The operator should utilise the resources of a non-government organisation specifically trained in this capacity to make counselling available to affected persons. It is further suggested that outreach services are available to retrenched workers who were not recruited locally or who are reluctant to approach agencies themselves for assistance. The retrenchment plan must also outline support for providing retraining programmes for the redundant workforce and will consider the retrenchment of contractors.

5.14.5 Summary of Impacts: Social Infrastructure, Health and Education

To adequately enable socio-economic impacts to be determined, the calculation outlined in the impact methodology section (Section 5.2) factors in both the magnitude of impact (duration of impact and scope of impact) which for socio-economic impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity and communities and considers whether vulnerable people are affected).

The summary of impacts can be found in Table 5.14.2 below, which shows that, using this methodology, no significant adverse impacts are expected as a result of inadequacies in social or physical infrastructure. Post-mitigation, only road accidents as a result of increased traffic as well as

[2] This is in line with recognised best practice community health and safety requirements, including those outlined in the IFC's (2006) *Performance Standards on Social and Environmental Sustainability*

socially related health issues, such as the possible presence of STDs, are predicted to have a moderate negative impact on local communities.

Table 5.14.2: Impact Assessment, Summary of Key Impacts – Social and Physical Infrastructure, Health and Education

Project phase	Sub-category	Direction	Scope	Duration	Impact (prior to mitigation)	Impact (post mitigation)
Construction and Operation	Increased Traffic – wear and tear on the roads	Negative	Local - Regional	Long-term	High (negative)	Low (negative)
Construction and Operation	Increased Traffic – road traffic accidents	Negative	Local - Regional	Long-term	High (negative)	Moderate (negative)
Construction and Operation	Pressure on physical infrastructure in Auezov village associated with return migration	Negative	Local	Long-term	Low (negative)	Negligible
Construction and Operation	Social Issues – increased prevalence of STDs	Negative	Local - Regional	Long-term	High (negative)	Moderate (negative)
Construction and Operation	Social Issues – increased alcohol related conditions and social maladies	Negative	Local - Regional	Long-term	Moderate (negative)	Low (negative)
Closure	Traffic	Negative	Local - Regional	Medium-Long-term	Moderate (negative)	Low (negative)

5.15 Economy, Livelihoods and Labour

5.15.1 Introduction

The Project's impact on economy, livelihoods and labour is the focus of IFC Performance Standards 1 and 2 (Labour and Working Conditions), which aim to identify risks and impacts of the Project on the local and regional economy and livelihoods, as well as to promote the fair treatment, non-discrimination, and equal opportunity of the Project's workers (Table 5.15.1).

All settlements in Zharminsky District have a decree of livelihood insecurity, including underemployment, seasonal employment, and the insecurities accompanying subsistence-based provision. Agricultural employment conditions and seasonal employment are also prevalent across the wider East Kazakhstan Oblast, with the exception of Ust-Kamenogorsk and Semey cities. On this basis, Polymetal's official policy[3] favouring local employment during Project construction and operation is likely to have a positive demographic impact across the district and wider region.

Table 5.15.1: IFC Performance Standards Key Relevant Requirements

Economy, Livelihoods and Labour
PS1 refers to the assessment and management of environmental and social risks and impacts. This standard underscores the importance of managing environmental and social performance throughout the life of a project, with the aim of promoting sound and sustainable environmental and social performance, leading to improved financial, social, and environmental outcomes.
PS2 on Labour and Working Conditions recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. Its main objectives are, a) to promote the fair treatment, non-discrimination, and equal opportunity of workers; b) to establish, maintain, and improve worker-management relationship; c) to promote compliance with national employment and labour laws; d) to protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain; e) to promote safe and healthy working conditions, and the health of workers; f) to avoid the use of forced labour.

5.15.2 Economy

The construction phase of the Project will have a positive impact on the national economy through payments of value added tax (12%) on construction supplies, including: materials and equipment, fuel, food stuffs, and advisory services and through construction workforce income tax contributions and capital payments for mining land rights and other mine licensing rights. During construction and operation, the project will have positive macroeconomic benefits, including to the regional and local economy will benefit from the Project, employee and contractor expenditures.

Project operation will positively impact the national economy through the payment of a minerals extraction tax (5%) and corporate income tax (15%), in addition to value added taxes (12%) on operation supplies, including: materials and equipment, fuels and reagents, food stuffs, advisory

[3] As outlined in Polymetal's "Personnel Recruitment Regulation" (2015)

services, and international import duties. All payments are calculated in accordance with the articles 495 of the Kazakh Tax Code that lists all rates of the charge. The Kazakh Environmental Code defines the taxation rates imposed on projects that use natural resources and payment for emissions, discharges and pollutants. Polymetal continues to ensure that a majority of these taxes will be paid to the district government. The national economy will also benefit from workforce income tax contributions as well as economic stimulus by sourcing industrial supplies from within Kazakhstan. The most immediate local economic benefits will stem from Project, employee and contractor expenditures.

5.15.3 Land Use

When Polymetal took ownership of the Bakyrchik Mining Venture, approximately 370ha of land were classified for industrial use. Land category reclassification through development of the Kyzyl project means that, at present, approximately 1100ha of additional land that was previously unclassified ("state land") has been converted to industrial use land. The project has not changed the official land use for any land currently designated as agricultural.

Almost all of the land surrounding Auezov is state-owned communal grazing land, which is abundant in relation to community livestock populations and densities. The development of the project will lead to loss of land; some for the duration of the project and even after mine closure and remediation.

Another impact of the Project will be intensified land use pressure on the projected TSF facility area to the south-east of Auezov village, which is currently used by local people and herders to graze their animals. However, Polymetal's current plans indicate that the areas to be fenced off around the future TSF facility and processing plant will maintain a broad enough corridor of land between the fence and the hamlet of Solnyechni to allow for herders to graze their animals. The land in question is also used by local people for collecting berries.

The key areas identified in the household survey for foraging appear to be in the countryside to all directions from Auezov village, including to the north far enough to be accessed only by car and to the south as far as the railway tracks. Hunting activities are currently undertaken on an ad hoc basis on land around local communities by a limited number of local people, including those from Zhanaaul hamlet. Local people confirmed that they fish as part of a leisure past time, in numerous small lakes around Zharminsky District as well as local rivers. It was reported by some villagers that fish counts in many of the local lakes have dropped in recent years, it is assumed by locals because of illegal fishing with nets.

5.15.4 Livelihoods

Economic displacement from changes to land access and imposed restrictions from land take directly affect local agriculture. Land take for the project has amounted to 816 ha, incorporating both the privately owned land from the commercial farms and the state owned land. Land take will have a permanent effect on some land users, including construction and mining, leading to irretrievable loss

of grazing land, in particular in the area designated for the TSF facility and processing plant. Loss of grazing land can affect the current and future income from the use of pastures, which may also affect the employment opportunities of the population (the shepherds and herders).

Some of the 25 households displaced as a result of the Project will experience a livelihood shift as a result of moving from their homes to apartments either in Auezov or elsewhere. Such a shift occurs when residents move from a self-sufficiency lifestyle, customary of those owning a vegetable garden and livestock, to an urban livelihood characterised by living in an apartment without a garden or the facilities for keeping livestock.

Apart from the land which will house the TSF facility and processing plant land as well as the physical household displacements, impacts on other land users by the Project are minimal. The licence area itself was not identified by surveys as being a foraging area; foraging and hunting activities take place around Auezov in all directions from the deposit. In addition, the site is located far away from any identified hunting sectors. Apart from the fenced-off areas directly adjacent to the open pits and the TSF storage facility and processing plant, the proposed development will therefore not impact livelihoods relating to foraging or hunting activities undertaken at present. Grazing of local animals from Auezov and Shalabay was reported to be mainly undertaken in the direct vicinity of the villages, in particular to the south of Auezov and around Shalabay, on land owned by respective Akimats.

5.15.5 Labour and Working Conditions

Until recently many of the positions created by Polymetal have been managerial and largely based in the Kyzyl site office. The aim, however, is to rapidly increase employee numbers when the site becomes operational (Table 5.15.2 and Table 5.15.3). The number of people employed during the life of the Project will vary, depending on the phase of the Project. The first phase will employ 1,025 and the second phase will employ 1,617 workers. Mining and processing activities are designed to operate 24 hours per day, all year round except for planned maintenance shutdowns and Christmas day. In addition, project construction will generate short-term employment for those associated with haulage and the preparation of the waste rock dumps and ore stockpiles, tailings facility, open pit, fuel storage area, workshop, mine offices, accommodation facilities, and power, water and sewerage facilities.

The Project is also likely to promote closer connections between the regional and local economy, thus creating an enabling environment for the development of other local businesses generating indirect employment. There is evidence to show that it is reasonable to conservatively assume a three-fold employment multiplier[4] for mining Projects of this scale in a developing country context, which would result in indirect operational employment generation for over 2000 people in total. In an area with relatively high unofficial unemployment figures and reliance on seasonal jobs, widespread dependency on subsistence provision, and limited salaried employment opportunities, the Project's direct and indirect employment opportunities represent a positive development for beneficiaries and

[4] Macfarlane, M (2000) '*Comparative Evaluation of Socio-economic Impact Assessment in the Mining Sector*' PhD Thesis. University of Bath.

their families. For these people, incomes will be raised, poverty alleviated and self-esteem enhanced. The multiplier for operational mining activities is higher than that for construction (1.32 compared to 1.29). This means that for each unit of contribution to GDP there will be an additional 0.32 units of positive impact through indirect opportunities. A breakdown of employee numbers for the closure period has not yet been confirmed, though this number is generally around 10% of the full work force.

The importance of addressing any such impediments to local employment is reinforced by the fact that in addition to providing salaried work, Project employment can also provide Auezov residents with the opportunity to up-skill and move away from seasonal job opportunities that create fluctuations in income and vulnerabilities. Planned training will provide all mine workers with a standard health and safety course as well as more specialised courses in: bulldozing, excavating, drilling, heavy vehicle driving, process plant working and open pit working. Polymetal should continue to support community members in training relevant to undertaking Project work. This training, and the subsequent experience of working at the Project, will increase the transferable skill base and future income generating prospects of community members selected for employment.

Project employment positions available to local residents will largely be of an unskilled or semi-skilled nature and the salaries will be comparable to industry averages. This level will still be considerably higher than their current incomes, salaries or subsistence level equivalent received for livestock farming by the majority of the working population locally. In addition, in the absence of mitigation, however, mine salaries could fail to be reinvested or utilised for the sustained development of the community as a whole, and further economically and socially marginalise more vulnerable community members who are unable to directly or indirectly benefit from the Project. Through providing financial advice to employees and by ensuring salary payments are not made in cash, Polymetal can continue to minimise the effects of these phenomena.

Table 5.15.2: Total Manpower Requirement for the First Operational Phase - Bakyrchik Project (Open Pit Mining)

Manpower	Shift		Daily	
	male	female	male	female
Open pit				
Engineers and technicians	22	-	24	-
Workers	61	-	92	-
Total	83	-	116	-
Process plant				
Engineers and technicians	10	2	11	3
Workers	26	8	45	16
Total	36	10	56	19
Assay laboratory				
Engineers and technicians	1	1	1	1
Workers	1	5	2	10
Total	2	6	3	11
QA/QC				
Engineers and technicians	1	2	1	4
Workers	-	6	-	12
Total	1	8	1	16
Metallurgical laboratory				
Engineers and technicians	1	4	1	4
Workers	1	5	1	5
Total	2	9	2	9
MSR department				
Engineers and technicians	3	-	3	-
Workers	10	-	10	-
Total	13	-	13	-
Sample preparation area				
Engineers and technicians	1	-	1	-
Workers	1	1	2	2
Total	2	1	3	2
Ore preparation facility				
Engineers and technicians	1	-	1	-
Workers	4	-	6	-
Total	5	-	7	-
Concentrate containerization area				
Workers	4	-	8	-
Total	4	-	8	-
Repair and storage facilities				
Engineers and technicians	8	-	10	-
Workers	41	-	68	-
Total	49	-	78	-
Utility network services + coal-fired boiler house				
Engineers and technicians	2	-	2	-
Workers	5	-	11	-
Total	7	-	13	-
Power network services				
Engineers and technicians	7	-	9	-
Workers	12	-	18	-

Table 5.15.2: Total Manpower Requirement for the First Operational Phase - Bakyrchik Project (Open Pit Mining)

Manpower	Shift		Daily	
	male	female	male	female
Total	19	-	27	-
Tailings storage facility				
Engineers and technicians	2	-	3	-
Workers	3	-	7	-
Total	5	-	10	-
Transport station				
	Main vehicle fleet			
Drivers	36	-	72	-
	Administrative vehicle fleet			
Drivers	27	-	32	-
	Auxiliary vehicle fleet			
Drivers	10	-	20	-
Total	73	-	124	-
Housekeeping personnel				
Total	9	17	15	19
Office and management personnel				
Total	42	14	42	14
Total	352	65	518	90
	417		608	

Table 5.15.3: Manpower Requirement for the Second Bakyrchik Project Operation Phase (Underground Mining of Under-Pit Reserves)

Manpower	Shift		Daily	
	male	female	male	female
Mine (with a lamp room)				
Engineers and technicians	57	-	105	-
Workers	181	-	543	-
Engineers and technicians	238	-	648	-
Process plant				
Engineers and technicians	10	2	11	3
Workers	26	8	45	16
Engineers and technicians	36	10	56	19
Assay laboratory				
Engineers and technicians	1	1	1	1
Workers	1	5	2	10
Engineers and technicians	2	6	3	11
QA/QC				
Engineers and technicians	1	2	1	4
Workers	-	6	-	12
Engineers and technicians	1	8	1	16
Metallurgical laboratory				
Engineers and technicians	1	4	1	4
Workers	1	5	1	5
Engineers and technicians	2	9	2	9
MSR department				
Engineers and technicians	3	-	3	-
Workers	10	-	10	-
Engineers and technicians	13	-	13	-
Sample preparation area				
Engineers and technicians	1	-	1	-
Workers	1	1	2	2
Engineers and technicians	2	1	3	2
Ore preparation facility				
Engineers and technicians	1	-	1	-
Workers	4	-	6	-
Engineers and technicians	5	-	7	-
Concentrate containerization area				
Workers	4	-	8	-
Total	4	-	8	-
Backfill plant, hoisting machinery				
Workers	7	2	16	4
Total	7	2	16	4
Repair and storage facilities				
Engineers and technicians	6	-	7	-
Workers	31	-	51	-
Engineers and technicians	37	-	58	-
Utility network services + coal-fired boiler house				
Engineers and technicians	5	-	5	-
Workers	13	-	35	-
Engineers and technicians	18	-	40	-

Table 5.15.3: Manpower Requirement for the Second Bakyrchik Project Operation Phase (Underground Mining of Under-Pit Reserves)

Manpower	Shift		Daily	
	male	female	male	female
Power network services				
Engineers and technicians	7	-	9	-
Workers	12	-	18	-
Engineers and technicians	19	-	27	-
Tailings storage facility				
Engineers and technicians	2	-	3	-
Workers	3	-	7	-
Engineers and technicians	5	-	10	-
Transport station				
	Main vehicle fleet			
Drivers	7	-	14	-
	Administrative vehicle fleet			
Drivers	13	-	15	-
	Auxiliary vehicle fleet			
Drivers	6	-	12	-
Total	26	-	41	-
Housekeeping personnel				
Total	9	17	15	19
Office and management personnel				
Total	42	14	42	14
Total	466	67	990	94
	533		1084	

5.15.6 Closure

At the end of the mine's life, Polymetal can apply for formal land changes and reclassification of industrial land back to agricultural status. A full mine closure and reclamation plan can be found in Management Plan 5.

Following closure, nearly every Project employee and many 'spin-off' employees will at the very least experience a transitional period of unemployment or loss of secured income. The local significance of this impact in the rural district will be determined by the degree to which the economy of Auezov has once again become dependent on the mining Project in the interim, or been able to develop businesses and capabilities that can provide alternative employment independent of the Project. The adjacent village of Shalabay is less dependent on mining operations as a result of the presence of Shalabay LLP farm and the railway company, so Shalabay residents will be less likely to be impacted by mine closure. The effect of closure will also depend on the degree to which the community and households in the interim have transitioned from a culture emphasising collective mutual support to a culture emphasising individualist values.

Project closure will unavoidably negatively impact the national, regional and local economy through the loss of minerals extraction tax payments, in addition to corporation taxes, and value added taxes

on purchases, sales, and international goods and service provision. The national economy will also lose the benefit of workforce income tax contributions and the receipt of land tax. Finally, and of greatest significance to the local economy, there will be the loss of Project and employee expenditures at local businesses.

5.15.7 Mitigation and Enhancement

Community members perceive the employment of local people as the most positive potential impact of the mining Project. This in itself creates a social challenge, whereby local employment is pivotal to the goodwill currently exhibited towards the Project and the willingness of residents to accept some of the perceived negative impacts of the Project.

The Project's 'social licence to operate' (SLO) is contingent on maintaining public goodwill and by ensuring inclusivity of this important stakeholder group. Maintaining the SLO would ensure that potential livelihood benefits of Project development are maximised as equitably as possible within the Project affected communities. This is essential as principally it is the affected communities that will suffer the consequences of any accidental or unavoidable adverse Project impacts.

The SLO may be compromised if public expectations are not fulfilled or mitigated. It is therefore incumbent on Polymetal to continue to ensure that their local employment commitments are communicated and fulfilled as extensively as possible. Nevertheless, the geographical scope of Polymetal's local recruitment strategy should remain relatively broad, prioritising the Auezov municipality but also including Shalabay municipality, followed by the wider Zharminsky district, East Kazakhstan Oblast, and then employment of Kazakh nationals. Prioritising recruitment from Zharminsky District will help Polymetal gain and maintain their SLO.

To manage local expectations and allow prospective employees preparatory time to improve their employment prospects, it is important that Polymetal's recruitment policy continues to be clearly worded and transparent in its criteria and procedures. It is recommended that the policy and related items should be made available to the local population in a timely manner and include a realistic estimate of recruitment timeframes and the employment requirement within Zharminsky District. To avoid social discord and economic marginalisation, these procedures need to include the promotion of equality of opportunity for women across unskilled roles as well as more skilled managerial, administrative, and technical roles. These latter, more technical roles, may involve wider spatial recruitment.

To reduce the impact of economic marginalisation, Polymetal should ensure that its recruitment process is open to all people locally of working age and ability, including women and people with disabilities. The process should be based on appointment by merit rather than by any political, clan, or class affiliation but should be affirmative with regard to promoting opportunities and training to the less advantaged and meeting local content. Articulation of the new recruitment policy and process will therefore need to be very carefully crafted. To maintain community trust and confidence, this

policy should be developed and fully disclosed forthwith, with its implementation then monitored by an independent third party.

To further enhance the positive impact of either direct or indirect Project investment or expenditure in the local economy, Polymetal, in partnership with the local authority, should facilitate the development of a community business and training forum. Establishing an appropriate training programme will be informed through Polymetal undertaking a prior assessment of the skills of local people. This will provide community members, in a position to take advantage of economic opportunities associated with the Project, with basic business and financial management knowledge and skills, as well as ideas for mine linkage development.

Whilst Polymetal are actively engaging with local people regarding the overall development of the Project, many local residents remain unaware of important project details. Some have not previously engaged with Polymetal, often by choice as a result of apathy, a lack of time, or a lack of transportation facilities. On this basis, Polymetal need to continue proactive community engagement actions, including undertaking more informal consultation sessions with local people. These sessions should include informing residents of the Project's wider economic contribution, the financial risks of investment in Projects of this nature, and the uncertainties and constraints of the market in which the Project will operate. In this way, community members will have a wider appreciation for the complexities surrounding the operation; such transparency will also mitigate what are unrealistically high expectations of forthcoming employment and positive financial gains among the local community. In terms of maintaining transparency, to achieve compliance with international standards it is recommended that Polymetal adheres to the recommendations of IFC requirements and the Extractive Industries Transparency Initiative (EITI), which was established in Kazakhstan as a mechanism for publicly disclosing extractive company payments to government.

IFC PS 5 states the need to consider both formal and informal land users and affected persons and this approach will continue to drive Polymetal's approach to managing its livelihood monitoring programmes, in particular in monitoring local agricultural and herder activities to ensure that the Project's development does not adversely impact local agricultural production or grazing opportunities for livestock, as well as those employed in agricultural jobs or as herders. The availability of state-owned grazing land for local people from Auezov, coupled with the fact that the majority of the grazing was identified as being directly around Auezov village, negates the need to consider finding additional land due to the construction of the TSF tailings facility and processing plant. Nevertheless, in order to maintain strong links with local herders and related officials, as well as to keep abreast of relevant social developments, Polymetal should attend the annual springtime herder meetings in 2016 hosted by Shalabay and Auezov Akimats. This attendance would provide an opportunity for consultation/communication between the Project and herders in the area. The purpose of attending such a meeting would be to ensure that the Project is aware of the herder locations, as designated by the Akimat, and that the herders are aware of the areas of land that will no longer be available for summer pastures as a consequence of Project development. Attendance at this meeting is a voluntary commitment but has been recommended as best practice and provides a good opportunity for the Project Manager to listen to and respond to feedback from the herder community. Once the mine

infrastructure has been established there are no ongoing recommendations to attend the herder meetings, as the annual grazing requirements will adapt to the use of remaining pastures. No immediate action or mitigation is necessary regarding the households displaced by the Project, as these were sold on a voluntary basis.

Local land taxes are paid to the Akimat in Auezov. Local land taxes will be one of the most important sources of revenue for the local administration (particularly for the Auezov municipality, Zharminsky District, and East Kazakhstan Oblast). Support should be provided to help receivers of the local land taxes manage their increase in budget. This will help ensure that the money is well managed to ensure longer term investment in the local communities. This support should include the appropriate financial advice covering aspects such as financial accountability and transparency to the local community and other Akimat's and budgeting. Local communities, like Auezov or Shalabay municipalities, who will receive community development budgets, should also receive investment advice to help them achieve long term changes through projects. Community development projects should be selected in a fair and equitable manner, considering the views and needs of the wider community. Decisions should therefore be made using inclusive consultation methods.

It is highly unlikely that inflationary pressure on the local economy could develop, particularly relating to the rental market in Auezov. Nearly all houses in Auezov and Shalabay are owner-occupied, so a local rental market is almost entirely absent. As outlined above, by ensuring a high level of local recruitment takes place, through Polymetal implementing an effective local recruitment policy, impacts can be reduced.

Shalabay and Auezov municipalities support a diverse range of small commercial and subsistence farming activities. The Shalabay LLP farm is also an important entrepreneur-driven local business, which employs 150 workers and reports that it is looking to expand by up to double that in the next five years.

Kazakhstan has ratified a number of International Labour Organisation (ILO) Conventions that will be adhered throughout the lifespan of the Project. These are outlined in Table 5.15.4 below.

Table 5.15.4: Relevant Kazakh International Labour Organisation Conventions			
Convention No	**Name**	**Date**	**Status**
Fundamental			
C029	Forced Labour	18/5/01	In Force
C087	Freedom of Association and Protection of Right to Organise	13/12/00	In Force
C098	Right to Organise and Collective Bargaining	18/05/01	In Force
C100	Equal Remuneration Convention	18/05/01	In Force
C105	Abolition of Forced Labour	18/05/01	In Force
C111	Discrimination (employment and occupation)	06/12/99	In Force
C138	Minimum Age	18/05/01	In Force
C182	Worst Forms of Child Labour	26/02/03	In Force
Governance (priority)			
C081	Labour and Inspection	06/07/01	In Force
C122	Employment Policy	06/12/99	In Force
C144	Tripartite Consultation	13/12/00	In Force
Technical			
C026	Minimum Wage-Fixing Machinery	05/03/15	In Force from 05/03/16
C088	Employment Service	10/05/01	In Force
C095	Protection of Wages	03/02/15	In Force from 05/03/16
C135	Workers Representatives	13/12/00	In Force
C148	Working Environment (air pollution, noise and vibration)	30/07/96	In Force
C155	Occupational Safety and Health	30/07/96	In Force
C156	Workers with Family Responsibilities	17/01/13	In Force
C162	Asbestos	05/04/11	In Force
C167	Safety and Health in Construction	18/06/08	In Force
C183	Maternity Protection	13/06/12	In Force
C187	Promotional Framework for Occupational Safety and Health	03/02/15	In Force from 05/03/16

In addition, it is recommended that the Project employs workers whilst recognising the principles enshrined in the following additional UN conventions that Kazakhstan has ratified:

- Convention on the Elimination of All Forms of Discrimination against Women (ratified 1998, sets out an agenda to end discrimination against women). The project will employ workers and Polymetal will need to recognise the principles of equality of men and women.
- Convention on the Rights of Persons with Disabilities (ratified 2006, promotes non-discrimination and equality of opportunity).

- Convention to Suppress the Slave Trade and Slavery (ratified 2008, undertakes to prevent and suppress the slave trade and to progressively bring about the complete elimination of slavery in all its forms).
- Convention for the Suppression of the Traffic in Persons and of the Exploitation of the Prostitution of Others (ratified 2005, requires state signatories to punish any person who "procures, entices, or leads away, for the purposes of prostitution, another person, even with the consent of that person" and/or "exploits the prostitution of another person, even with the consent of that person").
- International Covenant on Economic, Social, and Cultural Rights (ratified 2006, promotes equal rights of men and women to enjoy all economic, social, and cultural rights).
- Convention against Torture and Other Cruel, Inhuman, or Degrading Treatment or Punishment (ratified 2008, requires states to take effective measures to prevent torture within their borders, and forbids states to transport people to any country where there is reason to believe they will be tortured.
- UNICEF Convention on the Rights of the Child (ratified 1994, a human rights treaty setting out the civil, political, economic, social, health, and cultural rights of children).
- International Convention on the Elimination of All Forms of Racial Discrimination (ratified 1998, undertakes to eliminate racial discrimination in all its forms and promotes understanding).
- UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (ratified 1972, acceptance 1994; confirms the protection and preservation of the world's cultural and natural heritage).
- UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (ratified 2011; Purposes are to safeguard intangible cultural heritage, ensure respect for the tangible cultural heritage of the communities, groups, and individuals concerned; to raise awareness at the local, national, international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof.

In addition, commensurate with IFC, UN, and ILO standards and recommendations on protecting the workforce, Polymetal should continue to ensure that its human resources policy includes a statement that it will not employ children in a manner that is exploitative, or likely to interfere with the child's education or be hazardous or harmful to their mental, moral or social development, and that it will not employ any forced labour. All applicable human rights policy, as developed in accordance with IFC PS 2 and the ILO conventions listed above, should also be followed by contractors, with terms incorporated into contractual agreements. Polymetal will continue to ensure that contractors are either covered sufficiently by their own human rights policy or that these gaps are compensated for within Polymetal's human rights policy.

Employees must have access to clear documentation and employment contracts in appropriate languages (Kazakh and Russian), to include information on conditions of employment, remuneration,

employer and employee rights and responsibilities, leave (annual leave entitlement and sick pay), contract period and termination and dispute resolution.

Polymetal will also continue to ensure that its human resources policy is accessible in its entirety and incorporating the following elements:

- personal conduct;
- non-discrimination;
- recruitment;
- induction;
- training;
- probation;
- medical and life insurance schemes;
- travel and expenses;
- occupational health and safety;
- equal employment opportunity;
- leave policy;
- performance management;
- performance improvement; and
- grievances.

One of the first aims of mine closure planning should be to avoid allowing the local economy to depend too heavily on the Project for jobs and other provisions. Therefore, while one of the most important benefits to be derived from the Project is direct and indirect employment, it will be equally important for Project communities to maintain their agricultural economic base while also encouraging diversification so that alternatives exist and losses are minimised at Project closure.

This can be achieved by developing local enterprises that are 'horizontally' (directly) linked to the Project and therefore able to supply goods or services to other complimentary sectors, or by developing local enterprises that are 'vertically' (indirectly) linked to the Project but that are able to secure a broader market base within the sector. Polymetal will continue to consider the conditions necessary for the community to economically sustain themselves beyond Project closure by:

- establishing a fund provision, to ensure sufficient finances exist to manage socio-economic closure plans;
- helping the community identify at the earliest stage (given the requisite lead times) complementary but independently sustainable business opportunities (for example through microcredit loan initiatives to support the development of small agricultural businesses); and
- establishing community self-help schemes that support down streaming, multi-skilling, and the provision of micro-credit initiatives to help local people diversify employment sources during the life of the Project.

Polymetal should define a retrenchment policy (employee closure policy), specifically with regard to the duration of notice, severance payments, and re-training. In addition to this, the company will need to develop a strategic plan to mitigate the most adverse impacts of employee retrenchment. This should include development of a comprehensive employee adjustment scheme that reflects consultation with employees and their representatives. There are a number of components that must be addressed in this comprehensive adjustment scheme, including:

- financial support to cover job search and relocation;
- appropriate levels of severance pay;
- skills inventory for prospective employers;
- job vacancy listings;
- development of job search skills;
- retraining in specific job skills; and
- personal financial management and planning skills.

To increase community, family and personal financial sustainability through savings and investment, it is important for salaries to be paid by the Project into bank accounts, rather than being provided in cash. It is recommended that Polymetal provide a short personal financial management course as part of the standard worker induction process.

In general, the land quality and relatively low usage and abundance of other land available, makes the overall sensitivity of the land low. The site was not a key grazing area, with local people from Auezov preferring to graze their animals in the direct surroundings of the village. Other land uses, including for foraging activities and wood collecting, are not undertaken directly around the site, with the exception of the relatively small area to be fenced in as part of the TSF tailings facility and processing plant.

Consultation with the hunters and their relatives confirms that hunting activities will not be affected by the Project. Consequently, whilst it is recommended that consultation continues with local hunting groups, other related mitigation measures are not required at present.

General mitigation measures for impacts caused by restrictions and land uses and users, include: minimising the overall project footprint, monitoring land users to assess impacts caused by restricted access, and integrating measures within the MCRP to ensure as much land as possible is returned to agricultural use after mine closure. As with all impacts on land users, Polymetal will continue to operate accessible community grievance mechanisms to allow affected people to register any complaints or issues about the project.

5.15.8 Summary of Impacts: Economy, Livelihoods and Labour

To adequately enable socio-economic impacts to be determined, the calculation outlined in the impact methodology section (Section 5.2) factors in both the magnitude of impact (duration of impact

and scope of impact) which for socio-economic impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity and communities and considers whether vulnerable people are affected).

The summary of impacts can be found in Table 5.15.5 below, showing that, using this methodology, no significant adverse impacts are expected within the spheres of the economy, livelihoods and the labour market. Post-mitigation, moderate negative impacts on local communities are predicted for land take impacts on agriculture and long-term land take and sterilisation, increased spending capacity of employees causing social problems, as well as job loss and retrenchment and community health and safety implications associated with pit recharge during closure.

Table 5.15.5: Impact Assessment, Summary of Key Impacts – Economy, Land Use, Livelihoods, Income, Labour and Working Conditions

Project phase	Sub-category	Direction	Scope	Duration	Impact (prior to mitigation)	Impact (post mitigation)
Construction and Operation	Macro-economic	Positive	National	Long-term	Moderate (positive)	High (positive)
Construction and Operation	Local and regional land tax	Positive	Local	Long-term	Moderate (positive)	High (positive)
Construction and Operation	Land acquisition	Negative	Local	Long-term	High (negative)	Low (negative)
Construction, Operation and closure	Restriction of Access. Impacts on livelihoods - hunting sector and foraging activities	Negative	Local	Long-term	Low (negative)	Negligible (negative)
Construction, Operation and closure	Restriction of Access Impacts on fishing and recreation	Negative	Local	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Land take impacts on agriculture – including arable and pastoral farming	Negative	Local	Long-term	High (negative)	Moderate (negative)
Construction, Operation and closure	Physical displacement - Voluntary Resettlement	Negative	Local	Long-term	Moderate (negative)	Low (negative)
Construction, Operation and closure	Economic displacement – impacts on livelihoods, including resettled people and hired shepherds	Negative	Local	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Inflation of rental prices in Auezov	Negative	Local and Regional	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Increased spending capacity of employees causing social problems	Negative	Local, Regional and National	Long-term	High (negative)	Moderate (negative)
Construction	Increased spending	Positive	Local	Long-term	Moderate	Moderate

and Operation	capacity of employees benefitting the local and regional economy		and Regional		(positive)	(positive)
Construction, Operation and Closure	Labour - Working conditions	Negative	Local	Long-term	Moderate (negative)	Low (negative)
Construction	Direct employment	Positive	Local, Regional	Medium-term	Low (positive)	Moderate (positive)
Construction	Indirect employment and procurement	Positive	National	Medium-term	Low (positive)	High (positive)
Operation	Direct employment and procurement	Positive	National	Long-term	Moderate (positive)	High (positive)
Operation	Indirect employment and procurement	Positive	National	Long-term	Moderate (positive)	High (positive)
Construction, Operation and Closure	Project development, implementation and closure – consultation and management of stakeholder expectations	Negative	Local and Regional	Long-term	Moderate (negative)	Low (negative)
Closure	Permanent Land Take and sterilisation	Negative	Local	Long-term	High (negative)	Moderate (negative)
Closure	Job loss and retrenchment	Negative	Local and Regional	Medium-term	High (negative)	Moderate (negative)

5.16 Community Health

5.16.1 Introduction

A health impact assessment has not been undertaken to date for the development of the Kyzyl Project. In the absence of a specific assessment, potential community health, safety and security impacts and mitigation measures have been discussed throughout the preceding sections, outlining mitigation measures. Community health, safety, and security are the primary focus of IFC PS4 (Table 5.16.1).

There were no complex medical issues, as defined in IFC PS4, raised during the community surveys in Auezov and Shalabay. However, baseline analysis on air quality shows elevated levels of arsenic. WAI previously recommended a health impact assessment as a precautionary approach and Polymetal should revisit the need for this assessment and, specifically, to continue to monitor air quality with regards to arsenic levels.

Table 5.16.1: IFC Performance Standards Key Relevant Requirements

Community Health
PS1 refers to the assessment and management of environmental and social risks and impacts. This standard underscores the importance of managing environmental and social performance throughout the life of a project, with the aim of promoting sound and sustainable environmental and social performance, leading to improved financial, social, and environmental outcomes.
PS4 on Community, Health, Safety, and Security recognises that Project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main objectives are, a) to anticipate and avoid adverse impacts on the health and safety of Affected Communities during Project life from both routine and non-routine circumstances, and, b) to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.

Taken together, the Project's key potential community health impacts include:

- communicable disease linked to the living environment;
- water and waste management related diseases;
- high risk sexual practices, STIs including HIV/AIDS;
- non-communicable diseases;
- environmental factors influencing health;
- social factors influencing health;
- local and regional health services;
- road traffic accidents; and
- security conflicts.

These impacts are described in detail below alongside mitigation measures. Polymetal will continue to develop an occupational health and safety plan that will integrate the key points outlined below, in addition to drawing on wider occupational health and safety measures and monitoring requirements.

5.16.2 Communicable Disease Linked to the Living Environment

The transmission of communicable diseases is associated with influx and migrant populations from populations with higher rates of communicable diseases. The main communicable disease of concern relating to the development of the Kyzyl project is TB, particularly relating to the management of the accommodation facilities and also due to the possible return of family members working abroad to seek employment opportunities.

Following the break-up of the Soviet Union, Kazakhstan experienced an increase in tuberculosis infections which, from 1998 and on, were carefully monitored by the National Tuberculosis Programme (NTP), which continues to oversee TB care and treatment in Kazakhstan. TB incidence in the country peaked in 2003-04. In East Kazakhstan, TB incidence per 100,000 of the population fell from 129.4 to 122.1[5] during the years 2007-2010 and continued to fall to 115 in 2014[6]. TB was not identified by local healthcare workers as being prevalent in the local area or across the Zharminsky District.

Mitigation and enhancement: Local recruitment measures will help to minimise the influx of workers and the spread of communicable diseases from migrant workers, including TB, STDs and influenza. Polymetal's workplace accommodation guidance should outline a management plan to prevent the spread of communicable diseases. In addition, employees should undertake medicals and be screened for TB before they are formally recruited, and where they are non-local, prior to them being brought into the area.

Ensuring accommodation standards are adequate and in line with IFC PS (Standard 2, Item 12) and EBRD guidance will also help minimise the possible transmission of communicable diseases. Monitoring of worker accommodation should occur alongside monitoring of the local and regional population for influx and the return of migrants.

5.16.3 High-Risk Sexual Practices, STIs and HIV/AIDS

The influx of workers for the project and increased salary levels will potentially lead to an increased potential for STIs and development of a local sex industry. Baseline investigations suggest that in general, the local, district and regional area where the project is located all have low rates of STIs, including HIV. Whilst surveys indicated that local settlements currently do not have a sex industry, Akimat officials and a member of the local police force suggest that prostitution does exist in Ust-Kamenogorsk and Semey.

Mitigation and enhancement: As the Project progresses, migrant (non-local) male workers may mix with local communities and form casual sexual relationships with residents. To that end, the location of the mine camp within the licence area will help reduce the accessibility of employees to Auezov;

[5] Terlikbayeva A et al 2012 (BMC Infectious Diseases)
[6] WHO: Kazakhstan Tuberculosis Country Profile

however, Auezov will still become the main hub for employee entertainment facilities. On this basis, in order to mitigate against the risk of high-risk sexual practices, Polymetal should apply the following mitigation measures:

- project design - mine camp location in the licence area;
- management of mine camp;
- code of conduct for employees that discourages interactions of the workforce with the local communities and relationships with local people;
- dry mine camp – zero tolerance of alcohol and drugs;
- recruitment of local workers, including women;
- implementation of Company HIV policy;
- development of a transport management policy that discourages visiting suppliers and contractors from mixing with local people;
- development and implementation of an employee educational awareness programmes;
- support of community and employee educational awareness programmes; and
- monitoring of the local, district and regional prevalence of communicable diseases, including STIs (and HIV).

In general, the risks posed by communicable diseases, excluding STIs, are moderate adverse. After mitigation has been applied, the impacts will be low. Relating specifically to STIs, including the spread of HIV, the nature of these diseases will create a high impact prior to mitigation and a longer-term residual moderate impact after mitigation measures have been applied.

5.16.4 Non-Communicable Diseases (NCDs)

Health data collected to date indicate that NCDs, including vascular diseases, diabetes, urological diseases, flu, rheumatoid arthritis, diabetes, glaucoma, cancer and respiratory diseases such as asthma, bronchitis and pneumonia, are reported as prevalent in the local area and across the wider Zharminsky District. In particular, diseases caused by obesity, including diabetes, were reported to be on the rise by healthcare professionals in Auezov during surveys.

Mitigation and enhancement: Increased disposable income, relating to higher salaries, may influence poor dietary and exercise practices, which in turn could increase the prevalence of NCDs in employees and, where applicable, their families. Employees will be subject to occupational health screening and monitoring; these findings should determine health promotion measures lead by Polymetal.

5.16.5 Environmental and Social Factors Influencing Health

Surveys engaging local stakeholders in Auezov identified concerns around the possible impact of the project on water quality, which in general was already perceived to be of moderate to poor quality. In particular, Auezov's pre-1991 water pipes were identified by healthcare professionals to be

responsible for a recent drop in quality of potable water. However, the continuous monitoring of water quality conducted at the existing pumping and filtration station, which supplies Auezov settlement with drinking water, indicates no exceedance of water quality norms. The water at the pumping and filtration station can be classified as "good" or "very good" according to monitoring results.

Air quality surveys suggest levels of baseline arsenic at 1.9µg/m^3, falling within within Kazakh standards (3µg/m^3 daily average limit) but exceeding World Health Organization guidelines (0.006µg/m^3 annual mean limit). These levels are higher than typically found in an urban area but typical of those found near a non-ferrous smelter. No health issues have been raised by medical personnel during the baseline.

Increased salaries may lead to positive health impacts, with increased financial spending capacity and health checks of employees being beneficial for employees and their families.

Mitigation and enhancement: There were no complex medical issues, as defined in IFC PS4, raised during the community surveys in Auezov and Shalabay. However, baseline analysis on air quality shows elevated levels of arsenic. WAI previously recommended a health impact assessment as a precautionary approach and Polymetal should revisit the need for this assessment and, specifically, to continue to monitor air quality with regards to arsenic levels.

Environmental health impacts, and mitigation measures, are described in detail in the following documents:

- Management Plan 1: Water and wastewater management plan;
- Management Plan 2: Tailings management plan;
- Management Plan 3: Waste management plan;
- Management Plan 4: Emergency response and spill prevention management plan;
- Management Plan 5: Mine closure and reclamation plan;
- Management Plan 6: Air quality management plan;
- Management Plan 7: Soil erosion management plan;
- Management Plan 8: Biodiversity management plan;
- Management Plan 9: Traffic management plan;
- Management Plan 10: Stakeholder engagement plan;
- Management Plan 11: Cultural heritage management plan;
- Management Plan 12: Chance finds procedure;
- Management Plan 13: Social management plan; and
- Management Plan 14: Noise management plan.

It is recommended that Polymetal remain aware of the health implications of the Project on members of the local community, in line with recommendations set out in IFC PS4 on community health.

Post-mitigation measures, which include regular health checks for employees and continuous company policy to promote a healthy lifestyle (e.g. by way of healthy food options at the mine camp), as well as monitoring the community health baseline in Auezov, the environmental and social factors influencing community health are likely to be low positive.

5.16.6 Health Services

Polymetal will provide on-site medical care both for regular check-ups of employees and to administer emergency treatment to employees on site in the event of accidents.

Mitigation and enhancement: Given the limited projected population influx and the overall population levels of Auezov and Shalabay, predicted impact on the local and regional health services will be low. This requires Polymetal to continue ensuring the following basic mitigation measures are in place: maximise local recruitment, monitor in-migration, develop adequate first aid facilities on site, build relations with the main hospital that will be used in case of emergencies, monitor occupational health and safety (including accident rates); and ensure the effective development and implementation of an occupational health and safety plan by Polymetal. During WAI's site visit, doctors at both Auezov and Shalabay healthcare centres reported being confident the centres can cope with increased population numbers, as long as they are accordingly supplied with staff and equipment, as was the case before the Project fell into Care & Maintenance.

5.16.7 Road Traffic Accidents

Increased traffic at the local, district and regional level will create long-term adverse impacts on the road traffic accident rate. Local officials suggest that these impacts can be reduced through the mitigation measures outlined below.

Mitigation and enhancement: A traffic assessment outlines the appropriate mitigation measures for minimising road traffic accidents. Polymetal will continue to monitor occupational health and safety (including accident rates) and ensure the effective development and implementation of an occupational health and safety plan. Furthermore, the company's employee code of conduct should cover personnel driving behaviour, referring to both communities and on site. Upon closure, the predicted rate of road traffic accidents will drop, although likely not down to pre-closure levels.

5.16.8 Security Conflicts

Mitigation and enhancement: All security personnel employed by Polymetal on site will continue to undergo appropriate training exercises to ensure, in particular, that human rights violations do not occur and that security personnel understand appropriate levels of force to deploy in various situations. Security arrangements should be commensurate with IFC PS4 (Items 12-14), which outline the need for Polymetal to assess the risks posed by their security arrangements to those within and outside the Project site. Importantly, the standards recommend that Polymetal do not sanction any use of force except when used for preventative and defensive purposes in proportion to the nature

and extent of the threat. To that end, the Project's grievance mechanism should allow local community members to express concerns about the security arrangements and acts of security personnel.

Management of security personnel on site should be in line with the Voluntary Principles on Security and Human Rights. This will include consideration of the following factors, with future risk assessments integrating on-going monitoring to consider:

- identification of security risks;
- the potential for violence as the project progresses;
- the human rights records;
- integration and on-going consideration of Kazakh law relating to human rights;
- potential for future conflicts; and
- equipment transfers.

The Voluntary Principles on Security and Human Rights have developed implementation tools (in line with a range of organisations including the IFC and International Council on Mining and Metals (ICMM)) that would assist Polymetal to the implementation process.

5.16.9 Summary of impacts: Community Health

To adequately enable community health impacts to be determined, the calculation outlined in the impact methodology section (Section 5.2) factors in both the magnitude of impact (duration of impact and scope of impact) which for health impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity and communities and considers whether vulnerable people are affected).

The summary of impacts can be found in Table 5.16.2 below, showing that, using this methodology, no significant adverse impacts are expected within the sphere of community health. Post-mitigation, moderate negative impacts on local communities are predicted for communicable disease linked to the living environment, high risk sexual practices, environmental factors influencing health (water and air), and increased traffic accidents.

Table 5.16.2: Impact Assessment, Summary of Key Impacts – Community Health, Safety and Security

Project phase	Sub-category	Direction	Scope	Duration	Impact (prior to mitigation)	Impact (post mitigation)
Construction, Operation and Closure	Communicable disease linked to the living environment	Negative	Local and Regional	Long-term	High (negative)	Moderate (negative)
Construction, Operation and Closure	High risk sexual practices, STIs including HIV/AIDS	Negative	Local and Regional	Long-term	High (negative)	Moderate (negative)
Construction and Operation	Non-communicable diseases	Negative	Local and Regional	Long-term	Low (negative)	Negligible (negative)
Construction and Operation	Environmental factors influencing health	Negative	Local and Regional	Long-term	High (negative)	Moderate (negative)
Construction, Operation and Closure	Social factors influencing health	Positive	Local and Regional	Long-term	Low (negative)	Low (positive)
Construction and Operation	Local and regional health services	Negative	Local and Regional	Long-term	Moderate (negative)	Low (negative)
Construction and Operation	Increased traffic accidents	Negative	Local - Regional	Long-term	High (negative)	Moderate (negative)
Closure	Traffic	Negative	Local - Regional	Medium- Long-term	Moderate (negative)	Low (negative)
Construction, Operation and Closure	Security conflicts	Negative	Local - Regional	Long-term	Moderate (negative)	Low (negative)

5.17 Human Rights

5.17.1 Introduction

Human rights impacts can be created by the development of mining projects. These impacts draw upon the range of potential adverse impacts outlined in the above sections, with some of these impacts having the potential to lead to human rights impacts if the appropriate management measures are not in place. Guidelines and recommendations around human rights are set out in IFC PS1 (Item 3), which states that "business should respect human rights, which means to avoid infringing on the human rights of others and address adverse human rights impacts business may cause or contribute to" (Table 5.17.1). At present, Polymetal should continue to manage the following issues, to avoid impacts on human rights:

- labour;
- security related;
- health and safety;
- environmental; and
- relating to land acquisition and resettlements.

Table 5.17.1: IFC Performance Standards Key Relevant Requirements

Human rights
PS1 refers to the assessment and management of environmental and social risks and impacts. This standard underscores the importance of managing environmental and social performance throughout the life of a project, with the aim of promoting sound and sustainable environmental and social performance, leading to improved financial, social, and environmental outcomes.

Mitigation and enhancement: The UN Guiding Principles 'Protect, respect and remedy framework' (released in 2011) is one of the fundamental guides for businesses on human rights. The underlying principle of the UN Guiding Principles framework for businesses is to 'comply with applicable laws and to respect human rights'. This guidance pays particular attention to groups within a population who are at risk of becoming vulnerable or marginalised. This framework outlines that businesses as a minimum should respect all internationally identified human rights, including the International Covenants on Civil and Political Rights and on Economic, social and cultural rights; and the 8 International Labour Organization Core Conventions.

In order to identify and start addressing these issues, mining projects need to undergo a review of potential and actual human rights impacts through a due diligence or audit process. This may require a more in-depth human rights impact assessment if serious concerns are raised and in all cases this should be followed up by regular reviews of conditions on site. The process of monitoring key risk areas is best practice that WAI recommends Polymetal should follow.

Relating to mine workers' accommodation, according to IFC/EBRD benchmarks [7], where construction is proposed in the licence area, the following mitigation measures will be provided to the design of the accommodation, which helps ensure the human rights of workers:

- all workers to have a minimum floor space of 5.5m^2 of floor space each, in a room with a minimal roof height of 2.1m;
- separate accommodation and sanitary facilities for males and females;
- minimum room temperature of 20°Celsius;
- room occupancy minimised with no more than four people sharing a single room and all residents to have their own bed, with a minimum spacing of 1m between beds;
- Polymetal will develop and implement a worker accommodation management plan prior to construction; and
- Polymetal will outline in their HR policy accommodation management measures that adequately balance the need to respect workers' rights and not to restrict workers' freedoms, alongside the need to provide accommodation recreational and entertainment facilities (e.g. a gym, TV room). This will help minimise disturbances on the local community.

5.17.2 Summary of Impacts: Human Rights

To adequately enable human rights impacts to be determined, the calculation outlined in the impact methodology section (Section 5.2) factors in both the magnitude of impact (duration of impact and scope of impact) which for human rights impacts can equate to the number of people affected, the duration of impact and the sensitivity of receptors (addressed as impact intensity, which categorises the proximity and communities and considers whether vulnerable people are affected).

The summary of impacts can be found in Table 5.17.2 below, showing that, using this methodology, no significant adverse impacts are expected within the sphere of human rights. Post-mitigation, the risk of breaches of community human rights will be low negative.

Table 5.17.2: Impact Assessment, Summary of Key Impacts – Human Rights

Project phase	Sub-category	Direction	Scope	Duration	Impact (prior to mitigation)	Impact (post mitigation)
Construction, Operation and closure	Human Rights	Negative	Local	Long- term	Moderate (negative)	Low (negative)

[7] From Workers' accommodation: processes and standards (International Finance Corporation and European Bank for Reconstruction and Development) http://www.ebrd.com/downloads/about/sustainability/Workers_accomodation.pdf

5.18 Impact Assessment Data

Table 5.18.1 defines the probability ratings used in the calculations shown in Table 5.18.2, which documents the precise calculations used in this analysis.

Table 5.18.1: Probability of Rating Definitions

Probability Rating	Definition
Negligible	Occurrence is Highly unlikely
Low	Occurrence is of a low degree of likelihood
Moderate	May occur
High	Occurrence is of a high degree of likelihood

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
Project phase – Construction, Operation or Closure											
Demography, Culture and Governance											
1 Con - Direct employment	2	2	2	8	+ Low	Recruitment policy prioritises local candidates by proximity, including contractors. Employment statistics are kept up to date to monitor gender and age statistics. Audit list of contractors to monitor local employment. Monitor changes to population through coordination with Akims by obtaining and reviewing local, district and regional passport data. Monitor worker, contractor and community grievances and how they are resolved.	2	2	4	16	+ Moderate
2 Con - Indirect employment and procurement	2	2	3	12	+ Low	Local recruitment policy to prioritise candidates by proximity. Benefits to local community through the multiplier effect.	3	2	4	24	+ Moderate
3 Op - Direct employment and procurement	2	4	3	24	+ Moderate	Recruitment policy prioritises local candidates by proximity, including contractors. Monitor recruitment adverts and their effectiveness. Employment statistics are kept up to date to monitor gender and age statistics.	2	4	4	32	+ High

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						Audit list of contractors to monitor local employment. Accessible community grievance mechanism and effective resolution. Regular updates to the Stakeholder Engagement Plan. Monitor changes to population through coordination with Akims by obtaining and reviewing local, district and regional passport data. Monitor worker, contractor and community grievances and how they are resolved.					
4 Op - Indirect employment and procurement	3	4	2	24	+ Moderate	Local recruitment policy to prioritise candidates by proximity. Benefits to local community through the multiplier effect.	3	4	3	36	+ High
5 Con & Op Influx and movement of population	2	4	3	24	- Moderate	Local recruitment policy to prioritise candidates by proximity	2	4	1	8	- Low
6 Con & Op Influx - increased spending leading to salary disparities, reduced social cohesion	2	4	3	24	- Moderate	As above, articulate local recruitment intent as clear policy and procedures that are widely disclosed. Develop cultural sensitisation and emersion course and clear Codes of Conduct for all existing and new employees (including contractors) and an induction for new employees.	1	4	2	8	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						Develop Influx Management Strategy in accordance with IFC guidance covering all stages of the Project. Develop Community development management plan during construction period to help facilitate community-lead projects in the most affected area: Zharminsky District. Such projects could be aimed at supporting the development of agricultural productivity in the local area. As part of the employee Code of Conduct, carry out random drugs and alcohol testing on employees. Accessible community grievance mechanism and effective resolution. Monitor recorded grievances.					
7 Con & Op Influx - increased spending	1	4	2	8	+ Low	Spending leads to economic benefits. Develop Influx Management Strategy in accordance with IFC guidance covering all stages of the Project.	1	4	2	8	+ Low
8 Con & Op - Social Issues	2	4	3	24	- Moderate	Polymetal to develop a policy on the prevention of STDs. Induction to outline policy to prevent the spread of STDs, including HIV.	1	4	2	8	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						Develop employee code of conduct. As part of the employee Code of Conduct, carry out random drugs and alcohol testing on employees. Accessible community grievance mechanism and effective resolution. Monitor recorded grievances.					
9 Con, Op & Clo - Influences on local culture	2	4	3	24	- Moderate	Short cultural sensitisation and emersion course for new employees from outside or overseas and clear Codes of Conduct for all new employees.	2	3	2	12	- low
10 Con, Op & Clo - Accentuation of gender and generational disparities	2	4	3	24	- Moderate	Employment statistics are kept up to date to monitor gender and age statistics. (i) Recruitment policy promotes equality of opportunity for women; (ii) salaries not paid in cash; (iii) employee course in personal financial management. Employment and labour policy that adheres to ILO standards on gender equality and avoidance of discrimination.	1	1	2	2	- Negligible
12 Clo - Retrenchment	3	4	4	48	- High	Define an employee closure/retrenchment policy, specifically with regard to duration of notice, severance payments, and re-training. In addition develop a strategic plan to mitigate the most adverse impacts of employee retrenchment.	2	4	3	24	- Moderate
Social Infrastructure											

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
13 Con & Op - Increased Traffic – wear and tear on the roads	4	4	2	32	- High	Ensure road upgrade and maintenance proposals include road clearance in winter and ensure that the maintenance regime is sufficient to offset degradation.	3	1	2	6	- Low
14 Con & Op - Increased Traffic – road traffic accidents	4	4	3	48	- High	On-going monitoring of road traffic accident rates and introduction of further traffic safety controls based on and extend the findings of the traffic assessment. Cross reference with SEP to disseminate findings to stakeholders. Polymetal to develop and implement a driver code of conduct.	2	4	3	24	- Moderate
15 Con & Op - Pressure on physical infrastructure in Auezov and Shalabay settlements associated with return migration	2	4	1	8	- Low	Polymetal work with and clarify with the regional and local authority the obligation to use the expanded tax base to improve capacity and reliability of physical and social infrastructure.	1	2	1	2	- Negligible
16 Con & Op - Social Issues – increased prevalence of STDs	4	4	4	64	- High	Polymetal to develop a policy on the prevention of STDs. Induction to outline policy to prevent the spread of STDs, including HIV. Short cultural sensitisation and emersion course for new employees from outside or overseas and clear Codes of Conduct for all new employees.	2	4	3	24	- Moderate
17 Con & Op - Social Issues – increased alcohol related conditions and social	2	4	3	24	- Moderate	Short cultural sensitisation and emersion course for new employees from outside or overseas and clear Codes of Conduct for all new employees.	2	3	2	12	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
maladies						Polymetal work with and clarify regional and local authority obligation to use expanded tax base to improve justice and enforcement capacity locally.					
19 Clo – Cessation of project traffic reduces accident rates and introduction of further traffic safety.	4	3	2	24	- Moderate	None required.	3	2	2	12	- Low
Economy, Livelihoods and Labour											
20 Con & Op - Macro-economic	3	4	2	24	+ Moderate	Kazakhstan as a signatory of the EITI makes national government accountable for Project's tax contributions and shifts some focus of expectations to the recipient authorities.	4	4	3	48	+ High
21 Con & Op - Local and regional land tax	3	4	2	24	+ Moderate	As above and Polymetal work with and clarify regional and local authority obligation to use expanded tax base to improve justice and enforcement capacity locally. Active membership of the EITI makes local government more accountable for Project's tax contributions and shifts some focus of expectations to the recipient authorities.	4	4	4	64	+ High
22 Con, Op & Clo - Land acquisition	3	4	4	48	- High	Minimise land take. Ensure practical remediation measures are selected to progressively remediate land. Polymetal must purchase the land cadastral data	2	4	3	24	- Moderate

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
24 Con, Op & Clo - Restriction of Access. Impacts on livelihoods - hunting sector and foraging activities	1	4	2	8	- Low	Foraging – Polymetal to continue consultation and ensure foraging activities are not affected. Hunting - None required, as very low impact on activities.	1	2	1	2	- Negligible
25 Con, Op & Clo - Restriction of Access Impacts on fishing and recreation	2	4	3	24	- Moderate	Follow the findings of aquatic studies.	2	2	2	8	- Low
26 Con & Op - Land take impacts on agriculture – including arable and pastoral farming	2	4	4	32	- High	Polymetal are involved in on-going community liaison to determine the impacts associated with land take and acquisition.	2	4	3	24	- Moderate
27 Con, Op & Clo - Physical displacement – voluntary resettlement	1	4	4	16	- Moderate	Be aware of displaced households.	1	4	2	8	- Low
28 Con, Op & Clo - Economic displacement –impacts on livelihoods, including impacts on resettled people and hired shepherds	1	4	4	16	- Moderate	Polymetal are involved in on-going studies to determine the impacts associated with land take around the future TSF facility and processing plant to identify impacts on arable and pastoral farming. Polymetal continue to determine the effect on the livelihoods of affected people, like herders. These studies will continue to inform development of appropriate mitigation measures.	1	4	2		- Low
29 Con & Op - Inflation	2	4	3	24	- Moderate	Monitor local and regional labour market	1	4	2	8	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
of rental prices in Auezov						statistics to pick up on any changes in salaries above the rate of inflation. This should include potential effects of the project on the housing rental market in Auezov.					
30 Con & Op - Increased spending capacity of employees causing social problems	4	4	3	48	- High	Polymetal to develop and implement an employee code of conduct. Develop cultural sensitisation and emersion course and clear Codes of Conduct for all existing and new employees (including contractors) and an induction for new employees. Location of the main mine camp on-site rather than in Auezov settlement. Development of entertainment facilities on site for employees.	2	4	2	16	- Moderate
31 Con & Op - Increased spending capacity of employees benefitting the local and regional economy	3	4	3	36	+ Moderate	None required.	3	4	3	36	+ Moderate
32 Con, Op & Clo - Labour - Working conditions	2	4	3	24	- Moderate	Ensure working conditions meet IFC guidance and ILO standards on employee health and safety and working conditions. This include development of the mine camp within the mining licence area. Polymetal continue to develop a full occupational health and safety plan, to be implemented before construction work starts on site. This will integrate all	2	4	1	8	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						mitigation measures on health and safety, and include a sub-section of community health and safety measures. The site will be a dry mine site, with no tolerance of alcohol or drugs usage. Random alcohol and drugs testing will take place on a regular basis.					
33 Con - Direct employment	2	2	2	8	+ low	As listed in Con 1.	2	2	4	16	+ Moderate
34 Con & Op - Indirect employment and procurement	3	4	2	24	+ Moderate	As listed in Op 4.	3	4	3	36	+ High
35 Op - Direct employment and procurement	2	4	3	24	+ Moderate	As listed in Op 3.	2	4	4	32	+ High
36 Con, Op & Clo - Project development, implementation and closure – consultation and management of stakeholder expectations	2	4	4	32	- Moderate	Polymetal liaise closely with project stakeholders, utilising communication methods outlined in the Stakeholder Engagement Plan, including for regular public consultation events to inform stakeholders on project developments and timeframes. Polymetal complete regular updates to the Stakeholder Engagement Plan. Accessible community grievance mechanism and effective resolution. WAI have provided an outline Community Development Management Plan for Polymetal to progress further during the	2	4	1	8	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						construction period for the mine. This will help direct community-lead projects in Auezov.					
37 Clo - Permanent Land Take and sterilisation	3	4	4	48	- High	The project design has taken measures to minimise the project footprint. Polymetal to ensure land re-classification occurs, on as much land as possible, from industrial to agricultural land. Land remediation will be undertaken in a progressive manner.	2	4	3	24	- Moderate
38 Clo - Job loss and retrenchment	3	3	4	36	- High	Define an employee closure/retrenchment policy, specifically with regard to duration of notice, severance payments, and re-training. In addition develop a strategic plan to mitigate the most adverse impacts of employee retrenchment. Develop community business and training forum to identify and boost linked but diversified and independently sustainable businesses. Polymetal to develop a local employment and training plan, establishing self-help schemes that support down streaming, multi-skilling. This will be linked to the SEP.	3	3	3	27	- Moderate
Community Health, Safety and Security											
40 Con, Op & Clo - Communicable disease linked to the living environment	4	4	3	48	- High	Local recruitment measures will help minimise the spread of communicable diseases from migrant workers. Polymetal to develop workplace accommodation guidance to include measures aimed at preventing the spread	3	4	2	24	- Moderate

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
						of communicable diseases. Polymetal to monitor standards of accommodation and the rates of communicable diseases. Employees will undertake medicals prior to recruitment and relocation, including TB screening.					
41 Con, Op & Clo - High risk sexual practices, STIs including HIV/AIDS	4	4	4	64	- High	Polymetal to develop a policy on the prevention of STDs. Induction to outline Polymetal's policy to prevent the spread of STDs, including HIV. Polymetal to implement employee educational awareness programme and to help support a community educational awareness programme. An employee code of conduct will be implemented. The main mine camp will be located on site away from Auezov, which does not presently have a sex industry. Development of a transport management policy that discourages visiting suppliers and contractors from mixing with local people. Polymetal to monitor the rate of STDs and HIV in the local, district and regional area.	2	4	3	24	- Moderate
42 Con & Op - Non-	2	4	1	8	- Low	Occupational health screening and	1	2	1	2	- Negligible

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
communicable diseases						monitoring of employees.					
43 Con & Op - Environmental factors influencing health	3	4	3	36	- High	Polymetal to implement the EIA mitigation measures and the range of environmental management plans developed by WAI and Polymetal (this includes the overall environmental and social management plan, the water resources management plan, the hazardous materials management plan and the emergency action plan.	2	4	2	16	- Moderate
44 Con, Op & Clo - Social factors influencing health	2	4	1	8	- Low	Polymetal to undertake occupational health monitoring of employees. Healthy food to be offered in the mine camp. Polymetal to monitor the community health baseline.	2	4	1	8	+ Low
45 Con & Op - Local and regional health services	2	4	2	16	- Moderate	Polymetal will develop adequate first aid facilities on site and will build relations with the local hospital in case of emergencies. Polymetal will monitor the accident rate in the work place. Polymetal will develop and implement an occupational health monitoring plan.	2	4	1	8	- Low
46 Con & Op - Increased Traffic – road traffic accidents	4	4	3	48	- High	As listed in 14 Con & Op	2	4	3	24	- Moderate
47 Clo - Traffic	4	3	2	24	- Moderate	As listed in 19 Clo	3	2	2	12	- Low

Table 5.18.2: Summary of Socioeconomic Impact Significance and Nature Pre and Post-Mitigation

Impact Summary	Pre-mitigation Impact					Mitigation, Enhancement Summary and Monitoring Indicator	Post-mitigation/Residual Impact				
	Scope	Duration	Intensity	Total Impact	Significance and Nature		Scope	Duration	Intensity	Total Impact	Significance and Nature
48 Con, Op & Clo - Security conflicts	3	4	2	24	- Moderate	Training of all security guards on site so they understand how to help foster positive relations with the local community and what the appropriate level of force is to use. Polymetal policy and mitigation measures will be in line with the Voluntary Principles on security and Human Rights. Regular review of security conflicts.	2	4	1	8	- Low
Human Rights Impacts											
49 Con, Op & Clo – Human Rights	3	4	2	24	- Moderate	Polymetal will operate in accordance with the UN Guiding Principles 'Protect, respect and remedy framework' and to respect the ILO Core Conventions and the Voluntary Principles on Security and Human Rights. Polymetal to monitor human rights impacts on a regular basis.	3	4	1	12	- Low

5.19 Cumulative Impact Assessment (CIA)

5.19.1 Introduction

Most major environmental and social management challenges are the result of cumulative impacts from a large number of activities that are for the most part individually insignificant, but together have regional or even global repercussions.[1]

5.19.2 Definitions

Cumulative impacts are those that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the proposed Kyzyl Project. Cumulative impacts act with others in a way that the sum is greater than the parts or sometimes as the sum of the parts, where the sum becomes significant.

Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development.

This chapter has been developed in line with the guidance provided in IFC's "Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013)". Cumulative Impact Assessment (CIA) hinges on defining Valued Environmental and Social Components (VECs), which are environmental and social attributes that are considered to be important in assessing risks. VECs include physical features, ecosystem services, natural processes, social conditions, or cultural aspects.

5.19.3 Guidance

IFC PS1: Assessment and Management of Environmental and Social Risks and Impacts recognises that in some instances, developers need to consider cumulative impacts in their environmental and social impact and risk identification and management process.

In order to provide guidance on undertaking a CIA, IFC released a guidance note in August 2013 titled "Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets". This guidance note uses the concept of Valued Environmental and Social Components (VECs), these being environmental and social attributes that are considered to be important in assessing risk, which can include:

[1] IFC Good Practice Handbook on Cumulative Impact Assessment: http://www.ifc.org/wps/wcm/connect/3aebf50041c11f8383ba8700caa2aa08/IFC_GoodPracticeHandbook_CumulativeImpactAssessment.pdf?MOD=AJPERES

- Physical features;
- Wildlife populations;
- Environmental processes;
- Ecosystem conditions (e.g. biodiversity);
- Social conditions (e.g. health, economics); and
- Cultural aspects.

The guidance note provides a six-step process for assessing the potential for cumulative impacts upon VECs as follows:

- Scoping Phase I – identifying VECs, spatial and temporal boundaries;
- Scoping Phase II – other activities and environmental drivers;
- Establish information on the baseline status of VECs;
- Assess cumulative impacts on VECs;
- Assess significance of predicted cumulative impacts; and
- Management of cumulative impacts – design and implementation.

This CIA has used the guidance note as a framework for assessing potential cumulative impacts associated with the Project and from other 'reasonably defined developments'.

5.19.4 Methodology

The CIA methodology adopted in this report has been defined taking into account the six step process as detailed in the IFC guidance note referred to above, and comprises the following:

- Scoping Phase I: Entails defining specific VECs to be included within the CIA, taking into account the characteristics of the Project and the prevailing environmental and social conditions within areas that are potentially impacted by the Project. This phase of the assessment also requires setting temporal and spatial boundaries of the CIA for specific VECs;
- Scoping Phase II: Requires the identification of other projects or human activities that could potentially impact upon defined VECs that could result in cumulative impacts. An analysis is subsequently undertaken aiming to define those development projects that are scoped into the CIA, given their potential ability to generate a cumulative impact associated with the Project (due to temporal or spatial interactions with the Project);
- Establish Information on the Baseline Status of VECs: Defining the baseline characteristics of VECs is an important stage in the CIA process, as this identifies their sensitivity to change. Note that relevant baseline information has been provided in Chapter 4 of this ESIA Report and is not reproduced here; and
- Assess Cumulative Impacts Upon VECs: Taking into account the Project's predicted impacts upon identified VECs, an assessment has been undertaken to evaluate the

ability of the Project to interact with other planned or reasonably defined developments in such a manner that gives rise to a cumulative impact (where the temporal and spatial influences may coincide). Note that the assessment presented in this chapter only considers the residual impacts arising from the Project (i.e. impacts following the application of mitigation measures as detailed in this ESIA Report). It follows that the chapter only considers those VECs that will experience any degree of residual impact associated with the Project. Thus VECs for which there is a Project residual impact that is deemed to be insignificant in this ESIA, do not need to be included in the CIA.

Where VEC residual impacts are defined as being **Moderate** or **High**, these are scoped into the CIA; on the other hand, where VEC residual impacts are assessed as being **Not Significant**, these can be scoped out of the CIA. VEC residual impacts defined as being **Low**, the applicable VECs have been subject to further evaluation to see if there is scope for cumulative impacts to be generated.

5.20 CIA Scoping Phase I: VECs, Spatial and Temporal Boundaries

5.20.1 VEC Identification

The ESIA Report considers the potential Project impacts across a range of VECs. These VECs have been defined by taking into account the prevailing environmental and social conditions in the Project Area, and the ability of the Project to impact upon these resources (during all Phases of the Project). Consultation with relevant stakeholders has been a key component of the environmental and social resource identification process – stakeholder engagement activities are detailed in Chapter 4 and Appendix 10. A summary of the VECs that have been considered within this ESIA Report, and thus within this CIA, comprise the following impacts to:

- Greenhouse gas and emissions;
- The geochemical environment;
- Air quality;
- Noise;
- Soils;
- Water resources (surface water and groundwater);
- Biodiversity;
- Archaeology;
- Transport and infrastructure; and
- Social.

5.20.2 Temporal and Spatial Boundaries

The temporal boundary of the CIA includes the Project Construction and Operational Phases. The Operational Phase is proposed to operate in open pit (2016-2024) and underground mining (2025-2039) phases. However, the degree of uncertainty increases the further into the future the assessment extends. As such, potential cumulative impacts during the latter phases of the Project have been scoped out of the assessment.

The spatial or geographic boundary of the CIA have been defined taking into account the Project characteristics (Chapter 3 - Project Description) and the assessment areas applied to defined VECs as included within the various technical assessments (Chapters 4 and 5) within this ESIA Report. A flexible approach has been maintained, such that the boundaries of the assessment vary depending upon the characteristics of the potentially impacted VEC. The geographic boundary thus varies from the space occupied by a small VEC feature (e.g. a discrete feature of cultural heritage value) to a large geographic region or habitat within which a particular VEC occurs (e.g. habitat occupied by a protected species). The spatial extent of relevant VECs is detailed in the various technical assessments as presented within this ESIA Report.

As per the IFC guidance note, this CIA considers those VECs that will be impacted by the Project with any degree of residual impact, thus VECs for which there is an impact that is deemed to be **Not Significant** have been scoped out of this CIA. Where the Project residual impact significance is defined to be negative and **Low**, **Moderate** or **High**, the applicable VEC is scoped into the CIA.

Table 5.20.1: Summary of VECs

ESIA Section	Valued Environmental and Social Components (VECs)	Impact source	Residual impact (post-mitigation)
Greenhouse Gas Emissions (5.4)	Atmosphere	Offsite power generation, onsite mobile plant and heating plant emissions	Moderately adverse
Noise (5.7)	Biotic ecosystem components, including humans	Routine mining operations	Moderate
Water (5.9)	Stream flow	Artificial stream diversion open pit dewatering	Minor
		Tailings contained in the TSF	Minor
	Stream and Lake (morphology)	Tailings contained in the TSF	Minor
	Surface water quality	Tailings contained in the TSF	Minor
	Groundwater quality	Plume of contaminants around open pit	Minor*
Biodiversity (5.10)	Ecosystem services: controlling erosion, pollination, soil creation, food from crops and livestock	Routine operations and land take	Minor
Traffic and Transportation (5.12)	Biotic ecosystem components, including humans	Construction and operation, staff transportation, deliveries	Moderate
Economy, Land Use, Livelihoods (5.15)	Local communities	Temporary/permanent land take	Low/Medium
		Economic effects (inflation of rental prices, increased spending capacity, managing expectations)	Moderate
		Labour working conditions/potential job loss from retrenchment	Low/Medium
Community Health (5.16)	Local communities	Communicable diseases linked to the living environment	Moderate
		High-risk sexual practices	Moderate
		Environmental factors influencing health	Moderate
		Traffic and increased traffic accidents	Low/Moderate

* Significance is highly uncertain in the long term since groundwater modelling is only completed for first ten years of operations.

5.21 CIA Scoping Phase II: Other Developments

5.21.1 Introduction

This section defines the planned and reasonably defined developments in the vicinity of the Project. If the Project is able to interact with such developments (temporally and/or spatially), the Project may be able to exert a potential cumulative impact.

The assessment has been conducted as a desk-based evaluation; however it has drawn on the experience and expertise of the specialists authoring different chapters and sections of the ESIA and upon the understanding of priority VECs within local communities gained through consultation during the social site visits.

5.21.2 Other developments

The following temporal and spatial developments have been identified in the vicinity of the Project:

- Proposed landfill site to serve Auezov households;
- Potential future business operations in Auezov; and
- Historical mining legacy at the Project site.

No other developments have been identified in the vicinity of the Project.

Proposed landfill site – Auezov

The Project will interface with the proposed landfill site to be constructed in the vicinity of Auezov settlement. At present, the landfill site is still under consideration by local authorities, coordinated by Auezov Akimat, with the aim of achieving construction and operation from 2016 onwards. Waste disposal has been identified by a number of key stakeholders as a key gap in the settlement's social infrastructure, suggesting the landfill project is likely to materialise. This development would have an important positive contribution to the local community, since currently household waste is disposed of informally by residents and a local company in an natural area adjacent to the town. **Polymetal should remain informed about the development of the landfill site, including its operational consequences relating to general infrastructure, traffic, and overall social impact.**

Potential future business operations in Auezov and further afield in Zharma District

The Project is expected to cause some in-migration to Auezov and Shalabay municipalities, mostly related to the arrival of opportunistic economic migrants and migrant labour. Increased population is usually accompanied by the expansion of existing settlements or the establishment of new settlements. As settlements expand or are established, new areas are impacted by building activity and it is possible that independent businesses and developments will take place in the vicinity of the Project, in particular in Auezov settlement. In addition, any new developments and job opportunities are likely to be adversely impacted upon mine closure. **Polymetal should remain informed about the**

development of local businesses, with the aim of avoiding cumulative impacts as a result of the Project and the Project's closure interfacing with other local developments.

Historical mining legacy at the Project site

The Project will operate on the site of mining activities dating back to the 1950s. In the context of the Project's recent development, the history of the site and memories it evokes affect the local community by heightening expectations about the potential for job opportunities and economic growth. In addition, the mining legacy at and around the Project site may cause cumulative impacts to the environment if emissions from the Project interface with legacy pollutants. **Polymetal should remain aware of the mining legacy at the Project site, with the aim of avoiding unforeseen environmental and social cumulative impacts.**

5.22 CIA and Significance Assessment

Section 5.20.2 indicates that the significance of all residual post-mitigation Project impacts upon soils, water resources, and the atmosphere are **Minor** in significance. Post-mitigation Project impacts on biotic (living) ecosystem components and local communities are **Low** to **Moderate** post-mitigation. This indicates that the Project generally has a low potential to exert a potentially significant cumulative impact on humans and the biotic environment when considering other developments.

Although this ESIA reports that greenhouse gas emissions are predicted to have **Moderately Adverse** impact on the atmosphere, it is acknowledged that the Project will interface with other development projects in its contribution to global emissions and that the strength of this interaction cannot at present be quantified.

5.23 Cumulative Impact Mitigation, Monitoring and Management

The CIA has not identified any cumulative impacts that are considered to be significant and in need of mitigation measures, monitoring or management. However, the assessment has made a number of recommendations with regard to the alignment of mitigation strategies. Taken together, these recommendations relate to the Project's management team remaining aware of the potential for cumulative impacts. In particular, the Community Liaison Officer should be aware of the potential for cumulative impacts during community liaison meetings relating to new business or infrastructural developments in Auezov or Shalabay.

5.24 Assumptions and Limitations

This CIA has been undertaken based upon the available information contained within this ESIA Report. Key assumptions and limitations are detailed below:

- The assessment only considers residual impacts after the implementation of mitigation measures as detailed in this ESIA Report; and
- With the exception of the effect of retrenchment, this CIA excludes potential cumulative impacts during the closure phase of the Project, given that the full extent of activities during that phase remain uncertain.

5.25 Conclusions

Polymetal's development proposals at Kyzyl have been considered in this CIA. The assessment has not identified any adverse cumulative impacts that are considered to be significant and in need of specific mitigation measures, monitoring or management. However, Polymetal will remain aware of the possibility of cumulative impacts on both biotic and abiotic components of the Project's surrounding area as a result of the Project interfacing with other development ventures in the wider region.

Chapter 5 Appendices

Appendix 5.1: General Layout Transportation

General Layout

This section considers space planning of sites for construction of the Bakyrchik Mine and Process Plant.

The mode of occurrence and geometry of the ore body, as well as geological characteristics of the Bakyrchik deposit, predetermine its development and mining by the combined method. The deposit is planned to be developed in two stages – by open pit method at the first stage and underground method at the second stage for final extraction of under-pit reserves.

All Project site facilities can be divided into three groups – existing, reconstructed (which are being upgraded) and new facilities.

Some of the existing main and auxiliary production facilities fall into a blast-induced fly-rock danger zone (300 m) and shall be dismantled and transferred before start-up of production. Some existing facilities will be transferred to the list of assets of the Auezov authorities.

The remaining existing facilities will be used by BMV on permanent basis over the LOM period or as temporary buildings and structures for the construction period. Some of them will be used after reconstruction/upgrading.

The following facilities shall be reconstructed at the 1st construction stage:

- pit drainage settling sump – reconstruction of Open Pit No 2, used currently as a water reservoir;
- sanitary and amenity building (OP) – reconstruction of the former mine rescue team building;
- office /administrative building – reconstruction of the former office building;
- materials and equipment storage – reconstruction of the central storage building;
- Bund Wall No 2 – reconstruction of the existing TSF dam;
- core storage – reconstruction of the mobile mechanical division building (Granite).

The following objects shall be reconstructed at the 2nd construction stage:

- Western and Eastern Ventilation Shafts;
- Capital Shaft;
- pithead building of the Capital Shaft, the Capital Shaft hoist building – reconstruction of the Capital Shaft surface set of facilities;
- backfill plant – reconstruction of the ore kiln charging building;
- mine water treatment station.

All other facilities belong to the new construction group.

The design mine and process plant include the following main and auxiliary production sites and facilities:

The 1st construction stage:

a) mining facilities: open pit, waste dump, buffer ore stockpile, pit and dump drainage settling sumps, water diversion channel of the Akbastaubulak and Kyzyltu Streams, water diversion and drainage ditches, top soil storage;
b) ore processing facilities: ore preparation facility (OPF), process plant (PP), tailings thickener, recycle water tank, laboratory, finished concentrate storage, carbon concentrate storage, tailings storage;
c) office and amenity block: canteen for 100 seats;
d) repair and maintenance facilities: repair shops, outdoor repair and mounting area, materials and equipment outdoor storage;
e) utilities: pumphouse with water tanks for process and fire water supply, pumphouse with water tanks for household and drinking water supply, treatment facilities for household sewage, surface water runoff pond;
f) heat and power supply facilities: boiler house with a flue gas stack, coal storage, ash storage, GPP-110/35/6kV main step-down transformer substation, external package transformer substation (EPTS), indoor switchgear, high voltage distribution switch etc.;
g) storage facilities: reagent storage, fuel and lubricants storage, 24 t explosives storage site, explosives test and destruction range;
h) utility facilities of Auezov Town: water tower, boiler house with a flue gas stack, coal storage, ash storage, 6 kV indoor switchgear.

The 2nd construction stage:

i) mining facilities: West vent raise (+385 m), Capital Shaft (+410 m), East Ventilation Shaft (+435m), pithead buildings, main fan units, power supply units, coal and ash storages, fire fighting supplies and equipment storages, ore handling stockpiles, pumphouses with water tanks for process and fire water supply, backfill supply drill holes, adits of heat supply network and utilities, lamp room, sanitary and amenity building (UG), backfill plant, cement storage silos, buffer tank of thickened tailings.

Locations of the main project facilities (sites, TSF, waste dumps) were selected based on the engineering communications between the production facilities, requirements of sanitary and fire protection norms, possible cooperation of the main and auxiliary plants and facilities, rational use of the Project area and its terrain features and zoning.

Open pit spatial location is defined by the ore bodies' positioning. Exits to the surface from underground workings are arranged within the mined-out areas of the corresponding open pit sections (after completion of the open pit mining).

In terms of territory, the open pit is located in the northern part of the allocated land, covering an area of 128.7 ha. It extends from west to east within the conventional boundaries (width - 1000 m, length - 2000 m).

The overburden dump is located in close proximity to the northern side of the open pit exits. Such position is defined by the initial open pit mining, local topography, pit and dump slope stability analysis and rational distance of overburden haulage. The dump extends from west to east along the entire wall of the overall open pit outline and covers an area of 326.2 ha.

Spatial location of permanent underground workings is defined by the ore bodies' positioning and stripping/opening of the mined-out pit area. The exits from the underground workings to the surface are arranged as follows:

- Western area – West Ventilation Shaft top (+385.0 m), West vent raise opening (+385.0 m) and collar of Backfill Supply Drill Hole No 1 (+385.0 m), located in close proximity to the southeastern pit wall at 40-70 m distance.
- Central area – Capital Shaft top (+410.0 m) and collar of Backfill Supply Drill Hole No 2 (+402.0 m), located in close proximity to the southern pit wall at 40m distance, Central adit for the heat network (+180.0 m), Central adits for Utilities 1 (+180,0 m) and Utilities 2 (+150.0 m) and Ore Handling Stockpile No 1, located in the western part of the mined-out pit area.
- Eastern area – East Ventilation Shaft top (+435.0 m) and collar of Backfill Supply Drill Hole No 3, located in close proximity to the southeastern pit wall at 30-50 m distance, Eastern adit for the heat network (+250.0 m), Eastern adit for Utilities 1 (+250,0 m) and Utilities 2 (+253.0 m) and Ore Handling Stockpile No 2, located in the eastern part of the mined-out pit area.

The Buffer ore stockpile is adjacent to the process plant and located on a common site with the primary crushing plant feed bin within the ore preparation facility, 700 m southeast of the open pit. The maximum stockpile capacity is 115 000 m^3.

The ore processing facilities, office and amenity block, repair and maintenance facilities, utilities, heat and power supply and storage facilities, except for explosives storage, ammonium nitrate storage, and the pumphouse with water tanks for household and drinking water supply and boiler house of Auezov Town, are designed as a single block in the southeastern part of the Bakyrchik deposit in the flattest areas of the existing terrain.

The site for the above facilities is selected outside the water protection/buffer areas, blast-induced fly-rock danger zones and the hazard zone of the explosives storage site, determined by blast effect analyses.

The ore processing facilities, with associated auxiliary and utility facilities, are located 1300 m south-east of the open pit. The processing area is divided into several conventional terraces to minimize earthworks and provide conditions for preparation of process plant feed:

- The lower terrace is occupied by the main process plant building with a recycle water tank and adjacent thickening facility and laboratory. The next terrace includes the crushed ore stockpile and primary crushing plant within the ore preparation facility and the highest terrace – a loading site for the primary crushing plant feed bin and buffer ore stockpile.
- The TSF will be located in the floodplane of the No-name Stream, below the existing TSF, and borders on it in the south.
- The carbon concentrate storage will be on the site of the unfinished tailings impoundment, 600 m north-east of the site of the processing facilities.
- The repair shops, outdoor repair and mounting site, materials and equipment outdoor storage, as well as reagent and finished concentrate storages, are arranged northeastward on another terrace, based on the local zones in maximum proximity to the main process plant building.
- On the same site, between the main process plant building and repair and storage facilities, there will be a utility facility (pumphouse with water tanks for process and fire water supply) and an office and amenity block (canteen for 100 seats).
- The treatment facilities for household sewage will be also located on a separate terrace, adjacent to the north-east side of repair and storage facilities site.

- A pumphouse with water tanks for household and drinking water supply will be outside the sanitary protection zone, 800 m west of the processing facilities.
- The heat and power supply facilities, as well as storage facilities, are arranged at several sites.
- The site for a boiler house with a flue gas stack and coal and ash storages will be on yet another terrace, in close proximity to the process plant site, and arranged north-northwesterly, based on the wind rose with prevailing winds directed away from the other Project facilities. Closeness of the *coal*-fired *boiler house also allows to shorten the distance of heat supply to major Project site consumers.*
- The main step-down transformer substation (GPP-110/35/6kV) is 500 m to the west of the processing facilities.
- The Auezov's utility facilities are also located at several sites. The boiler house with a flue gas stack and coal and ash storages, designed for the needs of Auezov Town, will be in the town western edge, between the existing sewage pump station and treatment facilities. The water tower is in the northeastern edge, 270 m west of the mine site and 6 kV indoor switchgear – in the centre of Auezov's southern periphery.
- The fuel and lubricants storage site will be 200 m north-west of the processing facilities. The site has its own storm water treatment facilities, where polluted runoff from all over the storage area is collected and treated.
- The ammonium nitrate storage will be in the northeastern part of the allocated land, 400 m from the dump. It is adjacent to the road heading to the explosives storage to minimize transportation costs.
- The explosives storage site will be away from the other Project facilities, 500 m north-east of the ammonium nitrate storage. The minimum allowable distances to the Bakyrchik facilities, as required to prevent propagation by blast (shock wave), as well as minimum safe distances to the transportation lines, were taken into account when selecting the explosives storage site.

The principle of maximum separation of the production and utility traffic flows was used in the design. All Project areas are linked by separate support roads, access ways and ramps to avoid intersection of traffic flows.

Maintenance of the site territory (snow removal and spreading of de-icing agents in the winter, clearance of debris, watering of roadways and vegetation in the summer) is proposed to be performed using the existing BMV equipment and machinery.

Fire engines access is provided to all buildings and facilities within the Project site, including the existing, upgraded and design facilities.

The site perimeter security will be ensured by the existing fences around the facilities and new galvanized steel-wire fences, erected along the perimeter of the design facilities using 2.6m-high metal posts.

Two gatehouses will be constructed to control access to the BMV site – mine site and process plant entry and exit points.

A mobile (movable) guard will be used in the open pit along the entire perimeter of a fly-rock danger zone to protect people during blasting operations.

Utility networks are arranged in the plan in undeveloped areas (free of buildings and roads) with the shortest routes spaced as closely as practicable and meeting the regulatory requirements to distances to buildings, facilities and access ways.

Appendix 5.4.1: GHG Calculation Tables

Appendix 5.4.1

Table 1: Annual Diesel Fuel Consumption & GHG Emissions during Construction

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
diesel fuel consumption, t	53.71	1271.9	841.24	86.45	134.66	238.34	0	53.71	1271.9	169.08	206.22	83.36	254.98	215.76	179.18
CO_2 emissions, t	169.1	4005.5	2649.3	272.3	424.1	750.6	0	169.1	4005.5	532.5	649.5	262.5	803.0	679.5	564.3
N_2O emissions, t	0.0089	0.2108	0.1394	0.0143	0.0223	0.0395	0	0.028	0.0342	0.0138	0.0423	0.0358	0.0218	0.0316	0.0297
CH_4 emissions, t	0.0089	0.2108	0.1394	0.0143	0.0223	0.0395	0	0.028	0.0342	0.0138	0.0423	0.0358	0.0218	0.0316	0.0297
CO_2e emissions, t	172.1	4075.3	2695.4	276.9	431.5	763.7	0	178.4	4016.8	537.1	663.4	274.4	810.22	690.0	574.1

Table 2: Annual Electrical Import and & GHG Emissions during Construction

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Carbon Emission Factors tCO2e/MWh	0.995	1.003	0.998	0.918	0.921	0.919	0.919	0.919	0.919	0.919	0.919	0.919	0.919	0.919	0.919
Power consumption MWh/y	256	710	1297	755	0	197	0	0	119	197	557	324	180	0	197
CO2e emissions, t	254.7	712.1	1294.4	693.1	0	181	0	0	109.4	181	511.9	297.8	165.4	0	181

Table 3: Annual Diesel Fuel Consumption & GHG Emissions during Operation

		Diesel*	CO_2	CH_4	N_2O	CO_2e
		t	*t*	*t*	*t*	*t*
2016 - 2024	Open Pit	23691.93	81645.63	3.927	3.927	82945.45
2026 - 2039	Underground	7862.16	15929.96	0.838	0.838	16207.48

* *Averaged over the years of open pit operation and underground operation respectively*

Table 4: Annual Coal Consumption & GHG Emissions during Operation

		Coal	CO_2	CH_4	N_2O	CO_2e
		t	*t*	*t*	*t*	*t*
2016 - 2024	Open Pit	5190	8892.5	0.0007	0.001	8915.4
2026 - 2039	Underground	6320	10828.6	0.0007	0.001	10856.6

Table 5: Annual Consumption of ANFO & GHG Emissions during Operation

		Ammonite	Ammonium Nitrate	Fuel Oil*	Total ANFO	CO_2e **
					t	*t*
2016 - 2024	Open Pit	110	17220.0	861	18191	3092.5
2026 - 2039	Underground	236	2059	102.95	2397.95	407.7

* *Assuming 5% Fuel Oil ratio to Ammonium Nitrate*

** *Australian Government - Department of Climate Change - National Greenhouse Accounts (NGA) Factors - Jan 2008*

Table 6: Annual Electrical Import and & GHG Emissions during Operation

		Electricity	CO_2	CH_4	N_2O	CO_2e
		MWh	*t*	*t*	*t*	*t*
2016 - 2024	Open Pit	120832.09				113206.51
2026 - 2039	Underground	160446.60				157711.43

Figures estimated by Polymetal

Table 7: Total Emissions from Diesel Consumption during Closure and Decommissioning

		Diesel	CO_2	CH_4	N_2O	CO_2e
		t	*t*	*t*	*t*	*t*
2040-2041		6370	20060	1.056	1.056	20410

Table 9: Total Emissions from Coal Consumption during Closure and Decommissioning

		Coal	CO_2	CH_4	N_2O	CO_2e
		t	*t*	*t*	*t*	*t*
2040-2041		12640	21657	0.001	0.001	21713

Table 9: Total Indirect Emissions from Electricity Use during Closure and Decommissioning

		Electricity	CO_2	CH_4	N_2O	CO_2e *
		MWh	*t*	*t*	*t*	*t*
2040-2041		380				349

* *projected from published grid emission factor forecast for 2020*

Table 10: Emissions over Life of Mine

		Construction		Operation		Annual	Cumulative	.
	Year	Direct	Indirect	Direct	Indirect	Emissions	Emissions	
						(tCO2e)	*(tCO2e)*	
0	2015	172	712			884		
1	2016	4075	1294	27576	115690	148636	148636	
2	2017	2695	693	72062	121829	197279	345915	
3	2018	277	0	94731	114227	209234	555150	
4	2019	431	181	107970	114259	222841	777991	
5	2020	764	0	107227	113502	221493	999484	Open Pit
6	2021	0	0	107974	113366	221340	1220824	
7	2022	542	109	100725	111098	212474	1433298	
8	2023	661	181	88101	109471	198414	1631712	
9	2024	267	512	57078	105417	163274	1794985	
10	2025	817	298	47491	109194	157799	1952785	
11	2026	691	165	36458	101974	139289	2092074	
12	2027	421	0	27963	164562	192946	2285019	
13	2028	611	181	25635	157595	184022	2469042	
14	2029	574	4582	25830	159135	190120	2659162	
15	2030	0	0	25109	158160	183269	2842431	
16	2031	0	0	25767	157197	182964	3025394	
17	2032	0	0	25913	157087	183001	3208395	Underground
18	2033	0	0	25771	157711	183483	3391878	
19	2034	0	0	26103	157879	183982	3575859	
20	2035	0	0	26256	157544	183800	3759659	
21	2036	0	0	25107	157427	182534	3942193	
22	2037	0	0	24012	149217	173229	4115423	
23	2038	0	0	22236	142493	164729	4280151	
24	2039	0	0	16309	124582	140892	4421043	
25	2040	0	0	21719	175	21893	4442936	Closure
26	2041	0	0	20405	175	20579	4463516	
	Total	13000	8909	1211527	3230964	4464400		

Appendix 5.10.1: Environmental Design Criteria

Environmental design criteria

Bakyrchik mining and processing plant

Measures aimed to improve wellbeing of the project region, which, along with social advantages, ensure environmental benefits due to rehabilitation of the abandoned mine site. Renewal of BMV activities will have an overall positive effect on economic development of the Zharminsky District in the East Kazakhstan Region. BMV business development is a practical step to promote economic growth of the Republic of Kazakhstan in general. Favourable social effects are expected (growth of employment opportunities, personal incomes, and payments to government budget). The mine will be constructed on the lands which are not used for agriculture. After the end of mine life, mine closure will be carried out, which will include rehabilitation and recultivation of disturbed lands. Within the social commitments, ownership of some of the facilities can possibly be transferred to the Akimat (local authority) for community needs.
Measures aimed to mitigate impacts on ambient air during the operating life of planned Bakyrchik mine facilities include: 1. Dust suppression in work areas and dumps, and watering of mine roads. 2. Equipping of conveyor and ore crusher transfer sections with baghouses for dust capture and return to the process. 3. Equipping of concentrate drying and big bag packing areas with local exhaust ventilation with baghouses for dust capture and return to the process. 4. All buildings and facilities shall be equipped with forced and natural supply and exhaust ventilation, which is designed for dilution of emitted pollutants.
Measures aimed to mitigate impacts on surface water during the operating life of planned Bakyrchik mine facilities include: 1. Site grading for planned facilities is designed, taking into account local terrain and geological features. The sites shall be sloped and soil shall be compacted in order to ensure storm and snowmelt water discharge. Water collection and diversion drains are also designed for water discharge. 2. Installation of a stream diversion channel, which will be located north of the planned dump and will divert the Kyzyltu and Akbastaubulak creek water into a receiving water body (Holodny Klyutch creek). 3. Installation of a stream diversion channel for the No-name creek to divert its flow outwards the TSF area. 4. Installation of a polyethylene film impervious liner at the bottom of the tailings impoundment, containment dams/dikes No 1 and No 2, upstream dam No 1, and the intercepting ditch. A drainage system is designed upstream of the upstream dam No 1 to capture and divert the No-name creek underflow to the stream diversion channel. 5. Use of the recycle water, consisting of the clarified TSF water and thickener overflows. 6. Diversion of surface run-off from the area, where the operating open pit and a waste dump are located; diversion of pit and dump water, as well as removal of suspended

solids and petroleum products in settling ponds.

More detailed information: Storm, snowmelt and ground waters inflow into the mined ouy void of the pit (Eastern site and Western site), which are hereinafter referred as pit water.

Pit water is pumped via pressure pipelines to the pit water settling pond, which is located in the existing mined out open pit and retained by the pit water settling pond dam.

Overburden (waste rock) dump is located on the pit slope. Storm and snowmelt dump water inflows from the dump site.

The dump water is diverted by ditch No 1 on the southern side and flows through settling pond No 1.

The dump water from the northern dump side is collected by ditch No 2. It then flows through settling pond No 2 and the settling ponds, which are contained by protecton dikes /bulkheads No 1 and No 2 in the Akbastaubulak and Kyzyltucreek valleys.

From the pit water settling pond, water proceeds to one of three possible directions:

- clarified pit water is sent to processing and fire-fighting water supply reservoirs on the mine site and to the tailings storage facility (via the first pipeline);
- in case of excess wastewater, it is discharged to a receiving water body after additional treatment in the existing mine water treatment facilities (via the second pipeline);
- during the period of underground mining, clarified pit water is sent to process and fire-fighting water supply reservoirs, which are located in the western, central and eastern sections of the underground mine (via the third pipeline).

7. Pumping of mine water from the existing underground mine workings, using the existing pumphouses via the Capital shaft to the surface, to the existing mine water treatment facilities.

During the period of underground mining, the in-pit sump continues operating, however, it is upgraded to handle increased amounts of water, which inflows into the pit, including mine and process water, delivered by the proposed mine de-watering system.

During the period of surface mining, the existing mine water treatment facilities are used to handle water from in-pit sump and mine de-watering system, when not required for process water supply.

During the period of underground mining, the existing mine water treatment facilities are upgraded to handle increased amounts of mine and pit water.

Equipping of the ore buffer stockpile with a 0.5 thick clayey impervious liner and filling of 1.5 thick gravel layer. The surface is sloped to location of the drainage pumphouse of the ore buffer stockpile. Collection and diversion of drainage water into the tailings impoundment to be then used for recycle water supply of the plant.

8. Equipping of the carbon product storage with an impervious liner, consisting of compacted rock bedding course, base soil course without large inclusions (made of particles less than 20 mm) and 1.5 mm thick polyethylene film; the surface is sloped to location of the drainage settling pond, which is located in the existing depression in the immediate vicinity of the storage. Diversion of the drainage water, which has been clarified in the settling pond and has infiltrated through the filtering dam, to the TSF to be then used for recycle water supply of the plant.

9. Collection and diversion of surface run-off from the Fuel and lubrication

materials site to local treatment facilities to remove suspended solids and petroleum products. Diversion of the treated run-off to the TSF to be then used for recycle water supply of the plant.

10. Collection and diversion of surface run-off from the sites of the process plant and heat and power supply facilities, using the drainage system, to the stormwater collection pond. Clarified water will be used for watering roads and site pavements.

11. Diversion of the surface run-off from the sites of the reagents store and repair and storage facilities along the sloped area to the TSF to be then used for recycle water supply of the plant.

12. Installation of local treatment facilities (water treatment packaged plant with mechanical, electrowinning, and physical and chemical treatment stages) for the recycle water supply of the vehicle wash area in the repair shop.

13. Diversion of household sewage from the mine site (mining area) to the existing sewer of Auezov Township and then to the existing municipal sewage treatment facilities.

14. Wastewater from other sites will be discharged into proposed treatment facilities. A range of treatment facilities, included in the process design, provides for high biological purification to meet MAC acceptable limits for fisheries. The treated and detoxified water is discharged to the TSF to be then used for recycle water supply of the plant.

15. At all stages of the mine life, regular observations will be carried out to monitor mine water pumping rates, chemistry, and sanitary and epidemiological parameters.

16. Waste collection and temporary storage in designated equipped sites in order to prevent the area littering and surface water contamination.

Measures aimed to mitigate impact on groundwater during construction and operation of the design Bakyrchik mine facilities include:

1. Water consumption and discharge control (recording);

2. At all stages of the mine life, groundwater levels and chemistry will be monitored in the adjacent area, using groundwater monitoring wells.

3. Installation of impervious liners in TSF structures, ore buffer stockpile and carbon product storage to ensure protection of the adjacent area, including groundwater, from penetration of pollutants.

4. Collection and diversion of drainage water from the sites, such as the TSF, ore buffer stockpile, and carbon product storage.

Measures aimed to mitigate impacts on the subsurface environment during construction and operation of the design Bakyrchik mine facilities include:

1. Construction site grading is designed, taking into account local terrain and geological features of certain project sites.

2. Establishment of systematic mine surveys and instrumental observations over stability and failures of pit walls and dump slopes.

3. Productive drilling at the Bakyrchik deposit throughout its mine life to obtain the most reliable exploration data, which are essential for long-term, mid-term, annual, quarterly and monthly mine planning, mining process management, and control over completeness of extraction and grades of minerals.

4. Due to low competence of ore and host rock (in contact with ore), underground mining will be carried out using paste backfill, which has the following roles:

- ensuring complete ore extraction and minimal mining dilution;
- ground control and movement management;
- ensuring mining safety.

Soil protection measures during construction and operation of the design Bakyrchik mine facilities include:

1. General layout, transportation lines and utility systems shall be designed so as to preferably employ land plots with disturbed natural terrain and topsoil.

2. Prior to construction, vegetated topsoil (if any at the site) shall be removed and stockpiled in a designated place to be then used for site landscaping. After technical considerations of the designated mine closure project or closure project for each of the mine facilities have been implemented, the stockpiled vegetated topsoil will be used for disturbed land reclamation.

3. Installation of impervious liners in TSF structures, ore buffer stockpile and carbon product storage to ensure protection of the adjacent area, including groundwater, from penetration of pollutants.

4. Collection and diversion of drainage water from the sites, such as the TSF, ore buffer stockpile, carbon product storage;

5. Waste collection and temporary storage in designated equipped sites in order to prevent littering and soil contamination in the adjacent areas.

Environmental protection measures related to industrial and household waste management

1. The industrial /production and household wastes, generated at the primary and auxiliary sites (facilities) of the mine, which are not to be used on site, shall be transferred to outsourced specialized companies. Transfer is carried out on the basis of contracts between BMV and the above companies. The company, which receives wastes, shall have an appropriate license for handling certain waste type according to RoK legislation.

2. Temporary waste storage locations shall be established within the framework of RoK laws and regulations, which regulate industrial and household waste management, as well as in compliance with BMV's Health, Safety and Environmental Risk Management Policy.

6 CONSIDERATION OF ALTERNATIVES

During the feasibility stage of the Project the potential project design alternatives were reviewed, in line with the requirements (rationale) of the Project and the environmental and social implications. Chapter 3 provides the main project description of the design and components that comprise the Kyzyl project. This Chapter contains a discussion of the alternative options and gives the rationale for the options chosen, with comments on the environmental context.

6.1 Extraction and Processing Technologies and Techniques

Mining Methods

The deposit is shallow and is readily amenable to conventional open pit mining, utilising blasting, loading shovels and truck haulage. The option of underground mining has also been assessed. Post-review a combination of open pit mining with subsequent underground mining has been selected for a number of reasons:

1. Open pit mining by the proposed method is the most economic option for near-surface deposits of the grades and characteristics defined at Kyzyl;
2. There are lower technological risks through utilising both methods;
3. Initial open pit mining will facilitate the longer term development stages of underground mining;
4. Initial open pit mining will develop the existing surface mine and enable higher recoveries of the mined orebody.

The technical challenges and cost of open pit mining limit the feasibility of extracting the ore body to its full depth, which thus requires subsequent underground mining of deeper reserves. The depth of the ore body that can be extracted by surface mining is limited by a stripping ratio which increases with depth from the surface. These reserves (and any subsequent deep reserves discovered by further exploration) will remain as assets for future underground mining.

The above methodology means the annual ore output can be increased from 1500 K t/year that could be achieved through underground mining, to 1800 K t/ year utilising higher tonnage equipment during the open pit mining stage.

Mining by open pit methods results in a different range of environmental and social impacts compared to underground mining, including potential impacts associated with dust emissions, permanent disruption and loss of land area, waste rock and overburden production, and resulting GHG emissions. At Kyzyl (in common with the majority of similar hard rock open pit mining operations) there is an intention to backfill the open pit with the waste and/or tailings material, to restore the original ground surface and reduce potential risks from waste materials. This alternative of progressive mining and backfilling is feasible with this type of orebody. The mine design is based on the following:

a) In this location, the loss of land during surface mining is offset by the productivity during this phase, combined with the engineering and processing capacity that can be developed for the mine life (including underground mining);
b) The environmental effects according to this assessment are generally not significant, provided that appropriate mitigation measures are implemented (see Chapter 8). The development of the surface mine operations would also generate employment both within the mine and in the associated service sector.
c) Utilising open pit methods allow the cut-off grade to be reduced from 3 g/t to 2 g/t.

Processing Technologies

Gold extraction from ores is based on four principal technologies:

- Gravity extraction of free gold from crushed and milled ores; this is only possible if the gold is free and accessible.
- Mercury amalgamation to extract the chemically or tightly bound gold within the ores, with subsequent heating to drive off mercury as a gas. The use of mercury is highly regulated due to its high toxicity and persistence in the environment.
- Extraction of gold using a cyanide solution and carbon adsorption (CIP or CIL) process, with subsequent extraction of the gold from the carbon and electrowinning. This process is well developed and has become the standard industry method for gold processing worldwide. Despite concerns about the toxicity of cyanide, it can be contained and is not persistent in the environment, and is extremely safe when used in a modern and properly managed operation. The process is regulated through adoption of the international cyanide management code.
- Extraction of gold using cyanide solution and HLP. The recovery rate of gold is lower from heap leaching and the geology of the ore at Kyzyl (based on grade and sulphidic material) can be processed more easily by CIP.

At Kyzyl the gold is bound tightly within the mineral lattice, though some is free gold. It therefore has only very limited amenability to gravity extraction. Tests have shown that the gold at Kyzyl is readily amenable to multistage flotation, including carbon and sulphide circuits, with sequential recovery possible after each grinding stage. Flotation is the metallurgical process selected for the Kyzyl project. The concentrate product from flotation will be transported, via freight rail, to another facility for further processing. Alternatives within this option are mainly concerned with optimising the process to maximise gold recovery and minimise the use of reagents.

Tailings Disposal

The location of the tailings storage facility (TSF) was selected based on the volume of tailings to be disposed and the local terrain. Terrain in the vicinity is undulating with an elevation variation of 420–460 masl. A number of tailings disposal options were considered at various stages:

1. Lined or unlined base of the TMF, to reduce seepage to groundwater. Whilst the groundwater resources beneath the area are not highly sensitive, and rock permeabilities are low, given the potentially reactive tailings and possible metal content, it was considered that lining with a membrane was a required mitigation measure.
2. An impoundment with hydraulic disposal of tailings was selected as the main TSF option to maximise water recycled back to the plant.
3. A single or multiple TSF compartment configuration. A conceptual design was undertaken for a single compartment configuration for the tailings disposal. This option however would not have enabled the TSF to be closed and rehabilitated progressively, in stages. Therefore an impoundment formed by containment dam No. 1 which will be the main facility, and No. 2 which will be used as an expansion of the first dam.

The dams will be constructed from topsoil stripped from pit waste rock and a tailings pond bed.

6.2 Siting of Project Facilities and Infrastructure

It is accepted that the location and orientation of the mineral deposit itself determines the location and configuration of the open pit. Subject to this, other components of the project can be located according to:

- operational convenience and logistics, generally minimising the distances for haulage, pipelines, etc;
- appropriate topography, ground conditions and other engineering factors;
- environmental and social constraints or sensitivities.

The identification of suitable locations to accommodate items of potentially contaminative infrastructure has key environmental, social and economic implications for the viability of the Project. Improper site selection could also result in health and safety hazards and long-term environmental and social liabilities. Thus, the site design process has considered both technical and non-technical issues, such as land suitability, in-country legal requirements, as well as technical, economic, environmental and social criteria.

In the case of Kyzyl, the siting of Project components has been based principally on the existing mining / industrial layout together with maintaining access to the ore body during surface and underground mining. Both the waste dump and TSF are located close to the other components, on ground with the most suitable configuration. The ore processing facility, which comprises the ore buffer stockpile, ore preparation facility and processing plant, is sited adjacent to the location of the old TSF facility.

The waste dump is located in close proximity to the northern side of the open pit exits reducing the transportation requirements and dust generation. The position is determined by the initial location of open pit mining, site topography, geotechnical slope stability analysis and rational distance of waste rock haulage.

The mine camp is located to the south east of the main site and at sufficient distance so that it is unaffected by dust or noise from the operation, or at risk from an accidental release or fire at the plant.

6.3 The Zero Option Alternative

The option of not having the project would result in closure of the mine in its current state. The national policies of the RK encourage the exploitation and development of the country's mineral wealth, for national and local economic benefit. If this can be done without environmental and social impacts that render the benefits un-sustainable or un-balanced, then the zero option is only a hypothetical option.

If the project was not to proceed, then the existing status and abandoned condition of the site would continue, with the mineral asset remaining in the ground and accessible for the future. The following immediate benefits would not accrue:

- Contribution to the national budget through tax revenues and royalties, both direct and indirect;
- Contribution to the regional economy through local employment taxes and spending, provision of goods and services and general economic activity;
- Opportunity to reclaim and restore the abandoned site through the mine closure plan proposed under the present proposals.

Whether these are of greater benefit in the short term, against holding off for future development under conditions that may be more or less favourable, cannot be accurately forecast.

The ESIA will summarise the key decision process to reach the Project design as presented in the FS. It includes a description of the different components of the proposed Project, including the alternatives which were considered for mining methods and equipment, processing flow sheet and the location and design options for surface infrastructure (Process facility, TSF, waste rock dump, transportation, accommodation, access, services and utilities).

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT

7.1 Introduction

Chapter 5 of this ESIA contains the assessment of the potential impacts resulting during the lifecycle of the Project. The significance of potential impacts together with appropriate mitigation and monitoring requirements in order to reduce them to within acceptable levels have also been identified in Chapter 5. This chapter provides a summary of the impacts, corresponding planned mitigation measures and management plan requirements. It also identifies any significant residual impacts, taking account of planned mitigation measures either incorporated into the site design, or through management plans. The hierarchy that has been adopted for assessing the significance of potential impacts has been organised to include the following:

Sensitive receptors:	People (communities) Employees Government Water (local water courses, local water supply) Flora Fauna Soil Air	
Stage and duration of the development:	Construction Operational Closure and post-closure	
Geographical coverage:	Local	The Project study area
	District	Auezov and Shalabay administrative areas
	Regional	Geographic area of East Kazakhstan Oblast
	National	Features or receptors of importance within Kazakhstan
	International	Feature or receptors that are recognised with international status
Duration of the effect:	Short to Long term Reversible or Irreversible though the life of the Project	
Nature of the effect:	Beneficial Neutral Adverse	

The nature of the effect has been combined with the degree of significance – to derive a level of significance for each potential impact, according to the following:

Level of significance:

Environmental Aspects
Very High
Major
Moderate
Minor / negligible
Positive

Social Aspects	
High (negative)	**High (positive)**
Moderate (negative)	**Moderate (positive)**
Low (negative)	Low (positive)

For all environmental aspects (Chapter 5, sections 5.2 - 5.9), the following categories have been used to summarise level of significance in the impact assessment tables (for pre and post mitigation) included in 7.2 below:

- Neutral ('None' in Chapter 5)
- Adverse ('Minor' in Chapter 5)
- Significantly adverse ('Moderate' and 'Major' in Chapter 5)

Only aspects considered significantly adverse prior to mitigation, or requiring mitigation, are summarised in 7.2.

For Social aspects (Chapter 5, sections 5.13 - 5.17), the following categories have been used to summarise level of significance in the impact assessment tables (for pre and post mitigation) included in 7.2 below:

- Significantly Positive ('High' positive in Chapter 5)
- Positive ('Moderate' positive in Chapter 5)
- Neutral ('Low or negligible' – positive or adverse in Chapter 5)
- Adverse ('Moderate' adverse in Chapter 5)
- Significantly adverse ('High' adverse in Chapter 5)

Only positive aspects and aspects considered adverse or significantly adverse, prior to mitigation, are summarised in 7.2.

The level of significance is a measure of the degree of change, as a consequence of a potential impact, in comparison to the baseline environment for a specific sensitive receptor. Significance has been assessed, to take account of:

- Mine design and process controls that are integral to the operation of the Project (in line with mitigation design), these include industry best practice;
- Measures that have been put in place as a consequence of specific management plans whose implementation is critical to reducing the effect of a potential adverse impact to non-significant (i.e. measurable effect is moderately adverse or neutral); and
- Measures that have been implemented through specific management plan requirements, which as a consequence of implementing the policies and procedures would result in a significant improvement (or benefit) when compared to the baseline condition (i.e. the measurable effect is significantly improved).

Following the findings of this ESIA, a cohesive approach to environmental and community/social management is required for future Project development and review to take account of the Project parameters.

7.2 Summary of Significant Impacts

Table 7.1: Summary of Significant Impacts

Environmental / Social Aspect	Potential Significant Impact	Geographical Coverage	Relevant Performance Standard	Project Phase			Sensitive Receptor	Control / Enhancement Measures	Significance of Effect			Framework Management Plan Reference
				Construction	Operation	Closure			Without Mitigation	With Mitigation (Short Term)	With Mitigation (Long Term)	
Climate Change	Greenhouse Gas Emissions from Offsite power generation, onsite mobile plant and heating plant emissions	Local/District/Regional	PS1, PS3	X	X		Air	Energy efficiency measures incorporated into engineering design. Use modern, energy-efficient mobile plant Regular maintenance on mobile plant Find energy efficiency in detailed design	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP6: Air Quality Management Plan
Acid Rock Drainage	Contamination of mine water from PAF and As-rich rock exposed in pit walls and underground workings.	District	PS3		X	X	Water,Soil	Characterisation, identification and delineation of any PAF and As-rich rock in the pit shells and U/G workings. Collection of all pit sump and U/G dewatering water for re-use within the Project, with storage in the TSF. Modelling of final pit shell geology for predicting post closure risk of ARD prior to complete pit flooding. Monitoring of groundwater around the mine workings to ensure the effectiveness of mitigations	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP1: Water and Wastewater Management Plan MP5: Mine Closure and Rehabilitation Plan
	ARD or metal contaminated runoff or seepage from Carbon cake storage facilities.	Local	PS3		X	X	Water,Soil	Management of carbon cake in a closed system, with all contact water collected and directed to the TSF. Monitoring of groundwater in the vicinity of the CCSF to inform the management measures Cover, seal and vegetate the facility as soon as carbon flotation ceases.	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP1: Water and Wastewater Management Plan
	Generation of contaminated water from ore stockpiles	Local	PS3		X		Water,Soil	Design and construct the ore stockpiles to contain all runoff and seepage Collect all contact water and reuse within the Project, with storage at the TSF if necessary Avoid long-term storage of ore materials (<2 months). If LGO stockpiling is necessary, they will be lined, and managed as a closed system. Ensure processing and/or removal of all ROM and LGO stockpiles at end of mine life.	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP1: Water and Wastewater Management Plan
Air quality	Point Source Emissions from boilerhouse and heating unit stacks	Local	PS1, PS2, PS4		X		Air; People	Construct boilerhouses and heating units with sufficiently high stacks so that combustion gas emissions do not mix close to the ground and so increase pollutant concentrations at receptor locations; Use dry low NOx type coal burners of proven, advanced design to reduce NOx emissions; Explore options to reduce SO2 emissions, through selection of coal with low sulphur content if feasible;	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP6: Air Quality Management Plan
Noise	Residential disturbance and nuisance due to noise	Local	PS3		X (2016)		People	Undertake baseline noise monitoring Additional noise management measures to be developed during detailed design phase Noisy activities during daylight hours, when practicable	**Major**	**Major**	**Moderate**	MP14: Noise Management Plan
	Residential disturbance and nuisance due to noise	Local	PS3		X (2019)		People		**Major**	**Moderate**	**Moderate**	MP14: Noise Management Plan
	Residential disturbance and nuisance due to noise	Local	PS3		X (2027)		People		**Moderate**	**Minor / negligible**	**Minor / negligible**	MP14: Noise Management Plan

								Use silenced equipment or attenuated equipment				
Soils	Loss and degradation of soil	Local	PS1, PS3, PS6	X	X	X	Soil	Use of appropriate methods of soil handling, storage and restoration to preserve soil quality and minimise risk of erosion. Restoration of disturbed areas after mine closure using stored soil resources	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP7: Soil Erosion Plan
Water												MP1: Water and Wastewater Management Plan
Biodiversity	**Land clearance and loss of land to construction and mining:**											
	Loss of lowland mesotrphic grassland - Wild Rosemary	Local	PS6	X	X		Flora	Apply avoidance measures as per MP8 Undertake research into potential translocation	**Moderate**	**Moderate**	**Minor / negligible**	MP8: Biodiversity Management Plan
	Loss of foraging or hunting territory: Golden eagle	Local	PS6	X	X		Fauna	Further field work in the second half of April or September - October to confirm the status and activity of Golden Eagle (actively hunting or just passing through) Additional monitoring every 2 to 3 years	**Moderate**	**Moderate**	**Minor / negligible**	MP8: Biodiversity Management Plan
	Loss of habitat for endangered species: Large Heath Butterfly	District	PS6	X	X		Fauna	Further field work to determine exact locations of populations prior to construction Avoid disturbance of identified areas where possible Translocate populations if avoidance not possible	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP8: Biodiversity Management Plan
	Natural riparian habitat lost to development											
	Diversion of headwater of Akbastaubulak leading to reduction in flow, loss of biodiversity, potential habitat changes	District	PS6		X	X	Fauna, Flora	Further studies will be required to fully assess the scale of the impact and to help devise appropriate mitigation measures, prior to constructing diversion Monthly mionitoring of water levels and flows in Akbastaubulak	**Moderate**	**Moderate**	**Moderate**	MP8: Biodiversity Management Plan
	Reduced quality of remaining habitat caused by Project-related actuivities (soil erosion, pollution, disturbance, noise, lighting etc.)											
	Reduced populations of rare/endemic plant species	Local	PS6	X	X		Flora		**Moderate**	**Minor / negligible**	**Minor / negligible**	MP8: Biodiversity Management Plan
	Construction and use of high structures, like powerlines											
	Electrocution risk to Golden Eagle from insufficient spacing between phase conductors and grounded hardware	Regional	PS6	X	X	X	Fauna	Consider installation or retrofit of "avian-safe" power transmission lines; or ensure exposed parts should be insulated to reduce electrocution risk	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP8: Biodiversity Management Plan
	Deposition of toxic or harmful elements and substances reducing viability of rare/endemic plants; and potential toxic effects on Golden Eagle and Large Heth Butterfly	Regional	PS6	X	X		Fauna, Flora	Emissions controls and monitoring Prevent pollution that can make habitat less attractive to prey species	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP8: Biodiversity Management Plan
Ecosystems Services	No Significant Ecosystem Services impacts have been identified	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Archaeology	Loss of undiscovered artefacts	Local	PS1, PS4, PS8	X	X		Cultural heritage	Carry out chance find procedure	**Minor / negligible**	**Minor / negligible**	**Minor / negligible**	MP11: Cultural Heritage Management Plan and MP12: Chance Finds Procedure

Transportation and traffic	Increased HGV traffic flow on certain road links and junctions	Local	PS1, PS3, PS4		X		The highway network – capacity and integrity	Review roads network leading to the mine access points to assess ability of HGV and low loaders to negotiate the bends and the roads network safely. Implement formal road signage and potentially speed restrictions During deliveries of oversize HGVs or convoys, divert other traffic	**Moderate**	**Minor / negligible**	**Minor / negligible**	MP9: Transport Management Plan
Demography, Culture, and Governance	Direct employment and procurement	National	PS1, PS2	X	X		People	Recruitment policy prioritises local candidates by proximity; Employment statistics kept up to date; Audit list of contractors; Monitor changes to population through coordination with Akims; Monitor grievances; Monitor recruitment adverts and their effectiveness.	**Construction: Low (positive)** **Operation: Moderate (positive)**		**Construction: Moderate (positive)** **Operation: High (positive)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Indirect employment and procurement	National	PS1, PS2		X		People	Local recruitment policy to prioritise candidates by proximity. Benefits to local community through the multiplier effect.	**Construction: Low (positive)** **Operation: Moderate (positive)**		**Construction: Moderate (positive)** **High (positive)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Influx and movement of population	Local, Regional	PS1, PS4	X	X		People	Local recruitment policy to prioritise candidates by proximity.	**Moderate (negative)**		**Low (negative)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Increased spending - development of economic disparities	Local, Regional	PS1, PS4	X	X		People	Articulate local recruitment intent as clear policy; Develop cultural sensitisation and emersion course; Develop Influx Management Strategy in accordance with IFC guidance; Develop Community development management plan during construction period; Carry out random drugs and alcohol testing on employees; Employ community grievance mechanism and monitor recorded grievances.	**Moderate (negative)**		**Low (negative)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Influences on local culture	Local	PS1, PS4, PS8	X	X		People	Develop Influx Management Strategy in accordance with IFC guidance covering all stages of the Project.	**Moderate (negative)**		**Low (negative)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Accentuation of gender and generational disparities	Local, Regional	PS1, PS4, PS8	X	X		People	Employment statistics kept up to date to monitor gender and age statistics. (i) Recruitment policy promotes equality of opportunity for women; (ii) salaries not paid in cash; (iii) employee course in personal financial management. Employment and labour policy adheres to ILO standards on gender equality and avoidance of discrimination.	**Moderate (negative)**		Negligible (negative)	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Retrenchment	Local, Regional	PS1, PS2, PS4			X	People	Define employee closure/retrenchment policy; Develop strategic plan to mitigate adverse impacts of employee retrenchment.	**High (negative)**		**Moderate (negative)**	MP5: Mine Closure and Rehabilitation Plan; MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
Social Infrastructure	Increased Traffic – wear and tear on the roads	Local, Regional	PS1, PS4	X	X		People	Ensure road upgrade and maintenance proposals include road clearance in winter and ensure that the maintenance regime is sufficient to offset degradation.	**High (negative)**		**Low (negative)**	MP9: Transport Management Plan; MP10: Stakeholder Engagement Plan: MP13: Social Management Plan
	Increased Traffic – road traffic accidents	Local, Regional	PS1, PS4	X	X		People	On-going monitoring of road traffic accident rates and introduction of further traffic safety controls.	**High (negative)**		**Low (moderate)**	MP9: Transport Management Plan; MP10: Stakeholder Engagement Plan: MP13: Social Management Plan
	Social Issues – increased prevalence of STDs	Local, Regional	PS1, PS4	X	X		People	Polymetal to develop a policy on the prevention of STDs. Induction to outline policy to prevent the spread of STDs, including HIV.	**High (negative)**		**Low (moderate)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan

	Social Issues – increased alcohol related conditions and social maladies	Local, Regional	PS1, PS4	X	X		People	Short cultural sensitisation and emersion course for new employees.	**Moderate (negative)**		**Low (negative)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Cessation of project traffic reduces accident rates and introduction of further traffic safety.	Local, Regional	PS1, PS4			X	People	None required.	**Moderate (negative)**		**Low (negative)**	MP9: Transport Management Plan
Economy, Livelihoods and Labour	Macroeconomic impact	Local, Regional	PS1	X	X		People	Kazakhstan as a signatory of the EITI makes national government accountable for Project's tax contributions and shifts some focus of expectations to the recipient authorities.	**Moderate (positive)**		**High (positive)**	MP10: Stakeholder Engagement Plan; MP13: Social Management Plan
	Local and regional land tax	Local, Regional	PS1	X	X		People	Work with and clarify regional and local authority obligation to use expanded tax base to improve justice and enforcement capacity locally.	**Moderate (positive)**		**High (positive)**	MP10: Stakeholder Engagement Plan
	Land acquisition	Local, Regional	PS1, PS5	X	X	X	People	Minimise land take. Ensure practical remediation measures are selected to progressively remediate land.	**High (negative)**		**Moderate (negative)**	MP10 - Stakeholder Engagement Plan; MP12 - Chance Finds Procedure; MP13 - Social Management Plan
	Restriction of access - impacts on fishing and recreation	Local, Regional	PS1, PS6	X	X	X	People	Follow the findings of aquatic studies.	**Moderate (negative)**		**Low (negative)**	MP8: Biodiversity Management Plan; MP10 - Stakeholder Engagement Plan
	Land take impacts on agriculture - including arable and pastoral farming	Local, Regional	PS1, PS6	X	X		People	On-going community liaison to determine the impacts associated with land take and acquisition.	**High (negative)**		**Moderate (negative)**	MP8: Biodiversity Management Plan; MP10 - Stakeholder Engagement Plan
	Economic displacement - impacts on livelihoods, including on resettled people and hired herders	Local, Regional	PS1	X	X	X	People	Determine the impacts associated with land take; Continue to determine the effect on the livelihoods of affected people, like herders.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Engagement Plan
	Inflation of rental prices in Auezov	Local, Regional	PS1, PS4	X	X		People	Monitor local and regional labour market statistics.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Engagement Plan; MP13 - Social Management Plan
	Increased spending capacity of employees causing social problems	Local, Regional	PS1, PS4	X	X		People	Develop and implement an employee code of conduct; Develop cultural sensitisation and emersion course; Location of the main mine camp on-site rather than in Auezov settlement. Develop entertainment facilities on site for employees.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Engagement Plan; MP13 - Social Management Plan
	Increased spending capacity of employees benefitting the local and regional economy	Local, Regional	PS1	X	X		People	None required.	**High (negative)**		**Moderate (negative)**	MP10 - Stakeholder Engagement Plan; MP13 - Social Management Plan
	Labour working conditions	Local, Regional	PS1, PS2	X	X		People	Ensure working conditions meet IFC guidance and ILO standards; Continue to develop a full occupational health and safety plan.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Engagement Plan; MP13 - Social Management Plan
	Project development, implementation and closure - consultation and management of stakeholder expectations	Local, Regional	PS1, PS2, PS4	X	X	X	People	Polymetal liaise closely with project stakeholders; Polymetal complete regular updates to the Stakeholder Engagement Plan.	**Moderate (negative)**		**Low (negative)**	MP5 - Mine Closure and Rehabilitation Plan; MP10 - Stakeholder Engagement Plan; MP13 - Social Management Plan
	Permanent land take and sterilisation	Local	PS1, PS5			X	People	The project design has taken measures to minimise the project footprint; Ensure land re-classification occurs.	**High (negative)**		**Moderate (negative)**	MP5 - Mine Closure and Rehabilitation Plan
	Job loss and retrenchment	Local, Regional	PS1, PS2			X	People	Continue to develop employee closure/retrenchment policy; develop a strategic plan to mitigate the most adverse impacts of employee retrenchment. Develop community business and training forum to identify and boost linked but diversified and independently sustainable businesses.	**High (negative)**		**Moderate (negative)**	MP5 - Mine Closure and Rehabilitation Plan

Community Health, Safety and Security	Communicable disease linked to the living environment	Local, Regional	PS1, PS2, PS4	X	X	X	People	Local recruitment; Develop workplace accommodation guidance to include measures aimed at preventing the spread of communicable diseases; Monitor standards of accommodation and rates of communicable diseases.	**High (negative)**		**Moderate (negative)**	MP10 - Stakeholder Management Plan; MP13 - Social Management Plan
	High risk sexual practices, STIs including HIV/AIDS	Local, Regional	PS1, PS2, PS4	X	X	X	People	Develop policy on prevention of STDs; Implement employee educational awareness programme; Locate main mine camp on site; Develop transport management policy; Monitor rate of STDs and HIV.	**High (negative)**		**Moderate (negative)**	MP10 - Stakeholder Management Plan; MP13 - Social Management Plan
	Environmental factors influencing health	Local, Regional	PS1, PS2, PS4	X	X		People	Implement EIA mitigation measures and relevant management plans.	**High (negative)**		**Moderate (negative)**	MP10 - Stakeholder Management Plan; MP13 - Social Management Plan
	Local and regional health services	Local, Regional	PS1, PS2, PS4	X	X		People	Develop adequate first aid facilities on site and build relations with local hospital in case of emergencies. Monitor accident rate in the work place. Develop and implement an occupational health monitoring strategy.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Management Plan
	Security conflicts	Local, Regional	PS1, PS2, PS4	X	X		People	Train security guards; Review of security conflicts.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Management Plan; MP13 - Social Management Plan
Human rights	Human rights	Local	PS1	X	X	X	People	Operate in accordance with UN Guiding Principles 'Protect, ILO Core Conventions and the Voluntary Principles on Security and Human Rights. Monitor human rights impacts on a regular basis.	**Moderate (negative)**		**Low (negative)**	MP10 - Stakeholder Management Plan; MP13 - Social Management Plan

7.3 Environmental and Social Management System (ESMS)

Polymetal has a corporate commitment to occupational health and safety; environmental and community protection and wellbeing. The Company understands that an integral part of this will be the development of an integrated ESMS. The ESMS will amalgamate all relevant components of the operation into a single coherent system that promotes consistent and effective achievement of its purpose and vision. Additional steps and procedures for Project development which have been highlighted by the ESIA process will be incorporated.

A management system is a set of management tools and principles that allows companies to systematically manage their health, safety, environment, and community matters. It is a framework for continual planning, implementing, reviewing and improving an operation to integrate environmental and community concerns into daily business practices and generate reports on performance progress. Management systems do not set compliance standards, but instead set out procedures designed to meet performance requirements that are relevant to the Project and/or required by government agencies and Project lenders.

The EMS for the Project according to ISO 14001:2004 has been developed and implemented. It is possible that a separate Management System (social) will be developed in accordance with ISO26000.

IFC Performance Standard 1 requires that clients will establish and maintain an ESMS appropriate to the nature and scale of the Project and commensurate with the level of social and environmental risks and impacts. The management system is therefore required to incorporate the following elements: (i) Policy, (ii) identification of risks and impacts; (iii) management programmes; (iv) organizational capacity and competency; (v) emergency preparedness and response (vi) Stakeholder engagement and (vi) monitoring and review. A management programme is therefore required to take account of the relevant findings of the ESIA and the result of consultation with affected communities/stakeholders.

Polymetal is now in the early planning phase of ESMS development and will take account of findings in the ESIA to develop appropriate management systems. This will be promoted by the initial development of the Implementation Plan and will further consider elements such as: management, legal requirements, risk assessment, establishment of clear objectives and targets, and the development of continuous improvement plans and programmes. Planning to limit or mitigate potential social and environmental effects will focus on fulfilling health, safety, social and environmental requirements and standards of the Kazakh regulatory agencies and applicable international lending institutions and/or Project sponsors.

Elements of the planning phase will include:

- Periodic review of applicable laws, regulations, policies, and guidelines;
- Identification of existing social and environmental baseline conditions and projected impacts identified in the Impact Assessment;

- Definition of internal performance criteria;
- Implementation of livelihoods assessment and income restoration programmes for communities directly impacted by the Project;
- Development and implementation of community development initiatives that will limit economic dependence on the Project and beneficially contribute to the long-term sustainability of local communities;
- Establishment of health, safety, environment, and community targets and schedules;
- Establishment of monitoring programmes, including data management systems and reporting;
- Identification of internal and external resourcing needs, roles, responsibilities and chains of command required to deliver the provisions of the ESMS;
- Training programmes; and
- Implementation schedule and budget.

The framework ESMS will comprise the following, as a minimum:

- Baseline conditions: documentation evidencing the pre-existing environmental baseline conditions as identified in the ESIA and local EIA (OVOS) submissions.
- The identification of potential environmental impacts and register of emissions, discharges, etc. This is to be based on the work undertaken for the ESIA, and the design and operations plan.
- Identification of potential social impacts from the ESIA, and the design and operations plan.
- The definition of environmental standards and quality objectives. In many case the standards will be set by the appropriate regulatory authority. However, there may be instances where other appropriate standards are adopted. The standards should be accompanied by a system for responding to identified breaches of the standard.
- The definition of control systems for limiting the impacts of the identified emission/discharges to ensure compliance with standards. This will include, for example, a dust control strategy, waste water treatment, etc.
- The specification of an environmental monitoring programme to confirm and demonstrate the efficiency of control measures. This will include, for example, ground and surface water monitoring.
- A social and community monitoring programme, including measures taken to involve stakeholders in participatory monitoring programmes throughout the duration of the Project.
- Development relevant management plans, outlined in the following Section.

The framework ESMS will need continual updating and further development and refinement as the final configuration of the operation is designed in detail.

Framework Management Plans

The ESMS will contain the operation-wide and discipline-specific environmental and social management plans.

The overall objectives of management plan activities are to:

- Ensure regulatory requirements are met;
- Check that impacts do not exceed Project, national and international standards thresholds;
- Verify predictions made in the ESIA by obtaining real time measurements;
- Verify that mitigation measures are effective and implemented properly;
- Identify, track and provide early warning of potential environmental impacts;
- Regulate process efficiency of mining activities;
- Inform future operations; and
- Contribute to continuous improvement of Project environmental and social management.

Polymetal has developed a draft framework **Social and Environmental Management and Monitoring Plan** (fSEMMP). This provides basic information relating to a global overview of the Project, legislative framework, SEMMP objectives and relevant management plans, Environmental and Social Policy, current roles and responsibilities (discussed in Section 7.6), training, stakeholder engagement, grievance mechanism(s) and proposed environmental monitoring (see Management Plan 10).

Polymetal will integrate the findings of the ESIA with their fSEMMP and will expand existing environmental and social baseline data and impact assessment via the introduction of targeted and refined monitoring regimes for the construction, operation, closure, and post-closure mine phases. This will be undertaken as soon as possible, prior to construction at site. The purpose of this is to produce a plan in line with international best practice which outlines the key on-going management requirements identified by the ESIA process to evaluate the environmental and social performance of the Project.

Other key plans Polymetal should consider developing prior to major construction and employment of people on site, as a matter of Best Management Practice include:

- Erosion Control and Rehabilitation Plan;
- Air Quality (dust) Management Plan;
- Biodiversity Management Plan;
- Contractor Management Plan;
- Waste Management Plan;

- Community development plan (CDP) (developed from what has been outlined for community development planning in the ComMP). The CDP should be defined by a CNA and involve participation of the CLC and CLO;
- Security Management Plan;
- Compliance Assurance Plan;
- Occupational Health & Safety Plan;
- Human Resources Management System;
- Community Safety and Transport Management Plan;
- Local Employment & Training Plan; and
- Influx Management Strategy; and

Polymetal should allow adequate time for preceding dissemination and training of employees and other relevant stakeholders on management plans as required. Some of these documents have already been prepared by Polymetal but have not been reviewed by WAI. These should be reviewed against International Best Practice prior to implementation, and assessed by a relevant specialist. All framework management plans prepared by WAI should be developed further as part of the ESMS alongside an implementation plan.

For submission as part of the ESIA, WAI have prepared framework management plans developed to reduce significant impacts identified, as identified in the impact assessment tables in 7.2 above (See Management Plans 1 to 14).

The timeline for the development of required management plans is summarised in Table 7.2, by sector. All management plans listed below should refer to the SEP and disseminate information to relevant stakeholders using two-way communication and participation of appropriate stakeholders in developing the management plan where beneficial. All plans should be developed/developed further in accordance with International best practices e.g. IFC PS, International Council on Mining and Metals (ICMM) etc. Framework management plans included in the ESIA should be developed for full management plans as the Project progresses.

Table 7.2: Timeline for the Preparation, development & Implementation of Key Working Management Plans for the Development of Kyzyl Mine

Title	Description	Action Required by Polymetal	Timeline for Completion & Training (involving relevant Project stakeholders)	Implementation Date
Operational Control				
Implementation Plan	A pivotal document to the initial development the ESMS. This will outline management targets, mitigation measures & monitoring requirements for ESIA- identified impacts & provide details of how these will be implemented from construction onwards in order to negate potentially adverse impacts & enhance Project benefits. It will include time-bound management targets, commitments, resources, policies & procedures as well as monitoring & reporting requirements & Polymetal's. Required prior to construction to ensure commissioning, contractor & site preparation/clearance is appropriately managed from the outset.	Prepare plan	As soon as possible, before large-scale construction activities at site; subject to continual review/update	On-going
Social & Environmental Management & Monitoring Plan	The core of the ESMS. Polymetal has developed a draft framework Plan. This requires expanding to a working plan for all Project phases. This will include impact mitigation measures & compliance targets/thresholds from the ESIA, but also present project-specific considerations such as construction scheduling & methods, as well as operational practices, logistics, process & pollution control (spill prevention), application of technology/equipment & overarching management practices. A project-phased targeted monitoring programme will be included at sensitive locations to yield real-time measurements, verify emission compliance, regulate process efficiency & also provide early warnings of, and track, releases/impacts.	Expand internal plan	As soon as possible	On-going
Emergency Preparedness & Response	The framework plan identifies general environmental & H&S risks which may result in a spill or emergency scenario. Outlines prevention & preparedness measures, awareness & drills. It identifies employees responsible for taking actions, training requirements, the chain of command & the general procedure for dealing with an event, as well as the facilities required on site. Best practice in crisis communication & post-event actions as summarised. This requires refining following a project hazard & risk assessment exercise, once more detail is available on proposed project design & operational parameters.	Expand ESIA framework	1 month prior to large-scale construction	Prior to large-scale earthworks, use of explosive in pre-stripping or commissioning of facilities holding hazardous or large volumes of materials
Mine Closure & Remediation	Considers closure objectives & impacts, with commitment to progressive rehabilitation of worked a reas, decontamination of affected sites; providing stability of physical & chemical environmental factors. The development of a costed & more detailed plan is required for eventual closure & implementation of rehabilitation. An appropriate fund, & funding mechanism, to meet Kazakh & ICMC requirements will be included.	Expand ESIA framework	1 month prior to large-scale construction	Prior to construction (in relation to erosion control, topsoil/overburden storage and progressive rehabilitation)
Contractor Management Plan	Polymetal has overall responsibility for the Project & implementation of the SEMMP and ESMS, but much of the work (especially construction) will be carried out by contractors engaged by Polymetal. These include design firms, surveyors, permitting specialists, environmental field staff, as well as the main Construction Contractor (construction & commissioning phases). It will be important that Polymetal outline & implement procedures in this Plan to ensure that Contractors are fully aware of, & committed to, the Implementation Plan as well as relevant SEMMP, ESMS & H&S issues & procedures. The Plan will include the identification of Polymetal employees to coordinate the Plan & manage contractors; chains of command, contractor employment/HR policies; training & awareness requirements; H&S considerations (including inductions); procurement procedures; targets & non-compliance measures; monitoring of contractor performance; & sub-contractor agreements.	Prepare plan	1 month prior to commissioning contractors	Prior to engagement of contractors & commencement of activities at site
Security Management Plan	Outlines security requirements at each stage of the Project.	Prepare plan	1 month prior to large-scale construction	Prior to delivery of materials & establishment of man camp
Occupational Health & Safety Plan	The 'umbrella' plan of the H&S Management System (MS) to guide the implementation of H&S policies, procedures & practices at Kyzyl Mine to eliminate all those conditions & work practices that could lead to illness or personal injury. The broad objectives of the Plan & MS will be to: avoid the human, political & economic consequences of unsatisfactory occupational H&S standards; Comply with national & local regulations; adhere to IFC occupational H&S guidelines & other relevant guidelines, identify hazards & control risks; motivate all concerned to be positive about H&S.	Prepare plan	1 month prior to recruitment & contractor commissioning	Prior to commencement of activities on site
Environmental Control				
Acid Mine Drainage	The framework characterises potential acid- & metal leachate- generating potential of Kyzyl ore & waste lithologies; & tailings. It provides practical design measures for ARD prevention & mitigation (where necessary),	Expand ESIA framework	1 month prior to large-scale construction	Prior to substrate removal, landscaping, pre-stripping, foundation excavations, haul road

	control of low pH waters to ensure Kazakh discharge standards are met &/or baseline conditions are not detrimentally altered. Guidance on performance assessment & monitoring is given. Recommendations for further sampling & geochemical analyses are provided, as necessary. The plan will need updating as any further testwork is completed & to include detailed information from geology exposed at site (open pit, infrastructure foundations etc).			construction or any other earthworks
Water	Covers site-wide water resource (surface and groundwater) protection measures as well as principles of sustainability & quality management.	Expand ESIA framework	1 month prior to large-scale construction	Prior to the establishment of a surface water management system for construction activities, abstraction or discharge of any water & the sinking of any boreholes
Waste	Polymetal has developed a framework plan. This plan requires adapting & expanding in line with international best practice & IFC PS 3. It will address all non-geological solid waste streams generated, handled, transported and/or processed at Kyzyl. Aspects of rock and soil waste will be covered by the working ARD MP. WMP to focus on principles of waste minimisation (materials selection, process efficiency, resource maximisation, recycling and re-use), classification/characterisation, disposal, monitoring, documenting, training etc.	Expand internal Plan	1 month prior to large-scale construction	Prior to delivery of construction materials & establishment of construction base camp or any other activities generating non-geologically derived wastes
Erosion Control & Rehabilitation Plan	An integrated plan will be prepared from relevant aspects of the Water & ARD MPs.	Prepare plan	1 month prior to large-scale construction	Prior to any ground disturbance
Air Quality (dust) Management Plan	The purpose of the air quality management plan is to prevent the release of particulates or gaseous emissions into the environment surrounding a site and, where these releases cannot be prevented entirely, to minimise them as far as possible. Incorporates processing and haul vehicle activities.	Prepare plan	1 month prior to large-scale construction	Prior to any ground disturbance
Biodiversity Management Plan	Comprised of projects & initiatives aimed at the protection & enhancement of biodiversity identified to be at potential risk from Project activities. Defines the activities, expected results, performance indicators, implementation responsibilities & schedule for those activities to meet IFC PS 6.	Prepare plan	1 month prior to large-scale construction	Prior to any ground disturbance
Community and Employee Relations				
Stakeholder Engagement Plan	Stakeholder engagement is a broad, inclusive & continuous process between a company & its stakeholders. It encompasses a range of coherent activities and approaches, spanning the entire life cycle of a project from exploration to closure. The framework Stakeholder Engagement Plan (SEP) has been developed to outline formal & informal approaches to be undertaken during the ESIA phase of the Project only, in line with IFC guidance & requirements. Polymetal will need to expand & update this plan & their Social Engagement Strategy to guide consultation throughout Project implementation.	Expand and update ESIA framework SEP	As soon as possible	Post ESIA consultation/finalisation & prior to employment of local residents;
Community Management Plan	The ComMP framework needs updating when Polymetal' have developed a Social Strategy & Year 1 target objectives & partnerships, including those which will cover the needs of accommodating new employees. The ComMP includes a programme to monitor changes caused by the Project development in the socio-economic environment. It also outlines a community management plan and required procedures that Polymetal should develop.	Expand ESIA framework	As soon as possible	Prior to potential employment of local residents for construction activities.
Community Development Plan (CDP)	Develop full CDP once Polymetal have agreed a community development budget. Involve community members (including CLC) and CLO to disseminate findings. Monitor and evaluate the effectiveness of community development projects. Update CDP on a regular basis.	Expand ESIA framework outlined in the ComMP	As soon as possible with on-going review	
Human Resources Management System	Establish Humans Resources management system including employment and retrenchment policies and a grievance mechanism for Polymetal employees and establish employee inductions (including H&S, biodiversity, cultural heritage and traffic management aspects) and provide training programmes;	Expand ESIA Framework	As soon as possible	Prior to wide-scale employment on site.
Local Employment & Training Plan	Develop an overarching plan for providing introductory training and regular updates to new and existing employees. All new employees should get an induction, covering job specific training requirements and generic training (health and safety procedures, fire safety, management structure, awareness of the employee grievance mechanism etc). The local employment plan will ensure that where possible, employment opportunities are provided for local people.	Prepare plan	As soon as possible	Prior to commissioning contractors & potential employment of local residents for construction and ancillary activities. Before wide-scale employment on site.
Influx Management Strategy	In accordance with IFC guidance, an influx management strategy (IMS) should be developed to assist in managing the influx of people created through direct and indirect employment opportunities generated by Project development. An IMS requires consideration for the Project as a whole, throughout the duration of the Project. An IMS needs to consider the wider area beyond the area directly influenced by the development of a Project. The IMS should include:	Prepare strategy	As soon as possible	Prior to wide-scale employment on site.

	• Review of operational responsibilities; • Consideration and integration of influx management interventions into existing operations and other management plans; • Regular monitoring and evaluation to assess their effectiveness throughout the duration of a Project. Amendments of the IMS as required.			
Community Safety & Transport Management Plan	Will set out a detailed mitigation strategy to avoid and minimise impacts during all phases of the Project from construction, operation through to closure.	Prepare plan	As soon as possible	Prior to wide-scale employment on site.
Cultural Heritage Management Plan	Implement Cultural Heritage Management plan and measures as outlined in Management Plan 11. Ensure all employees are aware of the need to accommodate cultural sensitivities in work and HGV traffic around the Project site. Training all personnel working in construction activities on site about how the 'Chance Finds Procedure' operates. The Cultural Heritage Management Plan applies throughout the entire life of the Mine and needs to be updated should the Project change in any way that would have repercussions on the graves or community access to the graves.	Prepare plan	1 month prior to construction	Prior to any large scale construction or ground disturbance, at the earliest possible opportunity.

7.4 Company Policies

The Project has established formal policies and vision with respect to the environment, community and health and safety development, and is committed to the observance of environmental legislation of the Republic of Kazakhstan and international best practice. Polymetal recognise that environmental and social management are corporate priorities and the Company has already fully committed to the integration of environmental and social considerations at all levels of Project development and operations. The Company's programmes and procedures are aimed at minimising and mitigating any adverse environmental and social impacts.

Polymetal's SEMMP is contained within Management Plan 10 (Stakeholder Engagement Plan). It designed for setting and meeting high standards as a prerequisite for carrying on business in a sustainable society and the protection of life, health and the environment. Polymetal recognise that it has responsibilities towards the local communities in close proximity to the Project and seeks the best possible outcome for progression of the Project for all stakeholders. Community relationships require fostering to ensure mutual respect and understanding, active partnership and long-term sustainable commitment.

Polymetal will also continue to work towards ensuring the health, safety and welfare of all who are affected by its operations. Company policy outlines how the Project can continue to maintain, as far as is reasonably practicable, a working environment that is safe and without risk to health. To this end Polymetal will allocate sufficient resources and sound management systems to the fulfilment of this policy. As far as is reasonable, the Company will follow current best practice in all aspects of its operations. Polymetal's Health and Safety Policy has been designed to maintain, as far as reasonably practical, a working environment that is safe and without risk to health.

7.5 Outline Responsibilities & Organisation

Currently Polymetal has an Environmental Manager ('Project Ecologist') based on site who reports to the Operations and Production Manager, who in turn reports to the General Director of the site. This individual is responsible for the high-level management of the entire Kyzyl mine project. There is a Project Ecologist at Kyzyl who reports to the Project Operations Manager, who in turn reports to the General Manager. The Project Ecologist is assisted by additional Polymetal employees and sub-contractors, who carry out environmental sampling and monitoring.

A Community Liaison Officer (CLO) covers social and community management around the Kyzyl site, in particular in the villages of Auezov and Shalabay. The management structure of Polymetal at the Kyzyl site is illustrated in the organogram presented as Figure 7.1.

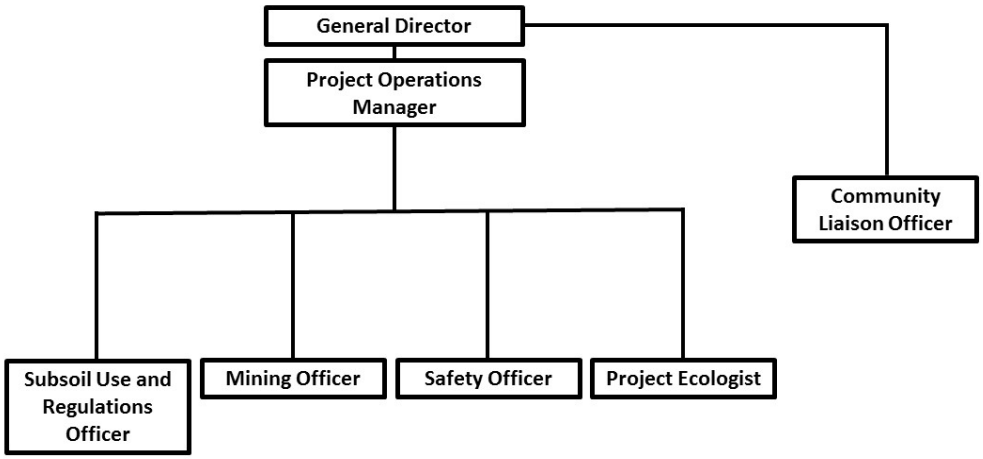


Figure 7.1: Polymetal resources for Kyzyl

Polymetal will ultimately be responsible for the implementation of, and compliance with, the requirements established in the ESIA and ESMS for Kyzyl, as well as any applicable national legislation, and will need to apply appropriate resources (monetary, staff, equipment etc.) to do so.

The Environmental and Social Manager should continue to be supported by formal Environmental and Community Offices/Departments of a sufficient number of suitably experienced support staff. All environmental and community matters will be directed and managed by these Offices. Matters concerning community engagement and conflict, community health and safety will be managed by a Community Liaison Officer, reporting to the Project Environmental and Social Manager.

The relevant Offices will be responsible for the proper management and control of documentation and records. Information should be made readily available on-site for review by either the authorities or by the independent auditors.

All third party contractors or representatives of the Project will be required to meet the requirements of the ESIA and this ESMS. Contractors will be required to establish their own designated Environmental and Social Manager and Office commensurate to the scale and scope of their operations. The contractor's manager will be required to report to Project Environmental and Social Manager.

Similar positions and Offices will need to be established for both health and safety and human resource management.

7.6 Health and Safety Management System

Polymetal has well-developed H&S policies and procedures for their other mining projects in Kazakhstan. The Company will use their considerable experience to develop a Health and Safety

Management System (HSMS) for Kyzyl in line with OHSAS 18001 (and 18002), the international occupational health and safety management system specification.

The key document of the HSMS will be the Occupational H&S Management Plan. This will be developed by Polymetal, in line with the requirements of IFC PS 2 on Labour and Working Conditions, and will aim to protect health, welfare and safety of workers at Kyzyl Mine. The Occupational H&S Management Plan will include the processes to be used to identify hazards, prevent accidents and promote and protect worker wellbeing. It will also provide formulae for relevant documentation and reporting processes for occupational accidents, diseases and incidents, together with a framework for Company structure relevant to H&S management, occupational H&S training and dissemination. It will be relevant to all tiers of employees, contractors and subcontractors and will therefore require preparation and implementation prior to construction of the Project.

7.7 Further Considerations

The list below provides a brief summary of other actions Polymetal should take within applicable timeframes e.g. before major construction on site and prior to operation and in some cases as on-going requirements:

1. Develop framework management plans into full management plans outlined in Table 7.2, prioritising the Implementation Plan;
2. Prepare framework ESMS and developing Health & Safety Management System to international standards alongside the implementation plan;
3. Develop Social Strategy;
4. Review and update the Polymetal internal Social and Environmental Management and Monitoring Plan, to ensure that the Company continues to improve in all aspects of the project and that IFC Performance Standards and Equator Principles are met;
5. Undertake a hazard identification and risk assessment for the construction, operational and post-closure phases of the Project to evaluate the nature, consequences and likelihood of hazards, events or other unexpected circumstances and inform emergency planning and budgeting;
6. Undertake further ARD assessments and incorporate measures required into Project design. Update ESIA based on ARD findings;
7. Carry out further analyses of radiation levels in groundwater and take actions as required based on findings e.g. H & S measures to employees. Undertake annual monitoring of radiation levels in soils and groundwater across the site;
8. Develop a Biodiversity Action Plan (BAP);
9. Review the 'chance finds procedure' on a regular basis;
10. Establish an environmental monitoring database;
11. Define contractor arrangements;
12. Monitor supply chains to ensure compliance with IFC principles e.g. ensure contractors respect human rights and do not use of child labour etc. (IFC PS 2);

13. Determine taxes & royalties;
14. On-going development and understanding of community needs. Undertake a Community Needs Assessment (CNA); and
15. Formalise community development budget and develop full community developmentplan in agreement with and communicated to stakeholders and based on the CNA.

8 PUBLIC CONSULTATION AND DISCLOSURE

The Kyzyl (Bakyrchik) gold deposit is currently operated by Bakyrchik Mining Venture LLP (BMV), a subsidiary of Polymetal International PLC (PI). The Project is located in the north-eastern sector of the Republic of Kazakhstan (RoK), adjacent to the town of Auezov in Zharminsky District, East Kazakhstan Oblast. The deposit is situated 90km south-west of the regional capital Ust-Kamenogorsk and 117km south-east of the town of Semey. The village of Shalabay is located 6km to the west of Auezov and Shalabay municipality surrounds the territory of Auezov.

The Kyzyl deposit was discovered in 1945 and open pit production commenced in 1956. Five major open pits were mined at the first production stage, complemented by ore from four smaller pits in the surrounding area. Underground mining was conducted between 1963 and 1997, after which no mining activities were undertaken and the site was run according to a Care & Maintenance regime with the aim of being able to quickly restart mining operations. Currently, the open pits do not operate and some of them are backfilled whereas others serve as water reservoirs.

BMV as a company was founded in 1955 under the name Bakyrchik Gold Mine. It was subsequently called the Bakyrchik Mining and Metallurgical Company (Bakyrchik GMK), taking on the BMV name in 1995.

8.1 International Good Practice

As part of the ESIA process, a framework Stakeholder Engagement Plan (SEP – Management Plan 10) has been developed and should be built upon further. Within the SEP, Polymetal plan on producing a range of documents to provide information to the public in both Kazakh and Russian languages. The purpose of these documents will be educational about how the Project is developing and the associated environmental risks and mitigation strategies, in addition to encouraging stakeholders to engage more with Polymetal. The SEP also outlines a grievance procedure which is now fully operational in Auezov and Shalabay villages, and should be reviewed on a regular basis.

Good Practice - EBRD and IFC Requirements

'Good practice' relating to both EBRD PR and IFC PS would relate to developing positive relationships with stakeholders built on mutual trust and respect through early, timely and regular communication. A large part of this relates to increasing the involvement and participation of stakeholders in a project, disseminating information widely amongst stakeholders in a transparent manner and providing stakeholders with regular opportunities to discuss aspects of a project, including time to ask questions and get answers from the company developing the Project. This includes establishing a formalised grievance procedure, which Polymetal now have up and running and requires regular review to ensure it is operating in an efficient way.

IFC Performance Standard 1 (PS1) relates to managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process for achieving this, involving the company and employees, local communities affected by the Project and other stakeholders where applicable e.g. Polymetal should develop collaborative partnerships with NGOs and local communities to establish participatory monitoring programmes. This will help Polymetal achieve a feedback-feed-forward approach which will help them in disseminating knowledge and breaking down barriers through local people and NGOs taking a more active role. Chapter 7 outlines the ESMS and summarises what Polymetal need to do to address any outstanding gaps.

The IFC have defined core values for consultation/stakeholder engagement [1]:

1. The public should have a say in decisions about actions that could affect their lives;
2. Public participation and influence in decision making. Public participation promoting sustainable decisions by recognising and communicating the needs and interests of all participants;
3. Public participation seeks out and facilitates the involvement of those potentially affected by or interested in a decision;
4. Public participation with input from participants in designing how they participate;
5. Public participation provides participants with the information they need to participate in a meaningful way (e.g. transparent, clear and timely information about different aspects of a development during the course of a development); and
6. Public participation communicates to participants how their input affected the decision.

EBRD PR 10 necessitates identification of all project stakeholders in the process of developing and implementing a SEP. Stakeholder mapping is documented as good practice in the IFS handbook on stakeholder engagement and Polymetal are committed to updating this on a regular basis, forming part of an on-going commitment to developing the SEP over time.

Stakeholder Analysis and Stakeholder Engagement Planning

Polymetal have identified key project stakeholders as part of their SEP. This SEP outlines how Polymetal will communicate with project stakeholders who have an interest throughout different project stages, including construction, operation and post mining at Kyzyl. The SEP is an evolving document that requires Polymetal to review and update it on a regular basis. It includes details of how the grievance process is being operated at Kyzyl. A SEP was developed by Polymetal and has s been revised by WAI.

[1] Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007) IFC

8.2 Summary of Consultation Undertaken During the ESIA Process

This chapter summarises consultation undertaken during the different stages of the ESIA process. The SEP provides further details of stakeholder engagement activities.

Scoping Stage

Scoping is an essential step in the ESIA process, whereby potential social and environmental impacts are identified and existing data examined, in order to narrow the field of study for the full ESIA. The scoping stage also contributes to the iterative design process being carried out alongside the Feasibility Study (FS), whereby environmental design measures and any social management requirements arising as a result of the continued operations or any new interventions are highlighted to the design team.

BMV commissioned WAI to carry out an Environmental and Social Scoping Study (published 2013) of the proposed re-commissioning of the Bakyrchik mine and the construction of a new processing plant and related infrastructure.

The Scoping Study relied on a number of complete and semi-complete documents commissioned by BMV at various stages of project design development. Of these, the key data sources are:

- Environmental Feasibility Study (EFS), Sustainability PTY Ltd (completed 2011);
- Social Impact Assessment (SIA), Environmental Resource Management (ERM) and Sange (completed 2011);
- Environmental and Social Impact Assessment (ESIA 2011), Sustainability and ERM, (incomplete, dated 2012).
- A full list of all source documents is provided in the Gap Analysis completed by WAI in March 2013.

Following public consultation for the scoping study, WAI outlined the following priority activities for the next phase for Polymetal including:

- Continuation of stakeholder engagement activities;
- Update stakeholder engagement list;
- Maintain grievance mechanism;
- Development of the current framework SEP and implementation of the plan;
- Development and implementation of the Community Management Plan (ComMP); and
- Monitoring of the grievance procedure.

Interim Consultations/ESIA Updates

Numerous ad hoc meetings have been held by the Project staff with representatives from potentially affected communities in Auezov and Shalabay. The SEP provides further details of consultations that have been undertaken by Polymetal, including meetings about the general development of the Project with high level officials.

8.3 Company Policy

Polymetal's procedures for major public hearings include:

- Advertising in the local media about how public hearings are conducted in both Kazakh and Russian, as well as posting of information on Internet websites of local executive bodies. Comments and questions can be submitted alongside each post;
- Preparing, publishing, and presenting the content of the OVOS on the website of the local administrative bodies. Comments and questions can be submitted alongside each post;
- If necessary, making edits on proposals and comments as a result of the public hearings; and
- Covering the final protocol and results of hearings in the OVOS itself.

Informed Consultation and Participation (ICP) has been promoted throughout the stakeholder engagement process in accordance with international best practice. As the Kyzyl site is a Project with potentially significant adverse impacts, BMV is conducting an ICP process that will build upon the steps outlined in the SEP on Consultation and will result in the Affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organised and iterative consultation, leading to the client's incorporating into their decision-making process the views of the affected Communities on matters that affect them directly. This includes: providing information on proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

8.4 Public Hearings at Kyzyl

BMV has sought to provide stakeholders with information on a regular basis prior to formal public consultation activities. Key disclosure events, including public hearings, include the following reports and information provided during the EIA and ESIA preparation:

- Public hearing on Bakyrchik OVOS Report submitted in 2011;
- Public consultation events for ERM ESIA submitted in 2011; and
- Presentation of the scoping study results and introduction to the concept of the ESIA, undertaken by WAI and BMV between May 27-30 2013 (Auezov on 27th May 2013; Shalobay on 27th May 2013; individual meetings with stakeholders on May 28th 2013;

29th May meetings in Kalbatau; 31st May meeting with UNICEF). Refer to Appendix 1 of the Scoping Study for further information on these meetings.

The documents used in the events listed above consist of preliminary Project information as part of the initial design and permitting phases to expand the existing mine development. It is being gradually updated as the ESIA and FS advance. Full information on the Project design, impacts and mitigation measures will be presented in the ESIA, with disclosure expected in 2015.

Copies of all documents can be viewed and obtained through:

- BMV offices in Bakyrchik and Almaty; and
- From the CLO.

Section 4.2 of the Stakeholder Engagement Plan covers stakeholder activities to date, including public hearings.

Consultation and engagement for the social portion of the ESIA was conducted by WAI on a site visit in June-July 2015, including meetings in Auezov as well as surrounding communities as well as on the Oblast-level in Ust-Kamenogorsk. These stakeholders will continue to participate in public hearing events and stakeholder engagement sessions. Specifically, the following stakeholders were interviewed:

- East Kazakhstan regional (oblast)-level in Ust-Kamenogorsk:
  - Representatives of the oblast Akimat's Entrepreneurship Office;
  - Representatives of the Environmental Department of East Kazakhstan Oblast;
  - Representatives of the regional Cultural Heritage Department;
- Zharminsky District (rayon)-level in Kalbatau:
  - Head of Kalbatau Hospital;
  - Chief Economist for the district;
  - Coordinator for the district-level Akimat;
  - Archaeological expedition to view pre-Bronze Age stone carvings;
- Auezov village (local)-level stakeholders:
  - Town Akim;
  - Representatives of Auezov Mosque, including the imam;
  - Shopkeepers from a range of shops and supermarkets;
  - Chefs and representatives of local restaurants and cafes;
  - Village elders;
  - Fishermen fishing in local rivers and lakes;
  - Herders responsible for local livestock;
  - Head Librarian;
  - Representatives of the Women's Union;
  - Head Teacher at the local school;

  - Police officer;
  - Residents displaced as a result of the Project;
  - Residents of Auezov and the satellite hamlet of Solnyechni, including through a structured household survey;
  - Range of private and industrial water users;
- Shalabay village (local)-level stakeholders:
  - Town Associate Akim;
  - Shopkeepers from a supermarket;
  - Leadership of Shalabay LLP, large-scale farm and major local-level employer;
  - Head Teacher at the local school;
  - Workers at Shalabay train station, set to serve the Project;
  - Range of private and industrial water users;
  - Residents of Shalabay, including through a structured household survey;
- Zhanaaul village (local)-level stakeholders:
  - Villagers on a hunting and fishing expedition;
  - Local farmers;
  - Private and agricultural water users;
- Polymetal and BMV employees:
  - Head of Project/General Director;
  - Chief of Security;
  - Health and Safety Officer;
  - Legal Office representatives;
  - HR Department representatives;
  - Environmental Department representatives;
  - Head of Production and Technical Department;
  - Community Liaison Officer;
  - Land Use and Subsoil Team representatives.

Polymetal held a public hearing in August 2014 under the theme, 'Preliminary evaluation of the impact on the environment' (preOVOS phase), developed based on the outcome of the Feasibility Study (TEO) of mining parameters at the Kyzyl deposit. The TEO and preOVOS report included decisions relating to mining (open pit and underground), infrastructure, and ore processing.

In July 2015, a public hearing was held regarding the OVOS entitled 'Assessment of the Impact on the Environment', which was written in accordance with RoK legislation. The OVOS is currently passing through a series of public consultations.

Minutes of all Public Hearings are publically available and can be provided on request to BMV. The company has also developed and is using a stakeholder engagement log that keeps track of all meetings with stakeholders at all levels: information or project meetings, public meetings etc. This stakeholder management system allows a formal recording of all meetings, demonstrating frequency of interaction with stakeholders and having records of the participants and questions or issues raised

by specific people. The documentation will help BMV to accumulate a "Questions and answers" report that will summarise questions raised and the Company's responses.

8.5 Public consultation on the draft ESIA report

A public consultation hearing was held on 3 December 2015 in Auezov on the subject of the draft ESIA report and Non-Technical Summary (NTS). The event, which took place in the hall of Auezov's school, was widely advertised across the company and the local communities of Auezov and Shalabay. The NTS was made publicly available on the local Akimat's website [2] 20 days in advance of the event.

Speakers at the event were the mine's General Director Yuri Ovchinnikov, the Akim of Auezov Mr Bakhytbek Amirgazinovich Amirgazin, and Senior Environmental & Social Specialist at Wardell Armstrong International Dr Edvard Glücksman. 67 residents of Auezov and Shalabay were registered in attendance, and were encourage to fill out feedback forms, which they received upon arrival to the school. Extensive minutes were recorded at the meeting (Appendix 8.1) and the entire session was filmed and photographed.

After a brief introduction from Mr Amirgazin, Mr Ovchinnikov addressed the hearing by providing an update on mine operations as well as Polymetal's development of local community projects. Dr Glücksman subsequently gave a 35-minute presentation, accompanied by slides, aimed at summarising the ESIA's findings, as described in the NTS, across each of the environmental and social facets covered by the report.

Formal presentations were followed by a question and answer session lasting roughly an hour, where a total of 8 questions and comments were shared by local residents. Of these, one of the comments presented was negative towards the project's development, where the resident expressed distrust towards the operation in general and the ESIA process more specifically. An older man, he explained that he had seen too many companies come and go at the site, always promising a new beginning at the mine but without subsequent development.

5 of the 7 comments that followed, including twice by the same woman, directly or indirectly expressed gratitude and hope that the Project's development proceeds smoothly, especially because of its potential to generate jobs for local people. Questions and comments asked by men and women of working age as well as retirees, including one by Auezov village 'veteran', part of the influential group of village elders. Each concern was addressed directly by the panel, with Yuri Ovchinnikov providing a response for every question from Polymetal's perspective.

The themes of the questions were the Project's creation of local jobs, expressions of gratitude to the Project developers for their efforts and the hope that they offer, the nature of blasting operations and in particular to make sure housing will not be damaged, the location of the explosives store, and plans for the construction of a sports hall in Auezov village.

[2] http://www.garma.vko.gov.kz/ru/hearings.htm 13 November 2015

Apart from answering yes/no questions (Table 8.1), six of the citizens attending the public consultation left written comments on feedback forms, which they were encouraged to fill out at the end of the session. Feedback answers are shown in Table 8.2.

Table 8.1: Feedback from those in Attendance at the Draft ESIA Public Consultation Event in Auezov On 3 December 2015.
Number of Responses Received in Parentheses out of 67 Total in Attendance.

	% Yes	% No
Are you satisfied with the venue? (50)	96	4
Did you get an idea of the projected enterprise? (50)	94	6
Did you get an idea of the current state of the environment in the area of business? (50)	92	8
You were given an opportunity to ask you a question? (50)	94	6
You got satisfactory answers to their questions? (47)	94	6
Are you satisfied with the way the whole hearing was held? (50)	92	8
Are you satisfied with the public hearings conducted by Polymetal to date? (49)	98	2
Do you know how to contact with suggestions or complaints in the future? (48)	98	2
Is it possible, in your opinion, something to improve such events in the future? (39)	77	23

Table 8.2: Written Comments (Modified for Clarity) on the Feedback Forms

The hearing was held at a high level and in an accessible manner. It is desireable for such hearings to be held again in future, so the public has accurate and timely information from the source.
Everything was wonderful and perfectly run.
No comments here. I believe that the ongoing work will positively affect villagers. I would also like to see our first villagers employed. I wish Polymetal success!
No comments. I wish the 'Kyzyl' Project success!
The Project is very important for jobs in the village. We are looking forward to the Project's launch. We would like to express our gratitude to the leadership of Polymetal for the activities they organise.
Three questions: 1. If you plan to use underground mining in the future, why are you flooding the mine? 2. Will there still be a career for herders? 3. What will happen to the people whose houses you have to demolish? Will they move to the city?

Photo 8.1: General Layout of the ESIA Public Consultation Event in Auezov, Showing the Panellists and Speakers, Slideshow Presentation, Cameraman, and Local Residents in Attendance

Photo 8.2: Local Residents and Representatives of Polymetal and Wardell Armstrong International in Attendance at the ESIA Public Consultation Event at Auezov School

Photo 8.3: Sitting Alongside Other Panellists, the Akim of Auezov Addresses the Audience at the ESIA Public Consultation Event at Auezov School

Photo 8.4: Audience Member Contributes During the Question and Answer Session of the ESIA Public Consultation Event at Auezov School

Photo 8.5: Audience Member Contributes During the Question and Answer Session of the ESIA Public Consultation Event at Auezov School

Photo 8.6: Local Residents Fill out Feedback Forms after the ESIA Public Consultation Event at Auezov School

8.6 Stakeholder Conclusions

The ESIA process provides stakeholders with opportunities to raise their concerns relating to different aspects of the Project development and design. A wide range of stakeholders have been included in the overall consultation process, including local communities and high level Oblast officials. Onward development of the Project presents challenges in maintaining community support and is essential for Polymetal to gain their 'social licence to operate'. Ensuring the implementation and continued development of a SEP and ComMP, in addition to monitoring local communities to detect signs of changes as a consequence of the Project, are essential to creating good relationships with the local community.

Following completion of the ESIA, Polymetal should maintain regular contact with people in Auezov, Shalabay and other surrounding settlements, listening to their views on the Project and actively involving them in the decision-making process regarding community development activities. Managing stakeholder expectations at Auezov is important, ensuring that the community has realistic expectations. Polymetal needs to ensure they continue operating in a transparent manner, informing local people about project developments and raising awareness of their proposed mining activities and any changes to the development or project schedule.

Polymetal employ a Community Liaison Officer (CLO) within the company. This role helps to guide all stakeholder engagement and community development activities for the Project at Auezov and Shalabay. Addressing key community concerns should form an on-going part of these plans. WAI are aware that Polymetal are taking steps to address employment concerns within the local villages, including informing local people how they can apply for jobs at the mine site and developing training opportunities for local people.

Managing Stakeholder Expectations and Strengthening Relationships

A wide range of stakeholders have been involved in formal consultation exercises and/or informal engagement as part of the ESIA process. Whilst in general most stakeholders are supportive of the Project developing, this in part relates to their expectations of increased employment prospects from the Project. Consultation with a wide range of stakeholders identifies their key concerns about the Project relating to the use of cyanide and the fact that some people perceive issues with radioactivity. Local stakeholders perceive that they may benefits from the Project through increased employment opportunities, indirect economic benefits and through Polymetal possibly funding community development projects that may improve their roads in Auezov and Shalabay.

It is important that Polymetal ensure they are transparent in how they provide information relating to the Project, taking steps to actively ensure they manage community expectations of benefits from the Project and do not promise things they cannot deliver. To ensure the Project benefits the local communities as much as possible, Polymetal should aim to source employees locally where possible, incorporating appropriate measures into their employment strategy to ensure this happens. This

should be targeted in particular at the vulnerable groups that have been identified who are of employable ages, including women, who do not have alternative sources of employment in Auezov or Shalabay in particular, and people who partake in fishing and subsistence farming, or herders. These vulnerable groups were identified on the basis of household surveys and informal interviews during WAI's site visit.

Future Stakeholder Consultation

Following completion of the ESIA, the focus will then be on regular monitoring during construction, operation and closure. Polymetal have an on-going commitment to develop the management plans further, from framework plans to full plans. It is important that communication with stakeholders is maintained and regular during this process. Building up trust is fundamental to developing positive stakeholder relationships and WAI are aware that there was a reduction in trust levels between local people in Auezov and Shalabay during the Project's period of Care & Maintenance from 1997 until the present, when little consultation occurred and activities on site ceased. WAI observed that local people felt let down that the delay in the Project was not adequately communicated to them. Despite this period where no engagement was carried out, WAI still consider that the majority of local people are supportive of the Project. To help re-build trust and to secure their 'social licence to operate', Polymetal need to focus on:

- Consolidating their relationships with local communities with transparent and regular disclosure of information;
- Develop the CLO role further and a Community Liaison Committee (CLC) to help disseminate information further (including considering what documents they make available to stakeholders and considering increasing the level of information they publicise in general, such as through newsletters and information publically available on the website they are developing;
- Developing and implementing participatory monitoring projects that involve local community members and NGOs during the construction, operational and post-closure phases of the mine; and
- Monitoring the environmental and social conditions during construction, operation and closure to allow them to form a baseline from which they can monitor future changes and take the appropriate measures based on these findings.

Chapter 3 Appendices

Appendix 3.2: Project Execution Schedule

Drawing 3.2c -- Auezov Infrastructure Development Schedule

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Infrastructure and Utilities of Auezov Town and Existing Facilities

Construction	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
External transportation lines																										
By-pass general-purpose road (Bakyrchik – Bursak)																										
External utilities																										
Power networks. 110kV single-circuit power line. Branch line from L-479 power line to new GPP-110/35/6kV																										
Power networks. 110-35kV double circuit power line. 110kV branch line from L-178 power line and 35kV branch line from L-84C power line to new GPP-110/35/6kV																										
Power networks. 35kV single-circuit power line. 35kV branch line from 110-35kV double-circuit power line																										
Household and drinking water supply pipeline from Kyzyltu intake (subsurface piping, L=6900 m)																										
Utilities of Auezov Town (Phase 1)																										
Feeder power and lighting networks of facilities, located in from GPP110/35/6kV to 6 kV indoor switchgear , 6 kV power line to Auezov's facilities.																										
Auezov's boiler house with flue gas stack, including: boiler house, coal storage, ash storage																										
Heat supply networks (from Auezov's boiler house to TK-21, L=790 m)																										
Household and drinking water supply networks – Auezov's boiler house (L=500 m)																										
Household sewer networks – Auezov's boiler house (L=150 m)																										
Household and drinking water supply pipeline from the site to pumping and filtration plant (subsurface piping, L=1000 m)																										
Auezov's water tower																										
Household and drinking water supply networks – Auezov's water tower (L=200 m)																										
Existing facilities																										
Mine rescue team building (will be reconstructed as sanitary and amenity building for OP and UG periods - Phase 1)																										
Office building (old) (will be renovated and used as office building - Phase 1)																										
Main fan unit (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Facilities subject to dismantling																										
300 m3 water tower (to be dismantled in 2016)																										
Skipovaya Shaft pithead buildings (to be dismantled)																										
Skipovaya Shaft hoist building (to be dismantled)																										
Gas supply facilities of sulphide ore process plant (to be dismantled in 2015)																										
Ore preparation building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Ore-roasting kiln (to be dismantled in 2015)																										
Building of dust control shop (to be dismantled in 2015)																										
Building of heavy fuel oil handling facilities (to be dismantled in 2015)																										
Control board room (to be dismantled in 2015)																										
Cooling tower with compressor station (to be dismantled in 2015)																										
Drainage pumphouse																										
Water recycle pumphouse																										
Building of uncompleted process plant (to be dismantled in 2015)																										
Private fuel-filling station (to be dismantled in 2015)																										
Crusher building of sulphide ore process plant (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Gallery and hopper - sulphide ore process plant (to be dismantled in 2015)																										
Process plant building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Oxide ore storage building (to be dismantled in 2015)																										
Mine office and amenity building (to be dismantled in 2015)																										
Central boiler house, including: buildings of wet slag and ash removal, multicyclone device, lifting gallery, garage, boiler room, salts wet and dry storage areas, flue gas stack (H=60m), fencing. (to be dismantled in 2016-2017)																										
Repair shops building (to be dismantled in 2017)																										
Power networks. 110kV power line (L=7550 m) (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
Power networks. 110-35kV power line to Auezov Town (L=600 m), (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
Power networks. 35kV power line (L=2610 m) (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
GPP110/35/6kV main step-down transformer substation, to be used before commissioning new GPP, then as: Indoor switchgear building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Pilot plant building (to be dismantled in 2017)																										
Ore kiln discharge area (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Calcine cooling area (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Main compressor plant (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Fencing of highly toxic substances storage (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										

Legend:

- construction period for capital facilities
- reconstruction and reequipment period for existing buildings and facilities
- lifetime of capital facilities
- dismantling period for existing buildings and facilities
- recultivation period for the mine and process plant facilities

Drawing 3.2b -- Stage 2 Underground Mining Schedule

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Phase 2 - Underground Mining

Construction - buildings, structures, utilities	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Mining facilities (Phase 2)																										
Mine site																										
Lamp room																										
Cement storage silos - backfill plant																										
Buffer tank of thickened tailings -backfill plant																										
Pulp supply pipeline - backfill plant																										
Water supply pipeline - backfill plant																										
Backfill supply pipeline																										
Power networks. 6kV power line to backfill plant																										
6/0.4kV external package transformer substation of backfill plant																										
Central and Western areas																										
Western area																										
Mine site. Western area.																										
Underground mining.																										
Western Ventilation Shaft, +385m elevation (reconstruction)																										
Pithead building of Western Ventilation Shaft																										
Main fan unit No1																										
MTEU-VNU 0751×4 power supply unit, including air heating unit																										
870 t coal storage (Main fan unit No1)																										
Ash storage (Main fan unit No1)																										
Pumphouse No1 with water tanks - process and fire water supply																										
Storage No1 - fire fighting supplies and equipment																										
Western vent raise, +385 m elevation																										
Western vent raise opening, +385 m elevation																										
Backfill supply drift hole No1, collar, +385 m elevation																										
Feeder power and lighting networks of the Western area, including:																										
1.Power networks. 6kV power line to Main Fan Unit No1 of the Western area.																										
2.Power networks. 6 kV power line to power supply unit of Main fan unit No 1 of the Western area.																										
3.6/0.4kV external package transformer substation for power supply unit of the Western area.																										
4.Power networks. 6kV power line																										
Western vent raise. +385 m elevation (UC)																										
5.Power networks. 6 kV power line from ZKTP-10000-35/6kV Central area transformer substation to the Western area.																										
6.PKTPN 6 300-35/6 kV Transformer substation No 2 of the Western area.																										
the Western area (transfered from the Western area of Phase 1)																										
7.Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 2.																										
Central area																										
Mine site. Central area.																										
Underground mining.																										
Capital Shaft, +410 m elevation (reconstruction)																										
Pithead building of Capital Shaft (reconstruction)																										
Capital Shaft hoist building (reconstruction)																										
Main fan unit No 3																										
MTEU-VNU 10×4 power supply unit, including air heating unit																										
1330 t coal storage (Main fan unit No 3)																										
Ash storage (Main fan unit No3)																										
Pumphouse No 2 with water tanks - process and fire water supply																										
Storage No 3 - fire fighting supplies and equipment																										
Heat supply network - Central adit, +180 m elevation																										
Heat supply network - Central adit portal, +180 m elevation																										
Storage No 4 - fire fighting supplies and equipment																										
Utilities 1 - Central adit, +180 m elevation																										
Utilities 1 - Central adit portal, +180 m elevation																										
Utilities 2 - Central adit, +150 m elevation																										
Utilities 2 - Central adit portal, +150 m elevation																										
Storage No 5 - fire fighting supplies and equipment																										
Backfill supply drift hole No 2, collar, +402 m elevation																										
Ore handling stockpile No1																										
Open pit water drainage pipeline for process needs L=4550m																										
Feeder power and lighting networks of the Central area, including:																										
1.ZKTP-10000-35/6kV package two-transformer substation of the Central area.																										
2. Power networks. Two 35kV power lines to ZKTP-10000-35/6kV transformer substation of the Central area.																										
3.Power networks. 6 kV power line to Main fan unit No 3 of the Central area.																										
4.Power networks. 6 kV power line to power supply unit of Main fan unit No 3 of the Central area.																										
5.6/0.4kV external package transformer substation for power supply unit of the Central area.																										
6.Power networks. 6kV power line to Capital Shaft hoist																										
7. Power networks. 6kV power line to Utilities 2 - Central adit																										
8.Power networks. 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 2.																										
9.6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 2.																										
Eastern area																										
Mine site. Eastern area.																										
Underground mining.																										
Eastern Ventilation Shaft, +435m elevation																										
Pithead building of Eastern Ventilation Shaft																										
Main fan unit No 2																										
MTEU-VNU 10×4 power supply unit, including air heating unit																										
630 t coal storage (Main fan unit No 2)																										
Ash storage (Main fan unit No2)																										
Pumphouse No 3 with water tanks - process and fire water supply																										
Storage No 2 - fire fighting supplies and equipment																										
Heat supply network - Eastern adit, +250 m elevation																										
Heat supply network - Eastern adit portal, +250 m elevation																										
Storage No 6 - fire fighting supplies and equipment																										
Utilities 1 - Eastern adit, +250 m elevation																										
Utilities 1 - Eastern adit portal, +250 m elevation																										
Utilities 2 - Eastern adit, +253 m elevation																										
Utilities 2 - Eastern adit portal, +253 m elevation																										
Storage No 7 - fire fighting supplies and equipment																										
Backfill supply drill hole No 3, collar, +435 m elevation																										
Ore handling stockpile No 2																										
Feeder power and lighting networks of the Eastern area, including:																										
1.Power networks. 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 1.																										
2.6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 1.																										
3.Power networks. 6 kV power line to Main fan unit No 2 of the Eastern area.																										
4.Power networks. 6 kV power line to power supply unit of Main fan unit No 2 of the Eastern area.																										
5.6/0.4kV external package transformer substation for power supply unit of the Eastern area.																										
6.Power networks. 6kV power line to Utilities 2 – Eastern adit																										
7.Power networks. 6 kV power line from ZKTP-10000-35/6kV Central area transformer substation to the Eastern area.																										
8.PKTPN 6 300-35/6 kV Transformer substation No 1 of the Eastern area																										
(operates at the same location as for Phase 1)																										
Office and amenity block																										
Sanitary and amenity building (SAB UG)																										
Utilities																										
(water and gas supply pipelines, sewage system and other networks, including inter-site ones)																										
Household and drinking water storage tanks																										
Household and drinking water supply networks L=700																										
Household sewer networks L=300																										
Heat supply networks L=1250																										
Inter-site transportation lines																										
Road (road fork - Central area)																										
Road (fork of Central area road - Western area)																										
Road (fork of Central area road - Eastern area)																										
Existing facilities																										
Ore kiln charging area (To be reconstructed and used for backfill mixture preparation - Phase 1)																										
Mine water treatment station (to be used for OP and UG periods)																										

Legend:

construction period for capital facilities

reconstruction and reequipment period for existing buildings and facilities

lifetime of capital facilities

dismantling period for existing buildings and facilities

recultivation period for the mine and process plant facilities

Drawing 3.2a -- Stage 1 Open Pit Mining Schedule

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Phase 1 - Open Pit Mining

Construction - buildings, structures, utilities	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Mining facilities (Phase 1)																										
Open pit																										
Open pit																										
Heating room and canteen for workers																										
Waste dump																										
Ore stockpile (buffer)																										
Pumphouse for buffer ore stockpile drainage water																										
Open pit dewatering –Area No1																										
Open pit dewatering – Area No 2																										
Settling sump No1																										
Drainage ditch No 1																										
Drainage ditch No 2																										
Settling sump No2																										
Water diversion channel of the Akbastaubulak and Kyzyltu Streams																										
Protection dike No1																										
Protection dike No 2																										
Top soil storage																										
Dam of pit drainage water settling sump																										
Pumphouse of pit drainage water settling sump																										
Pressure pipeline network for open pit drainage water																										
Fresh water supply pipeline to tailing storage																										
Ore processing facilities (Phase 1)																										
Ore preparation facility, including:																										
Primary/course crushing plant with trestle of Conveyor No1																										
Crushed ore stockpile, with gallery of Conveyor No 2																										
Process plant																										
Tailings thickener, D=32 m																										
Recycle water tank																										
Laboratory																										
Finished concentrate storage																										
Carbon concentrate storage																										
Tailings storage, including:																										
Bund wall No1																										
Bund wall No 2 (reconstruction)																										
Waterproof liner of tailings storage bed																										
Stream diversion channel																										
Upstream wall No1 (reconstruction)																										
Upstream wall No2																										
Water diversion ditch																										
Recycle water pumphouse																										
Recycle water pipeline (the 1st and 2nd stages)																										
the 1st stage																										
the 2nd stage																										
Pulp pipeline (right and left runs)																										
Drainage system with pumphouse																										
Repair and maintenance facilities (Phase 1)																										
Repair shops																										
Outdoor repair and mounting area																										
Storage facilities (Phase 1)																										
Reagent storage, including:																										
Reagent container storage area																										
Hangar No1																										
Hangar No 2																										
Decontainerization area																										
Office building																										
Ammonium nitrate storage, including:																										
Stacked ammonium nitrate storage area																										
Mixing and charging machine loading station																										
Mixing and charging machine parking lot																										
Fire water tanks																										
Fuel and lubricants storage, including:																										
Tank farm																										
Loading/unloading site																										
Service building																										
Drummed oil storage area																										
Empty drum storage area																										
Diesel fuel filling station																										
Container-type petrol filling station																										
Process pipelines																										
Emergency oil collection tanks (2 units)																										
Fencing																										
Explosives storage																										
24 t explosives storage site, including:																										
Explosives container storage site (2 units)																										
Room for initiating devices storage																										
Explosives preparation and distribution building																										
Laboratory																										
Store-house of fire-fighting means																										
Packing storage																										
Watch tower																										
Office building																										
Guardhouse																										
Heating room and canteen for workers																										
Empty container storage site																										
Explosives test and destruction range, including:																										
Explosives test and destruction area																										
Shot-firer safe location																										
Fencing																										
Materials and equipment outdoor storage																										
Heat and power supply facilities (Phase 1)																										
Boiler house with flue gas stack, including: boiler house, coal storage and ash storage																										
GPP-110/35/6kV main step-down transformer substation																										
Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 1																										
Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 2																										
Open pit feeder power and lighting networks, including: excavators, 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system pumphouses (Areas No 1 and No2), external package transformer substation for open pit and waste dump lighting (16 units, mobile light lines)																										
Mine site feeder power and lighting networks, including:																										
6kV package outdoor switchgear at the mine site																										
Power networks. 6kV power line from 6kV package outdoor switchgear to 6/0.4 kV power distribution unit at the mine site (L=600 m)																										
6/0.4kV external package transformer substations at the mine site and infrastructure facilities:																										
1x1000 - primary/coarse crushing plant																										
2x400 - laboratory																										
2x400 - boiler house with flue gas stack																										
2x630 - repair shops																										
2x100 - reagent storage																										
2x63 - explosives storage																										
2x63 - ammonium nitrate storage																										
2x250 - fuel and lubricants storage																										
2x250 - recycle water pumphouse																										
1x63 - drainage pumphouse																										
2x250 - treatment facilities																										
Power networks. 6kV power line to 6/0.4kV external package transformer substation of the mine site and infrastructure facilities (L=7900 m)																										
Feeder power and lighting networks of the sanitary and amenity building, including:																										
1. Power networks. 6kV power line to 6/0.4kV external package transformer substation of the the sanitary and amenity building (L=400 m)																										
2.6/0.4kV external package transformer substation of the sanitary and amenity building																										
5. Power networks. 6kV power line to 6/0.4kV external package transformer substation of the pumphouse for household and drinking water supply (L=400м)																										
6. 6/0.4kV external package transformer substation of the pumphouse for household and drinking water supply																										
Feeder power and lighting networks at the pit drainage settling sump, including:																										
1.6/0.4kV external package transformer substation of the pumphouse at the pit drainage settling sump																										
2.Power networks. 6kV power line to the pumphouse at the pit drainage settling sump																										
Power networks. 6kV power line to Capital Shaft (switching of existing mine drainage system)																										
Utility facilities (water and gas supply pipelines, sewage system and other networks, including inter-site ones)																										
Pumphouse with water tanks - process and fire water supply																										
Pumphouse with water tanks - household and drinking water supply, household and drinking water supply area fencing																										
Treatment facilities for household sewage																										
Treatment facilities for surface runoff of the fuel and lubricants storage																										
Surface water gathering pond																										
Sewage pump station																										
Household and drinking water supply systems, (subsurface piping, L=2400 m)																										
Process and fire water supply systems (subsurface piping, L=1750 m)																										
Household sewer systems (subsurface piping, L=1100 m)																										
Heat supply networks (surface piping, L=2550 m)																										
Inter-site transportation lines																										
Access road (open pit western exit – waste dump)																										
Access road (open pit eastern exit – waste dump)																										
Access road (open pit eastern exit – buffer ore stockpile)																										
Support road (buffer ore stockpile – repair and storage facilities)																										
Support road (buffer ore stockpile – carbon concentrate storage)																										
Support road (road fork - existing road)																										
Support road (top soil storage – explosives test and destruction range)																										
Support road (top soil storage – explosives storage)																										
Office and amenity block																										
Canteen for 100 seats																										
Security and fire-fighting facilities																										

Legend:

construction period for capital facilities

reconstruction and reequipment period for existing buildings and facilities

lifetime of capital facilities

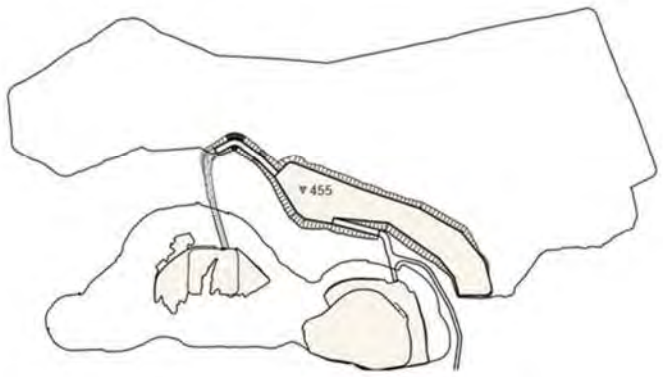
dismantling period for existing buildings and facilities

recultivation period for the mine and process plant facilities

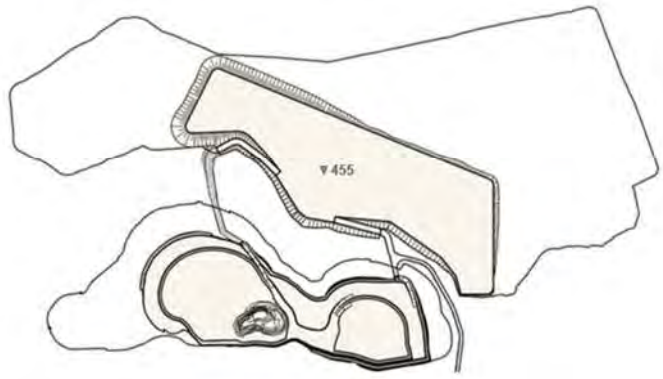
Appendix 3.3: Open Pit Waste dump Development

Drawing 3.3: Illustration of Open pit and waste development year by year

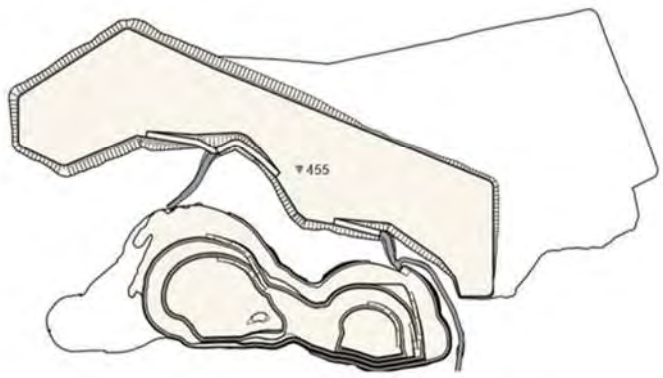
2016 г.



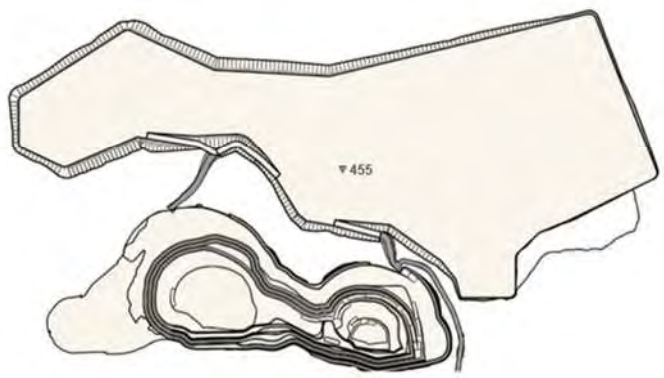
2017 г.



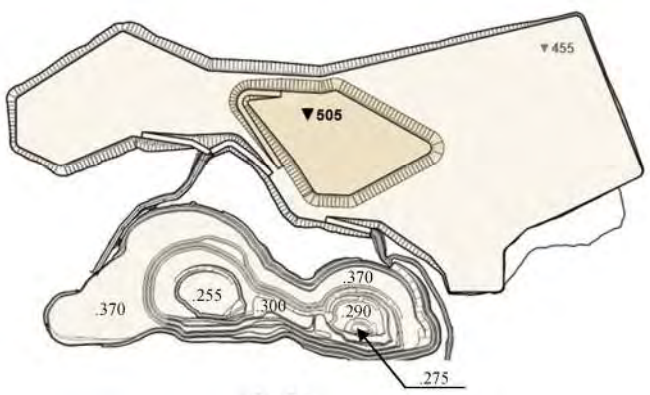
2018 г.



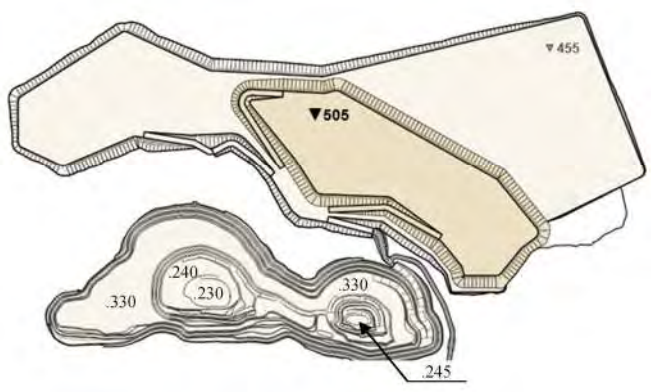
2019 г.



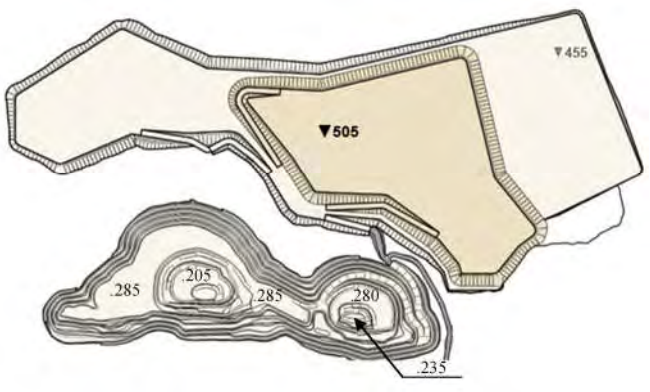
2020 г.



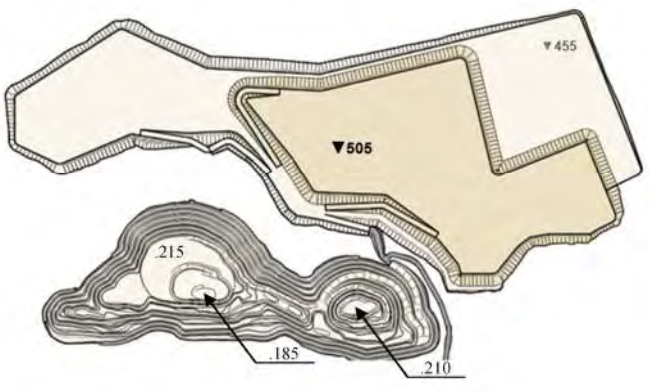
2021 г.



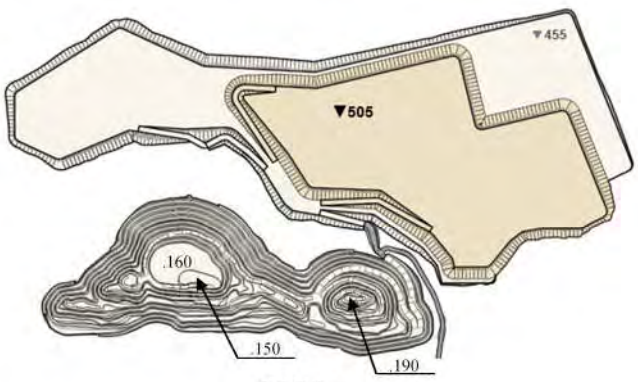
2022 г.



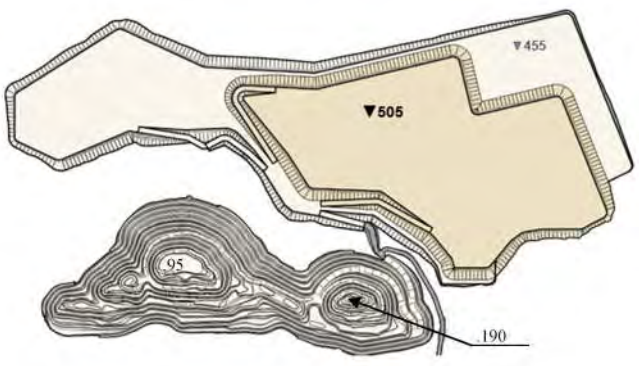
2023 г.



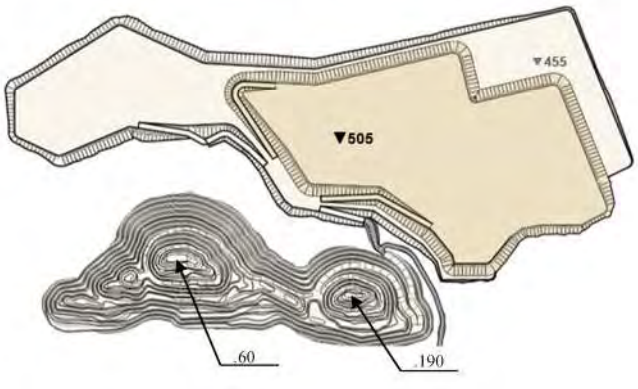
2024 г.



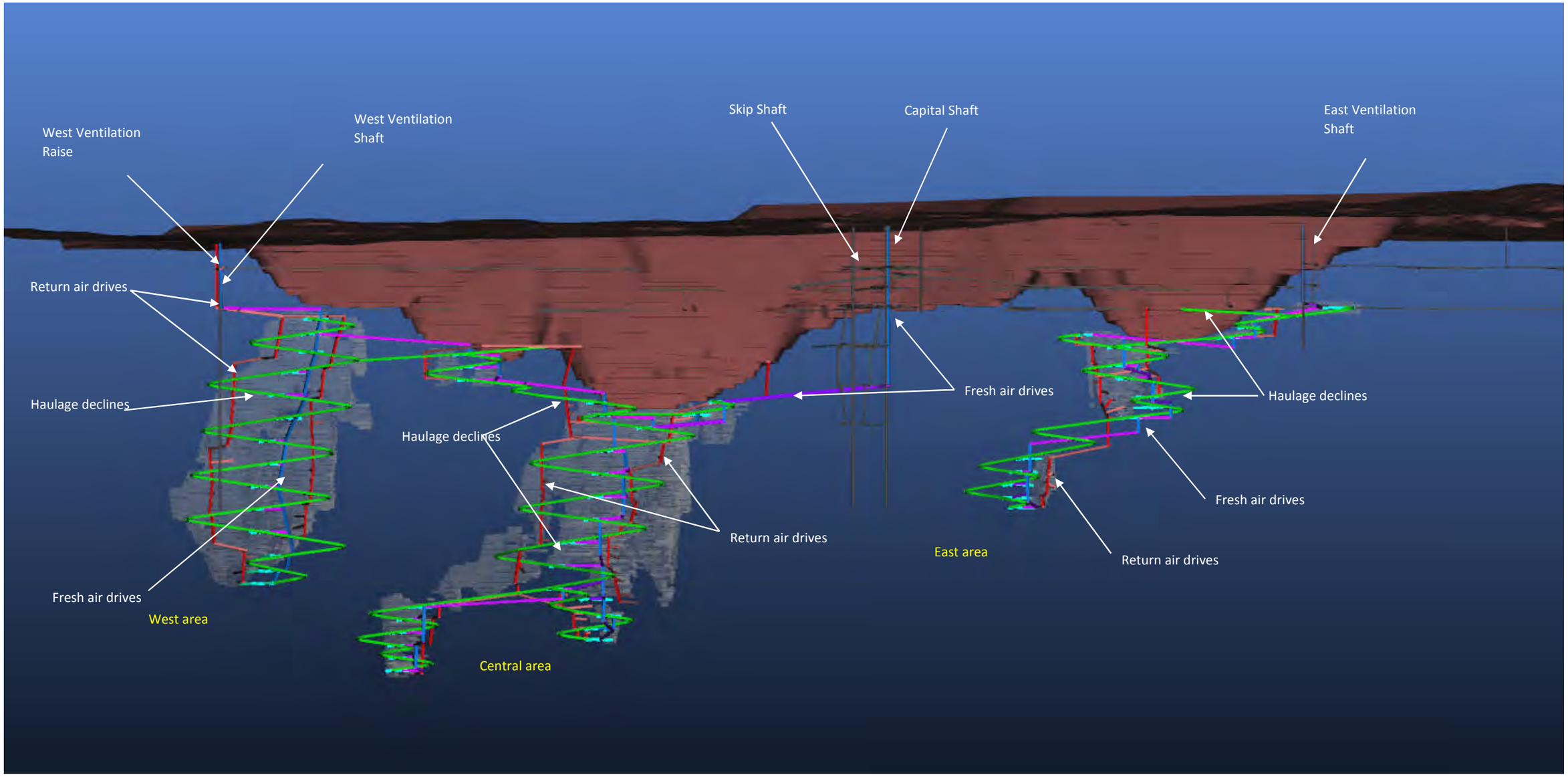
2025 г.



2026 г.



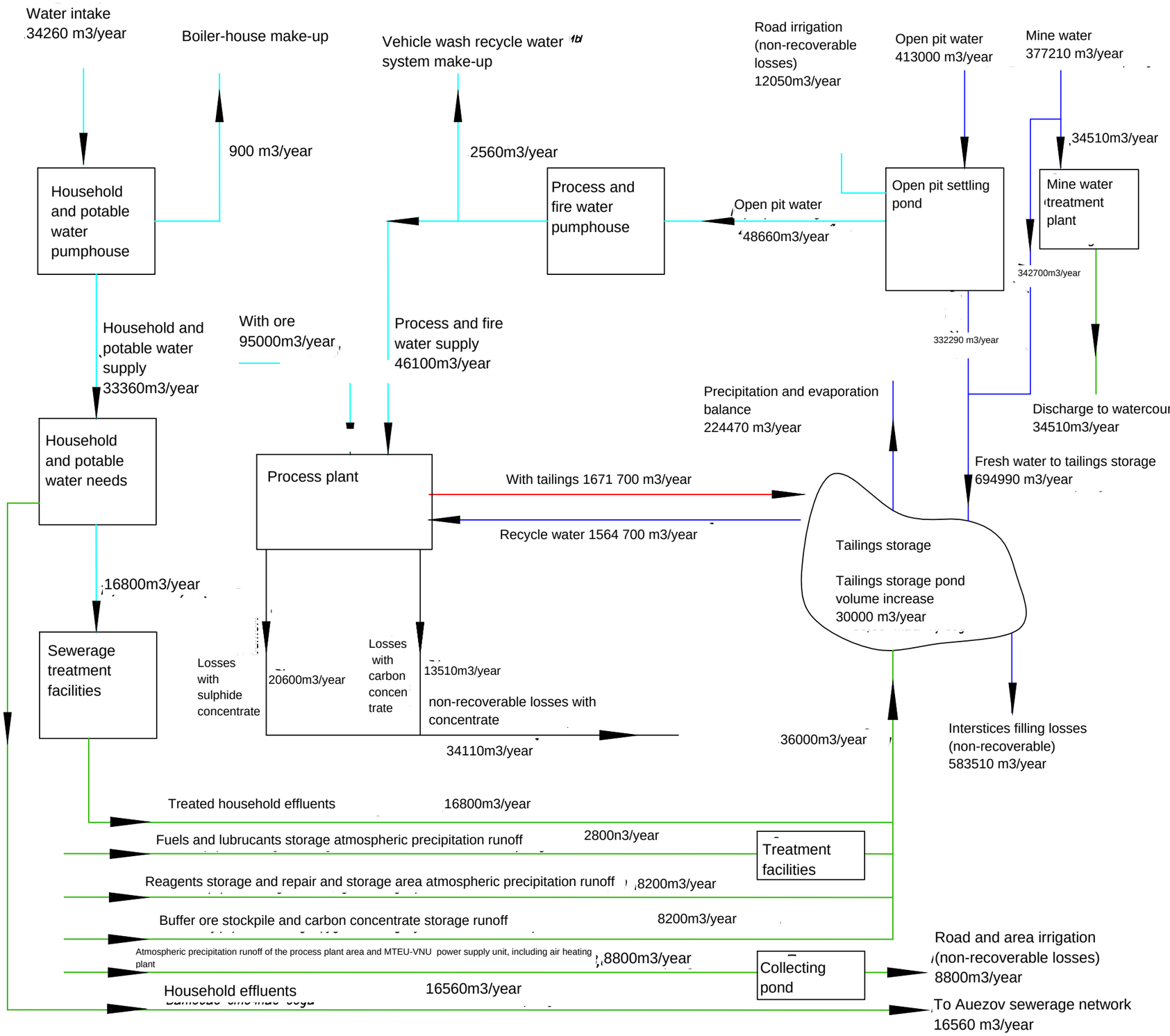
Appendix 3.4: Underground Mine Development



3D view of the open pit (coloured reddish-brown), and the extent of the western, central, and eastern deposits underground (coloured grey). The green lines show the routes (haulage declines) that underground haul vehicles will take to bring ore to the surface, at the bottom of the pit. It also shows the routes the ventilation network will take through the mine. Fresh air will be pumped into the mine via the routes shown in blue, while stale air will be pumped back out to surface along the routes shown in red. Historic underground mining infrastructure is also shown (grey lines).

DRAWING 3.4: Underground Mine Development

Appendix 3.5: Water Balance - Open Pit



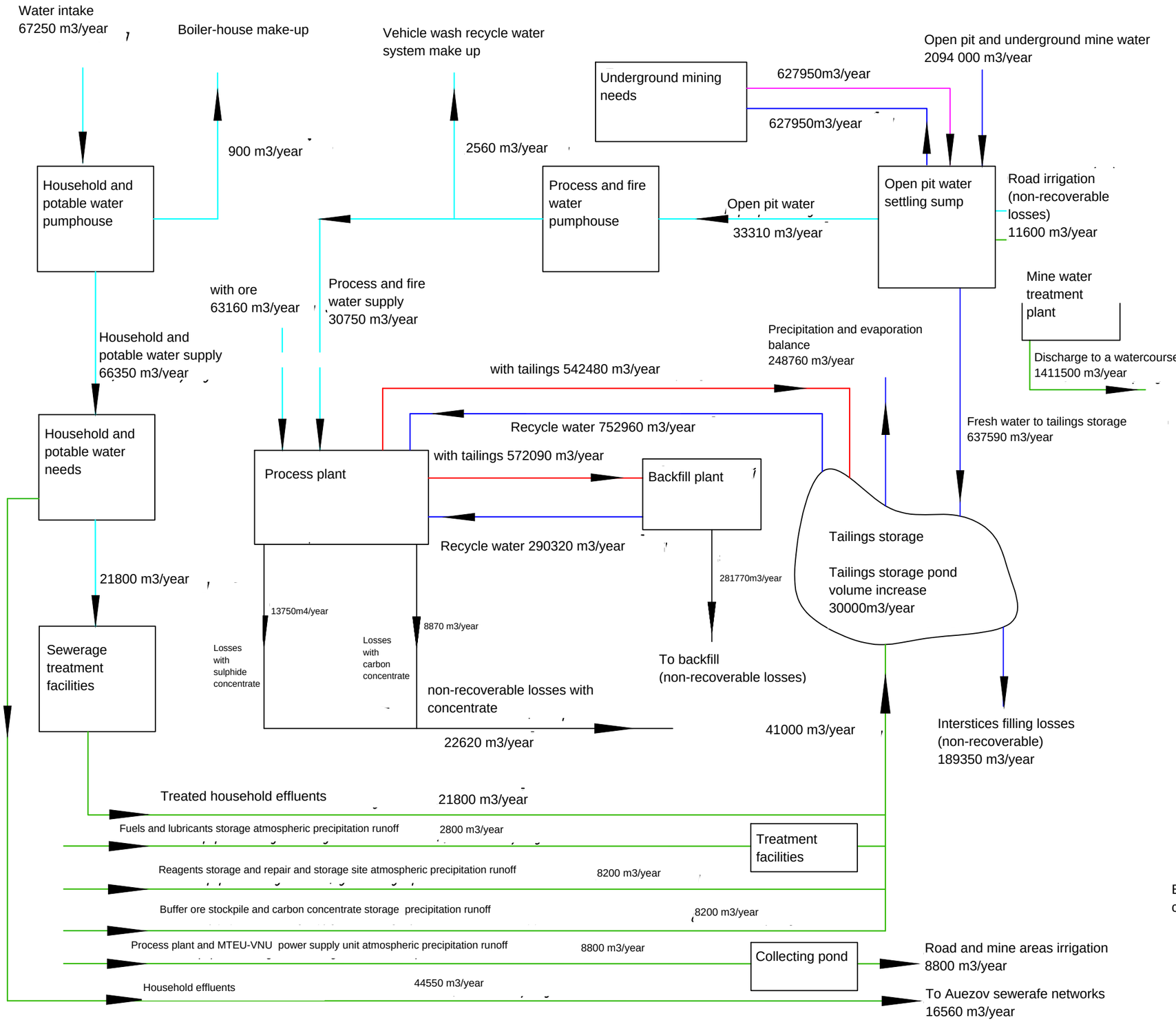
	,000 m3/year
1. Water, supplied to the mine and process plant, including:	947,47
– from Kyzyltu underground water intake	34,26
– with ore	95,00
– open pit water	413,00
– underground mine water	377,21
– Mine sites precipitation runoff	19,80
– buffer ore stockpile and carbon concentrate storage	8,20
runoff	
2. Mine and process plant effluents, including	51,07
– household effluents to the Auezov trearment plant	16,56
– Mine water to a water course	34,51
3. non-recoverable losses, including	866,40
– road and mine area irrigation	20,85
– tailings interstices filling	583,51
– losses with concentrate	34,11
– boiler house and vehicle wash recycle water	3,46
system make up	
– tailings storage evaporation	224,47
(precipitation and evaporation balance	
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
947,47=51,07+866,40+30,00

The balance is provided for 2025 at the process plant operation without concentrate selection

Drawing 3.5: Water consumption and diversion flow chart in the period of the deposit open pit mining

Appendix 3.6: Water Balance - Underground



	,,000 m3/year
1. Water, supplied to the mine and process plant, including:	2252,41
– from Kyzyltu underground water intake	67,25
– with ore	63,16
– Open pit and underground mine water	2094,00
– Mine sites atmospheric precipitation runoff	19,80
– Buffer ore stockpile and carbon concentrate storage atmospheric precipitation runoff	8,20
2. Mine and process plant effluents, including:	1456,05
– household effluents to Auezov treatment plant	44,55
– Open pit and mine water to watercourse	1411,50
3. Non-recoverable losses, including:	766,36
– tailings storage evaporation (precipitation and evaporation balance)	248,76
– road and mine areas irrigation	20,40
– tailings interstices filling losses	189,35
– losses with concentrate	22,62
– losses in backfill	281,77
– boiler house and vehicle wash recycle water system make-up	3,46
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
2252,41=1456,05+766,36+30,00

Balance is provided for 2027 at the process plant operation without concentrate selection

Drawing 3.6: Water Consumption and Diversion Balance Flow Chart in the Period of the Deposit Undergro

Chapter 8 Appendices

Appendix 8.1: Public Consultation Protocol

Public hearing record
"Report for environmental and social impact assessment (RESI)
for the Kyzyl Project".
Bakyrchikskoe Mining Company LLP,
East Kazakhstan Province, Zharma Region, Auezov st.

Date held: December 3, 2015, 3:00 pm.
Venue: Zharma Region, Auezov st., assembly hall of high school.

Public hearings (PH) were organized by local council (akimat) of the Auezov settlement.

Information on the holding of the public hearings was brought to the attention of the public by means of: announcements in newspapers "Ore Altai" No. 134 (dated 13.11.2015), "Rauan-Voskhod " No. 89 (12.11.2015), "Didar" No. 130 (of 12.11.2015), announcements at the stand of akimat of the Auezov, the Shalabai settlements, the announcement on Akim of Zharma Distict website: - http://garma.vko.gov.kz/ru/hearings.htm

Participants:

- representatives of the Akimat of Zharma Region,
- representatives of the Akimat of the Auezov settlement,
- the representatives of Bakyrchikskoe Mining Company LLP, (BMC LLC,
- representatives of Wardell Armstrong International (WAI)
- representatives of the "Department of Ecology for East Kazakhstan Province Committee of Ecological Regulation and State Inspectorate in the Oil and Gas Complex of the Ministry of Energy of the Republic of Kazakhstan" (Semey Town)
- media representatives,
- members of the public.

The number of participants in the public hearings - 67 people.

For a complete list of the residents who participated in the public hearings, is provided in the annex to this Protocol.

Agenda of the public hearing:

Time	Report topic	Program of the reports	Speaker
14:50 - 15:10	Registration of participants		
15:10 - 15:15	Opening of the public hearings, adoption of the agenda, election of the Chairman and the Secretary of the hearings		Akim of Auezov country district Amirgazin B.A.
15:15 - 15:20	opening speech by the Chairman of PH		Chairman of PH - Amirgazin B.A.
15:20 - 15:30	Opening speech by the representatives of Bakyrchikskoe Mining Company LLP	The preparatory work which is carried out in 2015 by the enterprise to the development of the deposit, work plans. Social commitment of the enterprise made in 2015, planned for 2016.	Director General of BMC LLC Ovchinnikov Yu.B.

15:30. – 16:10	Report (presentation) on "Report environmental and social impact assessment for the Kyzyl Project»	Kyzyl project - brief information. WAI: about the company and the role in the project. The process of executing the Report environmental and social impact assessment (RESI) and the results.	Representative of WAI Edward Glucksmann
16:10-17:00	Questions from the participants of the public hearings. Answers from the representatives of the enterprise.		All participants
17:00-17:10	Closing remarks by the Chairman of the public hearings.		Chairman of PH - Amirgazin B.A.

Speakers:

Akim of the Auezov st. Amirgazin B. A. - opened the public hearings, familiarized the participants with the subject of the public hearings.

The election of the Chairman and the Secretary of the hearings was carried out at the hearings.

Akim of st. Auezov Amirgazin B.A. was elected as a Chairman.

The head of legal Department of BMC LLC Romanenkov D. S. was elected as a Secretary.

The procedural rules of the hearings are approved: it was determined that the speakers are given 15-20 minutes, for presentation/questions of participants are of no more than 5-10 minutes on each question.

The agenda of the public hearings is approved.

Director General of BMC LLC Ovchinnikov Yu.B.

Today exploration work is carried out on Bakyrchik deposit, the necessary infrastructure for development of the enterprise, the settlement of Auezov and the village of Shalabai is being created.

Preparatory overburden operations shall begin at Bakyrchik in 2016 and the first ore extraction is scheduled for the second half of 2017. After the completion of the open mining operations in the 2026, i.e. in 10 years, the underground mining shall begin and the extraction shall continue until 2039. Performance of the quarry shall be 1.8 million tons of ore per year and 1.2 million tons for the mine. The ore will be processed by the method of flotation enrichment of gold concentrate intended for the subsequent sale to third-party processors.

As early as in the second quarter of 2016, on Bakyrchik field the work shall begin for the construction of a processing plant with a capacity of 1.8 million tons of ore per year and for the camp for the employees of the enterprise. It is planned that the factory would reach full capacity in 2019 and produce an average of more than 10 thousand tons of gold in concentrate during the operation period of the quarry and during operation of the underground mine - of more than 8 thous. tons.

More than 700 people and more than 200 employees of contract organizations shall work on the deposit. From the beginning of 2016, it is planned to start recruitment of qualified personnel to work in the quarry. Preference will be given to the local people, whose qualifications shall match the requirements of the enterprise.

It is worth noting that Bakyrchik mining enterprise pays much attention to social well-being of the population. The basic directions of social support are education, health care, infrastructure of the populated localities, support of sport and healthy lifestyles, as well as the development of the cultural potential of the region.

In 2014-2015, the memorandums of social and economic cooperation with akimats of the East Kazakhstan region and the Zharma Region for the total amount of 215 million tenges were signed.

In 2015, within the concluded memorandum we invested 30 million tenges in development of infrastructure of st. Auezov and v. Shalabai.

Also within the concluded memorandum with akimat of the East Kazakhstan region, 185 million tenges were invested on restoration of kindergarten "Akku" for 180 places. By the end of 2015, we shall complete the repair work of the outpatient clinic and it is planned to purchase medical equipment.

The toys were purchased for the mini-centre, established on the basis of the secondary school "Bakyrchik". Means (funds) are invested in the infrastructure development of the settlement: on the improvement and maintenance of the roads, development of the project documentation for the structure of the Central Park of st. Auezov, construction of mini-park in the village of Shalabai and a bypass road in the direction of "Bakyrchik — Bursak". Additional funds are allocated to provide financial assistance to children with limited physical and mental capacities as part of program "Lekoteka".

Today in Higher education institutions 19 graduates from st. Auezov (13 graduates) and v. Shalabai (6 graduates) are taught at the expense of the Polymetal Company. The company also provides on an ongoing basis the assistance in the organization of social, cultural, sports events and the public holidays. In addition, the enterprise finances the participation of high school students in sports, cultural events and scientific and practical conferences, in which the children achieve good results.

Also it should be noted that in 2016 memorandum shall be signed with akimat of the Zharma Region for total amount of 30 million tenges for further support of education, health care and infrastructure of the human settlements, as well as for the development and support of sport and a healthy lifestyle, for the development of cultural potential of the region.

The representative of WAI Edward Glucksmann introduced to the audience a presentation on the “Report environmental and social impact assessment (RESI) for the Kyzyl Project”.

Role of Armstrong Vardell in Kyzyl project:

- To ensure the implementation of RESI in accordance with the international standards of environmental and social responsibility.
- To provide independent assessment and recommendations for future work on the project, taking into account the social and environmental consequences.

Task:

- To assess the environmental and social impacts of the project at the stages: construction, operation, liquidation.
- To ensure the development of the project, taking into account the measures to prevent, minimize and manage the risks and impacts.
- Independent monitoring.
- Involvement of stakeholders - public participation in RESI

Visit to the area was carried out in June/July in 2015.

The summary of nontechnical character contains detailed information and the expected influences and impacts from the project, and also measures for their mitigation.

Procedure of submission of complaints and offers – on a site and in akimats of the settlements of Auezov and Shalabai is introduced.

According to the Kyzyl Project, the following studies of the environmental and social impacts were conducted:

- air quality (including greenhouse gas emissions);
- geochemical effects and impact;

- noise and vibration;
- soil and land use;
- water resources;
- biodiversity;
- ecosystem services;
- archeology and cultural heritage;
- transport and infrastructure;
- impact on social services studies and local population: Administration, demography and culture, social infrastructure, health care and education, economy, and the livelihood of the local population;
- hierarchy of mitigation;
- prevention when designing through the selection of alternative technological processes;
- minimizing /reduction, for example, the use of isolation, screening and cleaning;
- Compensation and reimbursement, for example, re-create a natural environment, restoration.

Assessment of the key impact

After carrying out the mitigation measures, the stated below the impact of the project shall be "middle" or "moderate":

Environment	Negative impacts from the Project
1. Air quality	Greenhouse gas emissions
2. Noise	Increase in noise level, acting on the components of an ecosystem, including humans
3. Flow of traffic and transportation	Increase of flow of traffic increases the risk of a road accident
4. Economy and sources of subsistence	After the liquidation of the mine - the loss of income for the regional and local economy, including the loss of the jobs Temporary withdrawal of lands

Main results of the impact assessment

Greenhouse gas emissions and climate change - climate change is a global problem, and Kyzyl project shall not make a significant contribution in the development of this problem.

Geochemical impact - impact of acidic runoff and leaching of metals will be negligible.

Air quality - in the case of the application of the necessary protective measures, it is believed that the impact of the Project on the air quality in terms of safety to human health shall be low in the short term and insignificant in the long term.

Noise and vibration - in carrying out appropriate measures to reduce exposure, and noise exposure and the level of vibration shall be within the limits established by WHO, when carrying out daytime work performance and within the requirements of Kazakhstan legislation when working during the day and at night. After the start of underground mining, noise during the day and at night shall be below the established standards.

Biodiversity and ecosystem services - effective environmental management shall reduce the impact of the project on biodiversity and ecosystem services

Soil and land use - proposed protective measures shall help restrain the loss and disruption of soil to a minimum and ensure the possibility of reclaiming the most part squares of the project

facilities. The residual effects shall be negligible, provided for the application of the protective measures.

Water resources - using the planned mitigation measures, the impact on surface water and groundwater shall be minimal. The destruction of the enclosing tailings dam is unlikely. Stream Akbastaubulak shall be taken away, that shall lead to decrease in water inflow.

Archaeological and cultural heritage - Polymetal shall conduct training for all staff concerning the order of action when detecting the finds of cultural value.

Transport services and infrastructure - impact of the project on residents of Auezov and Salaba caused by traffic, shall be low or moderate. Difficulties with traffic will be relatively short in duration and only along the specific road section.

Baseline state of socio-economic environment - collected comprehensive data on background as of a socio-economic environment, as described in the non-technical summary. Social impacts can be both negative and positive. Principal receptors shall be the population of Auezov and Shalabaj settlements. Socially unprotected groups of the population include women and elderly people. Dependent on source of income is considered to be moderately negative impact of the project, provided that the mitigation measures. Polymetal will annually update “Mine closure plan” (which shall include the reduction of the social impact of the closure of the mine) and closer to the completion of the project it shall develop a "policy of economy". "Social Management Plans” shall help to cope with the adverse effects of the project and increase the positive ones.

Potential social impact - Project shall provide from 608 to 1900 working place during pit mining and underground mine. Priority shall be given to the employment of the local population. Income from the project to local and State budget are considered to be a positive influence.

The positive impact of the project

Ecology: long-term recovery of the project area

Employment - direct and indirect opportunities.

- Potential entrepreneurial development opportunities for the local population.
- Measures to mitigate the negative impacts that are represented in RESI, emphasize the importance of employment for the local population (in particular for the residents of the villages of Auezov and Shalabaj.
- Inclusion of women.
- Training opportunities shall diversify the skill set of the local population
- Tax receipts from the project to the local, regional and state budgets.
- Improving the road conditions.
- The return of people leaving Auezov and Shalabaj settlements.

Questions, suggestions and comments from representatives of the public:

After speeches of all speakers at public hearings were listened, the following questions from the present inhabitants of st. Aueov were received:

Nurtazov K.M.

Question: Is there any data on the presentation of the report and why did you not work with the public (did not bring the reports to the people)?

Answer (Amirgazin B.A): Copies of the report have been placed in places accessible to the public (Akimat of st. Auezov and Environment Department), information on the holding of the public hearings, with an indication of the places, where you can familiarize yourself with all materials was published on the site, as well as the hanging ads all around the village of Auezov in crowded places (shops, cafe, school). Accordingly, you were given a real opportunity to get acquainted with the materials, and your presence in the room confirmed the fact that you have read the ad.

Question: From where the quarrying begins?

Answer (Ovchinnikov Y.B): From the east part, within the limits established in accordance with legislation of the Republic of Kazakhstan and project of a sanitary-hygienic zone.

Question: Where did Glucksmann E. conduct his researches, if we have not seen him in the village?

Answer: (Ovchinnikov Y.B): Edward Glucksmann worked both within and outside the village of Auezov, because for his research in accordance with international standards it is necessary to involve nearby settlements. Edward has conducted interview with people encountered on the street, shepherds, workers of the social spheres, etc. but he didn't have the task to cover each inhabitant of the village, but only receive objective opinion from the inhabitants of the region where the company operates.

Bekisheva R.N.:

First of all she thanked Edward Glucksman for the work done and for the prepared report. She indicated that more than 20 years, mine and quarry did not work and the local population have already lost any hope for performance restoration of the works and the normal life of the village. According to the majority of the villagers the obvious positive shifts began with arrival of Polymetal. There is now hope for the restoration of the village and the enterprise.

She focused attention on those measures of social support taken by the Company.

Question: Where will be the explosive storage?

Answer (Ovchinnikov Y.B): In the north-eastern part of the mining lease, with strict observance of safe zones.

Bayazhanova Zhanna

Question: regarding the employment of people who are now scattered all over Kazakhstan.

Answer (Ovchinnikov Y.B): The company expressly focuses on employment of local residents, including those from the nearby villages. All persons who wish to work in our company have a chance to submit resume in the HR Department. Any resumes submitted shall be reviewed and, where possible and appropriate, all specialists needed by the company, shall be forwarded to the relevant proposals.

Meirbaev Tokan

Remark: I wish that when conducting blasting explosions there shall not be any affect and impact on our homes and property. I would like to have developed activities to compensate for the damage.

Answer (Ovchinnikov Y.B): The company has measures to prevent the scattering of splinters, but even if there are proven cases of blasting operations caused damage, such damage will be fully compensated by the company.

The main direction of blasting is the Northern, which eliminates the impact on the residents and their property.

Musabayev S. T.

Question: There is a gym in the village and according to our information it will be eliminated, what facilities are assumed to maintain a healthy lifestyle?

Answer (Ovchinnikov Y.B): The company supports a healthy lifestyle, for example, we fully supply and provide the skating rink in the settlement.

The gym is on our land for the project, for implementation of the project, it is necessary to utilize this building. A natural person who claimed at the gym has not got any legal document, which it could not be otherwise, since the building legally belongs to the company. However, we have decided that the village needs a gym and, therefore, in 2017-2018 an issue will be solved by the construction of a new sports complex at the expense of the company.

Zhagiparov K. O.

He began his speech with positive words in the address of the company indicated that in other places where the production is stopped and not working the situation is much worse (abandoned house, aging of the local population due to the fact that the young people are leaving for work to the other places). Here there are visible specific activities, movement of machinery, etc.

The main conclusions on the basis of the results of the discussion:
Public hearings are considered valid.
There are no disagreements.
The following decision according to the proposal of the chairman, conducted by vote was adopted according to the results of the public hearings, taking into account the suggestions and recommendations:

1. **Take the report submitted into consideration:** "Report environmental and social impact assessment (RESI) for the Kyzyl Project". Bakyrchikskoe Mining Company LLP
2. **Approve the activities of** LLP "Bakyrchik mining enterprise", taking into account the suggestions and recommendations made in the presentations and discussions of the issues on the "Report environmental and social impact assessment (RESI) for the Kyzyl Project."
3. **Adopt** these solutions as a basis. Abstained - 1. For - all other participants. The draft decision is approved.

Chairman of the public hearings: _____ Amirgazin B.A.

Secretary of the public hearings _____ Romanenkov D.S.

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

POLYMETAL

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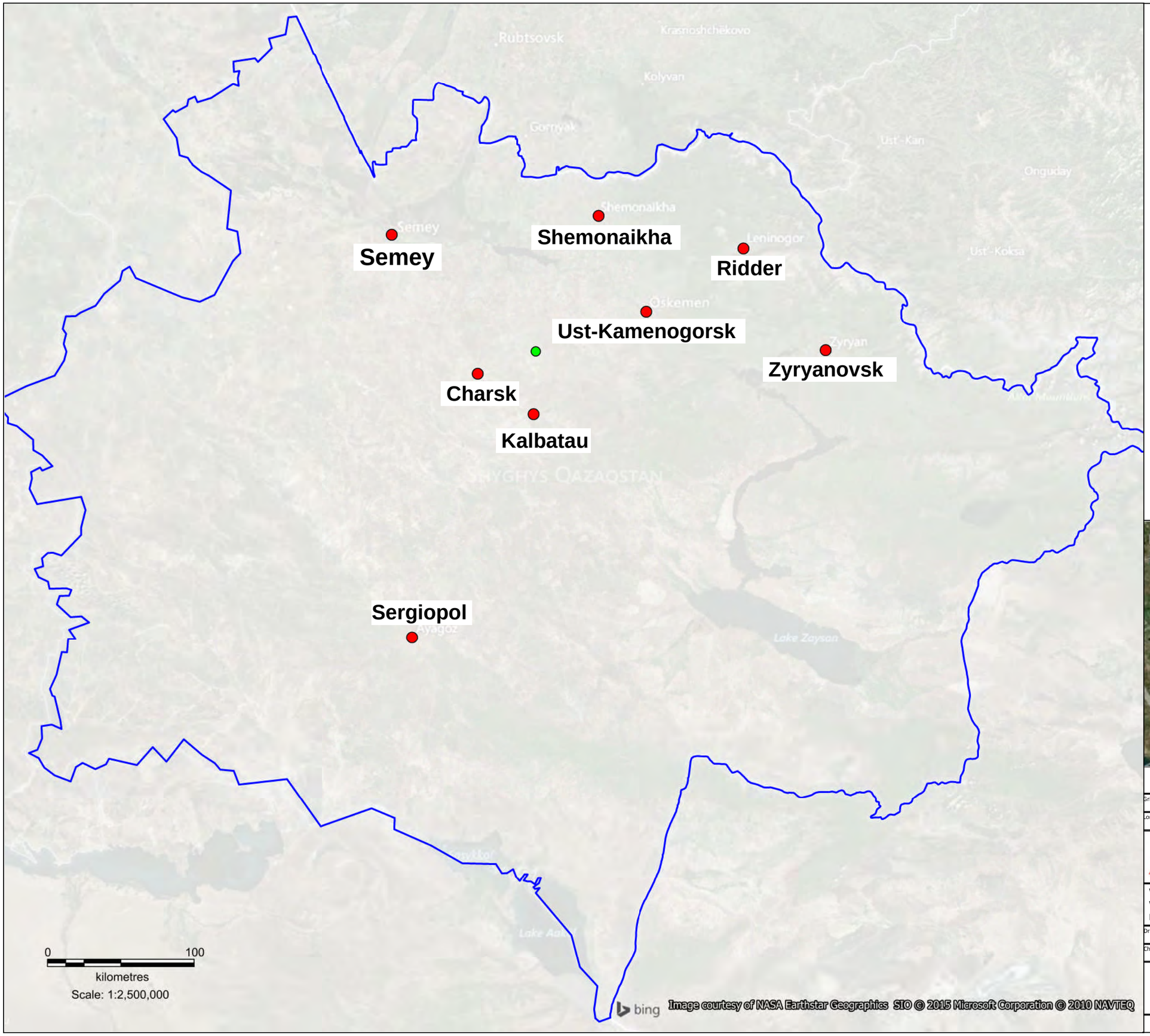
Drawn By:	CD	Date:	07/09/2015
Checked By:	NR	Date:	07/09/2015

Project Location in relation to Kazakhstan and Region
Bakyrchik
Kazakhstan

Section_100_Introduction	Drawing 1.1



Kyzyl Project Location

Major Urban Centres

East Kazakhstan

1 : 10 000 000

0 kilometres 100

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Drawn By:	CD	Date:	16/08/2015
Checked By:	EG	Date:	16/08/2015

Regional Setting of Project in relation to Major Urban Centres
ESIA Bakyrchik

EastKazAdmin_V1_520156	Drawing 1.2

Akbastaubulak
Zhumataybastau
Kyzyltu
Kyzyltu borefield
Mayranbastau
Settling pond No2
Settling pond No1
Protection dike No.1
Protection dike No.2
Settling sump No2
Water diversion channel of Akbastaubulak and Kyzyltu streams
Drainage Ditch No2
Explosion Storage Area
Ammonium Nitrate Storage
Explosive test area
Topsoil Storage
Waste Dump
Drainage Ditch No1
ROM ore pad
ROM ore pad
Open pit
Pit drainage water settling sump
Existing, disused arsenic waste dump
Dam of pit drainage water settling sump
Western Ventilation Shaft
Capital Shaft
Eastern Ventilation Shaft
Existing Auezov boiler-house to be decoommissioned
Settling sump No1
Backfill Plant
Mine Water Treatment Plant
Pump and filtration plant
Ore Stockpile
Ore Preparation
Carbon concentrate storage facility
Fuel and Lubricant Storage
Upstream dam No.2
Existing tailings storage facility
Pump House
Cut-off Trench
Coal Fired Boilerhouse
Process Plant Site
Repair and Storage Facilities
Reagent Storge
Finished concentrate storage
Sewage Treatment Plant for mine use
Upstream Dam No.1
Containment Dam No.2
Auezov
Akbastaubulak
Existing domestic sewage treatment facilities
New Auezov settlement coal-fired boiler house
Tailings Storage Facility (TSF)
Diversion Ditch
Solnyechni
Bakyrchik-Bursak bypass road
Containment Dam No.1
Bezymyanny
Alaigyr

0 500
metres
Scale: 1:11,000

1 40 000 000

BNG Ref:	14541819 : 5510091
Long - Lat DD:	81.580° : 49.721°
Long - Lat DMS:	81° 34' 48" : 49° 43' 16"

POLYMETAL
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Drawn By: CD	Date: 23.09.2015
Checked By: NR	Date: 23.09.2015

General Arrangement Plan
ESIA, Bakyrchik
Kazakhstan

Section_100_general_arrangement | Drawing 1.3

Drawing 3.2a -- Stage 1 Open Pit Mining Schedule

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Phase 1 - Open Pit Mining

Construction - buildings, structures, utilities	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Mining facilities (Phase 1)																										
Open pit																										
Open pit																										
Heating room and canteen for workers																										
Waste dump																										
Ore stockpile (buffer)																										
Pumphouse for buffer ore stockpile drainage water																										
Open pit dewatering –Area No1																										
Open pit dewatering – Area No 2																										
Settling sump No1																										
Drainage ditch No 1																										
Drainage ditch No 2																										
Settling sump No2																										
Water diversion channel of the Akbastausbulak and Kyzyltu Streams																										
Protection dike No1																										
Protection dike No 2																										
Top soil storage																										
Dam of pit drainage water settling sump																										
Pumphouse of pit drainage water settling sump																										
Pressure pipeline network for open pit drainage water																										
Fresh water supply pipeline to tailing storage																										
Ore processing facilities (Phase 1)																										
Ore preparation facility, including:																										
Primary/course crushing plant with trestle of Conveyor No1																										
Crushed ore stockpile, with gallery of Conveyor No 2																										
Process plant																										
Tailings thickener, D=32 m																										
Recycle water tank																										
Laboratory																										
Finished concentrate storage																										
Carbon concentrate storage																										
Tailings storage, including:																										
Bund wall No1																										
Bund wall No 2 (reconstruction)																										
Waterproof liner of tailings storage bed																										
Stream diversion channel																										
Upstream wall No1 (reconstruction)																										
Upstream wall No2																										
Water diversion ditch																										
Recycle water pumphouse																										
Recycle water pipeline (the 1st and 2nd stages)																										
the 1st stage																										
the 2nd stage																										
Pulp pipeline (right and left runs)																										
Drainage system with pumphouse																										
Repair and maintenance facilities (Phase 1)																										
Repair shops																										
Outdoor repair and mounting area																										
Storage facilities (Phase 1)																										
Reagent storage, including:																										
Reagent container storage area																										
Hangar No1																										
Hangar No 2																										
Decontainerization area																										
Office building																										
Ammonium nitrate storage, including:																										
Stacked ammonium nitrate storage area																										
Mixing and charging machine loading station																										
Mixing and charging machine parking lot																										
Fire water tanks																										
Fuel and lubricants storage, including:																										
Tank farm																										
Loading/unloading site																										
Service building																										
Drummed oil storage area																										
Empty drum storage area																										
Diesel fuel filling station																										
Container-type petrol filling station																										
Process pipelines																										
Emergency oil collection tanks (2 units)																										
Fencing																										
Explosives storage																										
24 t explosives storage site, including:																										
Explosives container storage site (2 units)																										
Room for initiating devices storage																										
Explosives preparation and distribution building																										
Laboratory																										
Store-house of fire-fighting means																										
Packing storage																										
Watch tower																										
Office building																										
Guardhouse																										
Heating room and canteen for workers																										
Empty container storage site																										
Explosives test and destruction range, including:																										
Explosives test and destruction area																										
Shot-firer safe location																										
Fencing																										
Materials and equipment outdoor storage																										
Heat and power supply facilities (Phase 1)																										
Boiler house with flue gas stack, including: boiler house, coal storage and ash storage																										
GPP-110/35/6kV main step-down transformer substation																										
Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 1																										
Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 2																										
Open pit feeder power and lighting networks, including: excavators, 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system pumphouses (Areas No 1 and No2), external package transformer substation for open pit and waste dump lighting (16 units, mobile light lines)																										
Mine site feeder power and lighting networks, including:																										
6kV package outdoor switchgear at the mine site																										
Power networks. 6kV power line from 6kV package outdoor switchgear to 6/0.4 kV power distribution unit at the mine site (L=600 m)																										
6/0.4kV external package transformer substations at the mine site and infrastructure facilities:																										
1x1000 - primary/coarse crushing plant																										
2x400 - laboratory																										
2x400 - boiler house with flue gas stack																										
2x630 - repair shops																										
2x100 - reagent storage																										
2x63 - explosives storage																										
2x63 - ammonium nitrate storage																										
2x250 - fuel and lubricants storage																										
2x250 - recycle water pumphouse																										
1x63 - drainage pumphouse																										
2x250 - treatment facilities																										
Power networks. 6kV power line to 6/0.4kV external package transformer substation of the mine site and infrastructure facilities (L=7900 m)																										
Feeder power and lighting networks of the sanitary and amenity building, including:																										
1. Power networks. 6kV power line to 6/0.4kV external package transformer substation of the the sanitary and amenity building (L=400 m)																										
2.6/0.4kV external package transformer substation of the sanitary and amenity building																										
5. Power networks. 6kV power line to 6/0.4kV external package transformer substation of the pumphouse for household and drinking water supply (L=400м)																										
6. 6/0.4kV external package transformer substation of the pumphouse for household and drinking water supply																										
Feeder power and lighting networks at the pit drainage settling sump, including:																										
1.6/0.4kV external package transformer substation of the pumphouse at the pit drainage settling sump																										
2.Power networks. 6kV power line to the pumphouse at the pit drainage settling sump																										
Power networks. 6kV power line to Capital Shaft (switching of existing mine drainage system)																										
Utility facilities (water and gas supply pipelines, sewage system and other networks, including inter-site ones)																										
Pumphouse with water tanks - process and fire water supply																										
Pumphouse with water tanks - household and drinking water supply, household and drinking water supply area fencing																										
Treatment facilities for household sewage																										
Treatment facilities for surface runoff of the fuel and lubricants storage																										
Surface water gathering pond																										
Sewage pump station																										
Household and drinking water supply systems, (subsurface piping, L=2400 m)																										
Process and fire water supply systems (subsurface piping, L=1750 m)																										
Household sewer systems (subsurface piping, L=1100 m)																										
Heat supply networks (surface piping, L=2550 m)																										
Inter-site transportation lines																										
Access road (open pit western exit – waste dump)																										
Access road (open pit eastern exit – waste dump)																										
Access road (open pit eastern exit – buffer ore stockpile)																										
Support road (buffer ore stockpile – repair and storage facilities)																										
Support road (buffer ore stockpile – carbon concentrate storage)																										
Support road (road fork - existing road)																										
Support road (top soil storage – explosives test and destruction range)																										
Support road (top soil storage – explosives storage)																										
Office and amenity block																										
Canteen for 100 seats																										
Security and fire-fighting facilities																										

Legend:

- construction period for capital facilities
- reconstruction and reequipment period for existing buildings and facilities
- lifetime of capital facilities
- dismantling period for existing buildings and facilities
- recultivation period for the mine and process plant facilities

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Phase 2 - Underground Mining

Construction - buildings, structures, utilities	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Mining facilities (Phase 2)																										
Mine site																										
Lamp room																										
Cement storage silos - backfill plant																										
Buffer tank of thickened tailings -backfill plant																										
Pulp supply pipeline - backfill plant																										
Water supply pipeline - backfill plant																										
Backfill supply pipeline																										
Power networks. 6kV power line to backfill plant																										
6/0.4kV external package transformer substation of backfill plant																										
Central and Western areas																										
Western area																										
Mine site. Western area.																										
Underground mining																										
Western Ventilation Shaft, +385m elevation (reconstruction)																										
Pithead building of Western Ventilation Shaft																										
Main fan unit No1																										
MTEU-VNU 07/3-4 power supply unit, including air heating unit																										
870 t coal storage (Main fan unit No1)																										
Ash storage (Main fan unit No1)																										
Pumphouse No1 with water tanks - process and fire water supply																										
Storage No1 - fire fighting supplies and equipment																										
Western vent raise, +385 m elevation																										
Western vent raise opening, +385 m elevation																										
Backfill supply drift hole No1, collar, +385 m elevation																										
Feeder power and lighting networks of the Western area, including:																										
1.Power networks. 6kV power line to Main Fan Unit No1 of the Western area.																										
2.Power networks. 6 kV power line to power supply unit of Main fan unit No 1 of the Western area.																										
3.6/0.4kV external package transformer substation for power supply unit of the Western area.																										
4.Power networks. 6kV power line Western vent raise, +385 m elevation (UG)																										
5.Power networks. 6 kV power line from 2KTP-10000-35/6kV Central area transformer substation to the Western area.																										
6.PKTPN 6 300-35/6 kV Transformer substation No 2 of the Western area. the Western area (transfered from the Western area of Phase 1)																										
7.Power networks. 35 kV power line to PKTPN 6 300-35/6 kV Transformer substation No 2.																										
Central area																										
Mine site. Central area.																										
Underground mining																										
Capital Shaft, +410 m elevation (reconstruction)																										
Pithead building of Capital Shaft (reconstruction)																										
Capital Shaft hoist building (reconstruction)																										
Main fan unit No 3																										
MTEU-VNU 10+4 power supply unit, including air heating unit																										
1330 t coal storage (Main fan unit No 3)																										
Ash storage (Main fan unit No3)																										
Pumphouse No 2 with water tanks - process and fire water supply																										
Storage No 3 - fire fighting supplies and equipment																										
Heat supply network - Central adit, +180 m elevation																										
Heat supply network - Central adit portal, +180 m elevation																										
Storage No 4 - fire fighting supplies and equipment																										
Utilities 1 - Central adit, +180 m elevation																										
Utilities 1 – Central adit portal, +180 m elevation																										
Utilities 2 - Central adit, +150 m elevation																										
Utilities 2 - Central adit portal, +150 m elevation																										
Storage No 5 - fire fighting supplies and equipment																										
Backfill supply drift hole No 2, collar, +402 m elevation																										
Ore handling stockpile No1																										
Open pit water drainage pipeline for process needs L=4550m																										
Feeder power and lighting networks of the Central area, including: 1.2KTP-10000-35/6kV package two-transformer substation of the Central area.																										
2. Power networks. Two 35kV power lines to 2KTP-10000-35/6kV transformer substation of the Central area.																										
3.Power networks. 6 kV power line to Main fan unit No 3 of the Central area.																										
4.Power networks. 6 kV power line to power supply unit of Main fan unit No 3 of the Central area.																										
5.6/0.4kV external package transformer substation for power supply unit of the Central area.																										
6.Power networks. 6kV power line to Capital Shaft hoist																										
7. Power networks. 6kV power line to Utilities 2 - Central adit																										
8.Power networks. 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 2.																										
9.6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 2.																										
Eastern area																										
Mine site. Eastern area.																										
Underground mining																										
Eastern Ventilation Shaft, +435m elevation																										
Pithead building of Eastern Ventilaton Shaft																										
Main fan unit No 2																										
MTEU-VNU 10+4 power supply unit, including air heating unit																										
630 t coal storage (Main fan unit No 2)																										
Ash storage (Main fan unit No2)																										
Pumphouse No 3 with water tanks - process and fire water supply process and fire water supply																										
Storage No 2 - fire fighting supplies and equipment																										
Heat supply network - Eastern adit, +250 m elevation																										
Heat supply network - Eastern adit portal, +250 m elevation																										
Storage No 6 - fire fighting supplies and equipment																										
Utilities 1 - Eastern adit, +250 m elevation																										
Utilities 1 – Eastern adit portal, +250 m elevation																										
Utilities 2 - Eastern adit, +253 m elevation																										
Utilities 2 - Eastern adit portal, +253 m elevation																										
Storage No 7 - fire fighting supplies and equipment																										
Backfill supply drift hole No 3, collar, +435 m elevation																										
Ore handling stockpile No 2																										
Feeder power and lighting networks of the Eastern area, including:																										
1.Power networks. 6kV power line to 6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 1.																										
2.6/0.4kV external package transformer substation of open pit drainage system – Dewatering area No 1.																										
3.Power networks. 6 kV power line to Main fan unit No 2 of the Eastern area.																										
4.Power networks. 6 kV power line to power supply unit of Main fan unit No 2 of the Eastern area																										
5.6/0.4kV external package transformer substation for power supply unit of the Eastern area.																										
6.Power networks. 6kV power line to Utilities 2 - Eastern adit																										
7.Power networks. 6 kV power line from 2KTP-10000-35/6kV Central area transformer substation to the Eastern area.																										
8.PKTPN 6 300-35/6 kV Transformer substation No 1 of the Eastern area (operates at the same location as for Phase 1)																										
Office and amenity block																										
Sanitary and amenity building (SAB UG)																										
Utilities																										
(water and gas supply pipelines, sewage system and other networks, including inter-site ones)																										
Household and drinking water storage tanks																										
Household and drinking water supply networks L=700																										
Household sewer networks L=300																										
Heat supply networks L=1350																										
Inter-site transportation lines																										
Road (road fork - Central area)																										
Road (fork of Central area road - Western area)																										
Road (fork of Central area road - Eastern area)																										
Existing facilities																										
Ore kiln charging area (To be reconstructed and used for backfill mixture preparation - Phase 1)																										
Mine water treatment station (to be used for OP and UG periods)																										

Legend:

construction period for capital facilities

reconstruction and reequipment period for existing buildings and facilities

lifetime of capital facilities

dismantling period for existing buildings and facilities

recultivation period for the mine and process plant facilities

Drawing 3.2c -- Auezov Infrastructure Development Schedule

Implementation Schedule for the Bakyrchik Mine and Process Plant Construction (Bakyrchik Gold Project)
Infrastructure and Utilities of Auezov Town and Existing Facilities

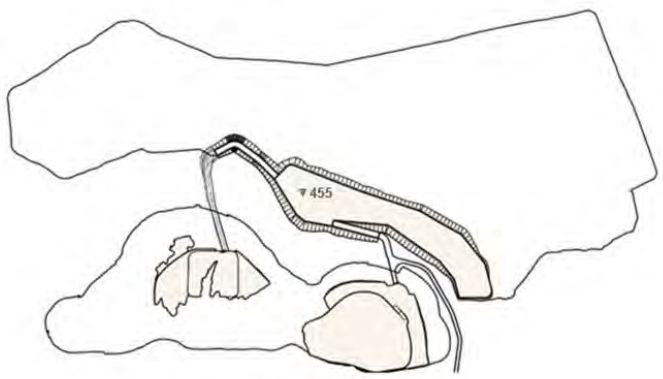
Construction	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
External transportation lines																										
By-pass general-purpose road (Bakyrchik – Bursak)																										
External utilities																										
Power networks. 110kV single-circuit power line. Branch line from L-479 power line to new GPP-110/35/6kV																										
Power networks. 110-35kV double circuit power line. 110kV branch line from L-178 power line and 35kV branch line from L-84C power line to new GPP-110/35/6kV																										
Power networks. 35kV single-circuit power line. 35kV branch line from 110-35kV double-circuit power line																										
Household and drinking water supply pipeline from Kyzyltu intake (subsurface piping, L=6900 m)																										
Utilities of Auezov Town (Phase 1)																										
Feeder power and lighting networks of facilities, located in from GPP110/35/6kV to 6 kV indoor switchgear , 6 kV power line to Auezov's facilities																										
Auezov's boiler house with flue gas stack, including: boiler house, coal storage, ash storage																										
Heat supply networks (from Auezov's boiler house to TK-21, L=790 m)																										
Household and drinking water supply networks – Auezov's boiler house (L=500 m)																										
Household sewer networks – Auezov's boiler house (L=150 m)																										
Household and drinking water supply pipeline from the site to pumping and filtration plant (subsurface piping, L=1000 m)																										
Auezov's water tower																										
Household and drinking water supply networks – Auezov's water tower (L=200 m)																										
Existing facilities																										
Mine rescue team building (will be reconstructed as sanitary and amenity building for OP and UG periods - Phase 1)																										
Office building (old) (will be renovated and used as office building - Phase 1)																										
Main fan unit (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Facilities subject to dismantling																										
300 m3 water tower (to be dismantled in 2016)																										
Skipovaya Shaft pithead buildings (to be dismantled)																										
Skipovaya Shaft hoist building (to be dismantled)																										
Gas supply facilities of sulphide ore process plant (to be dismantled in 2015)																										
Ore preparation building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Ore-roasting kiln (to be dismantled in 2015)																										
Building of dust control shop (to be dismantled in 2015)																										
Building of heavy fuel oil handling facilities (to be dismantled in 2015)																										
Control board room (to be dismantled in 2015)																										
Cooling tower with compressor station (to be dismantled in 2015)																										
Drainage pumphouse																										
Water recycle pumphouse																										
Building of uncompleted process plant (to be dismantled in 2015)																										
Private fuel-filling station (to be dismantled in 2015)																										
Crusher building of sulphide ore process plant (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Gallery and hopper - sulphide ore process plant (to be dismantled in 2015)																										
Process plant building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Oxide ore storage building (to be dismantled in 2015)																										
Mine office and amenity building (to be dismantled in 2015)																										
Central boiler house, including: buildings of wet slag and ash removal, multicyclone device, lifting gallery, garage, boiler room, salts wet and dry storage areas, flue gas stack (H=60m), fencing. (to be dismantled in 2016-2017)																										
Repair shops building (to be dismantled in 2017)																										
Power networks. 110kV power line (L=7550 m) (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
Power networks. 110-35kV power line to Auezov Town (L=600 m), (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
Power networks. 35kV power line (L=2610 m) (to be dismantled in 2016-2017 after construction of new main step-down transformer substation (GPP))																										
GPP110/35/6kV main step-down transformer substation, to be used before commissioning new GPP, then as: Indoor switchgear building (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Pilot plant building (to be dismantled in 2017)																										
Ore kiln discharge area (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Calcine cooling area (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Main compressor plant (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										
Fencing of highly toxic substances storage (used as temporary buildings and facilities during the construction period. To be dismantled in 2018)																										

Legend:

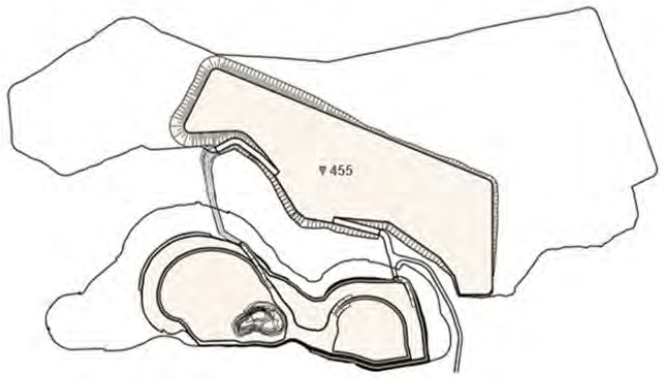
- construction period for capital facilities
- reconstruction and reequipment period for existing buildings and facilities
- lifetime of capital facilities
- dismantling period for existing buildings and facilities
- recultivation period for the mine and process plant facilities

Drawing 3.3: Illustration of Open pit and waste development year by year

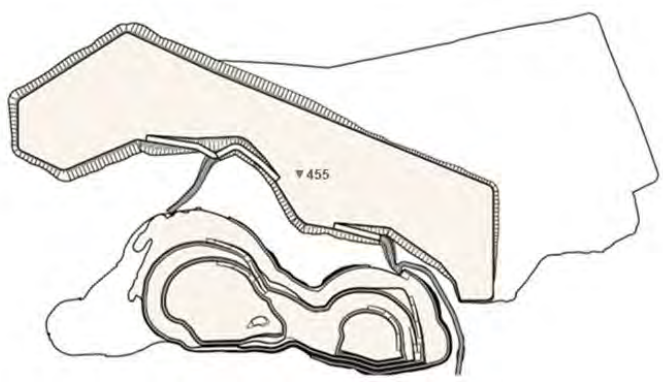
2016 г.



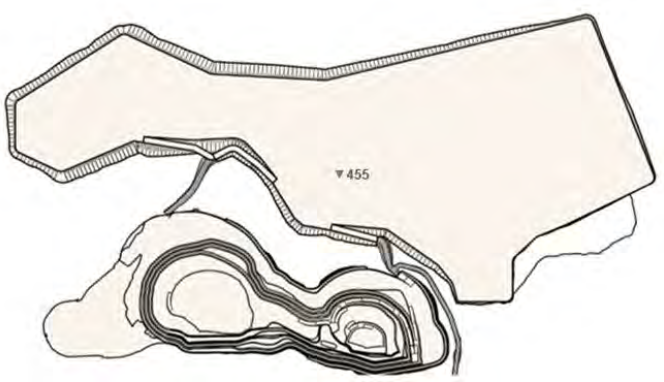
2017 г.



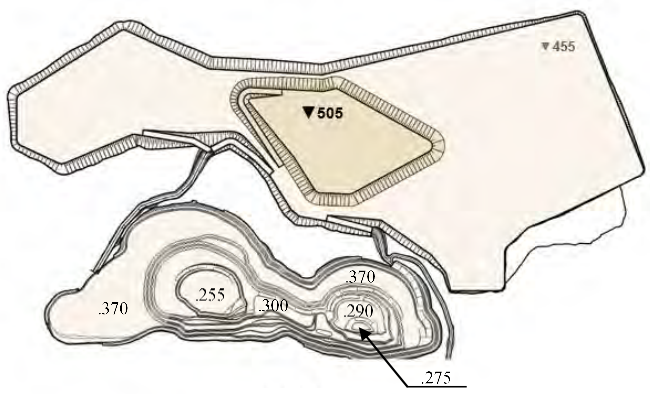
2018 г.



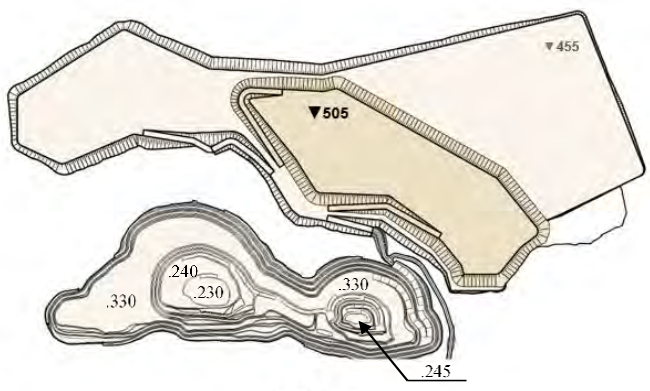
2019 г.



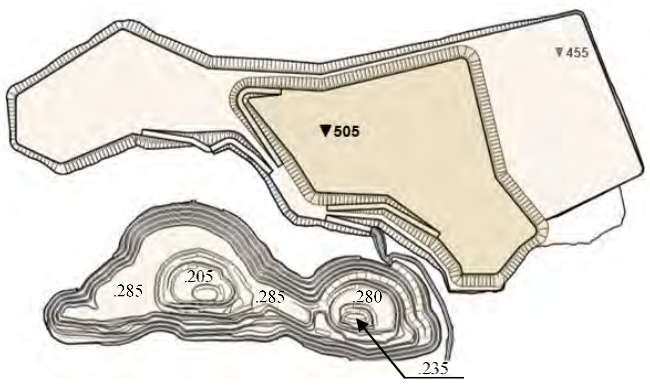
2020 г.



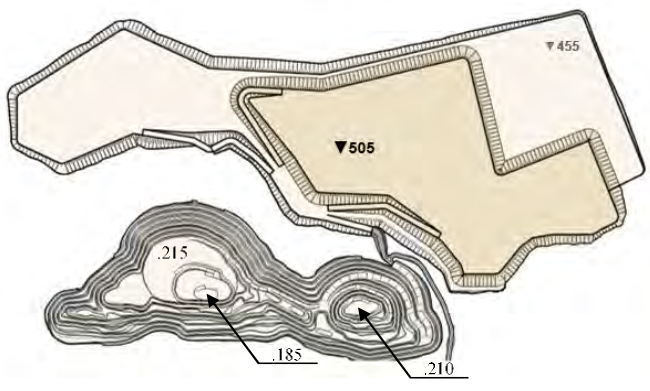
2021 г.



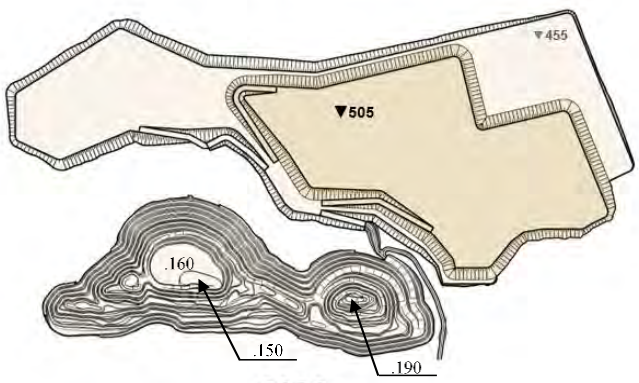
2022 г.



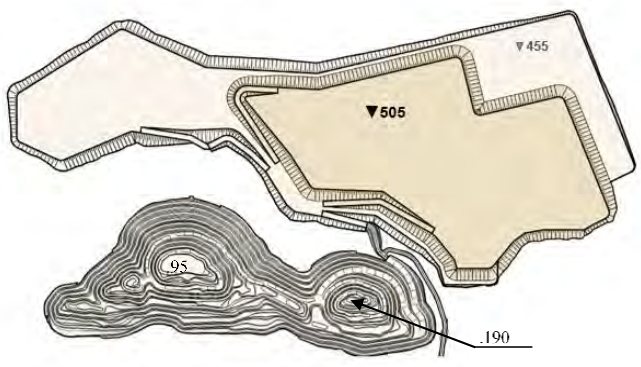
2023 г.



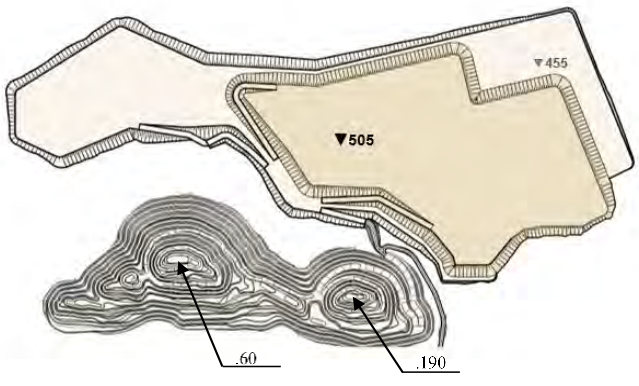
2024 г.

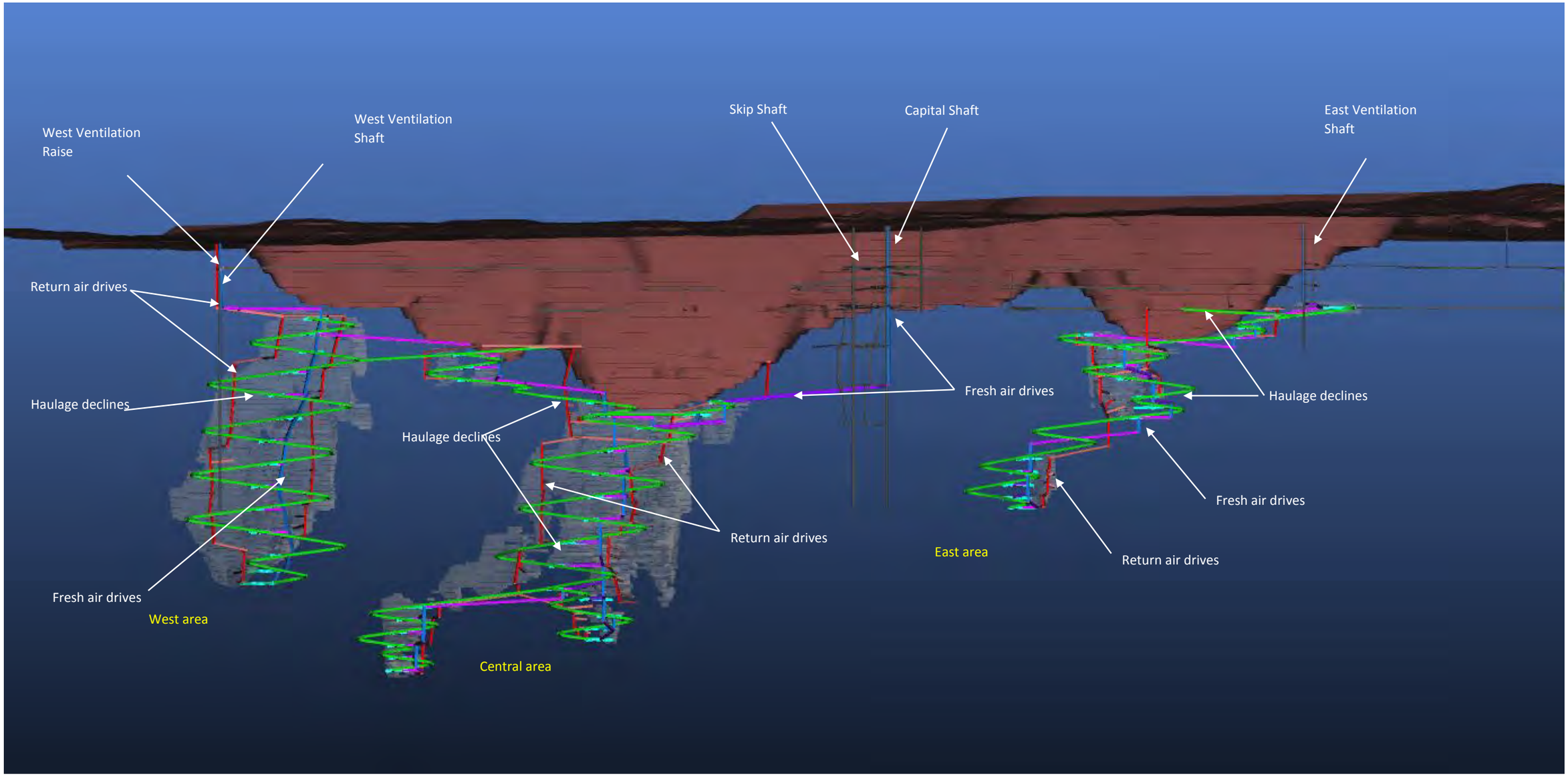


2025 г.



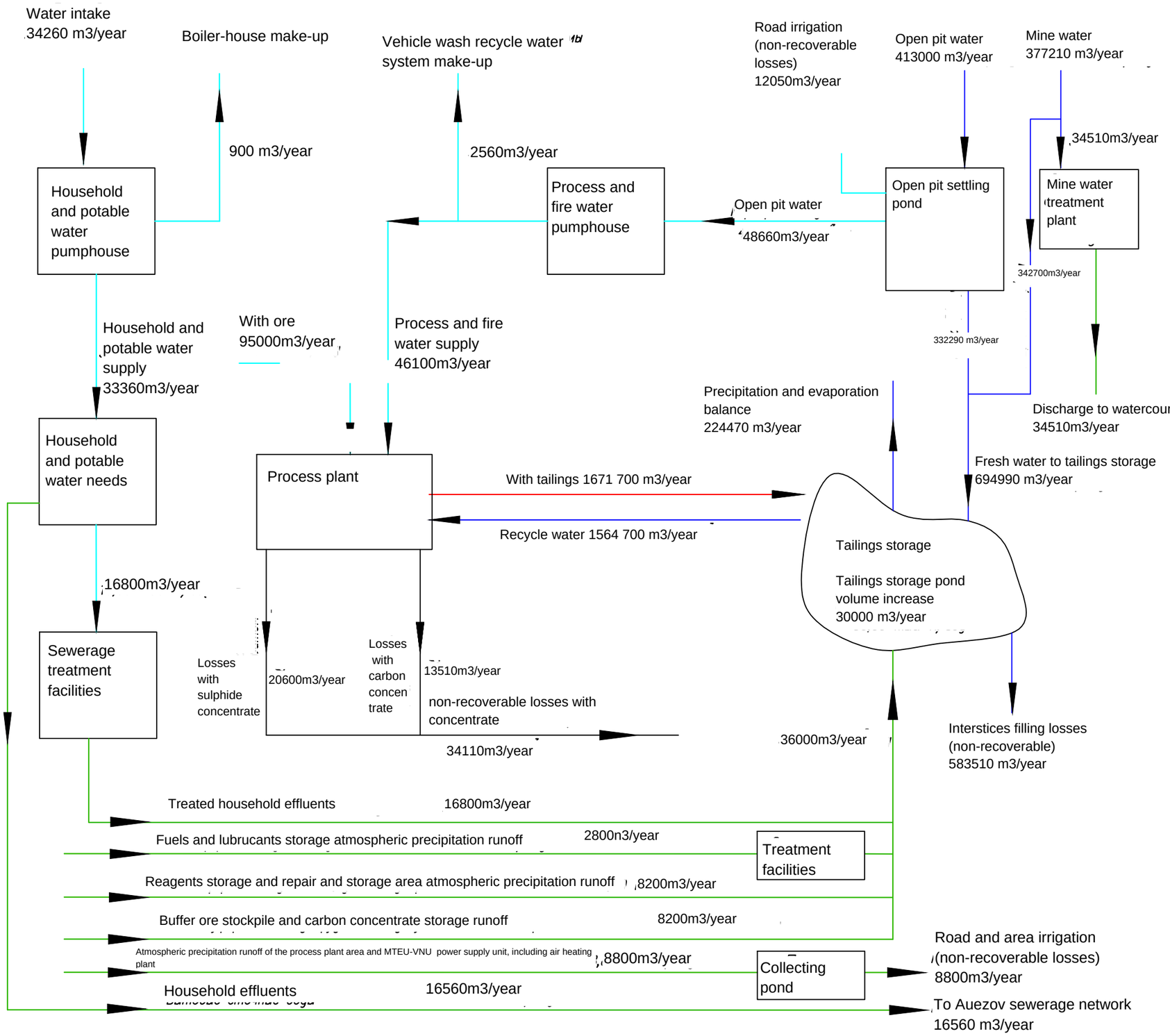
2026 г.





3D view of the open pit (coloured reddish-brown), and the extent of the western, central, and eastern deposits underground (coloured grey). The green lines show the routes (haulage declines) that underground haul vehicles will take to bring ore to the surface, at the bottom of the pit. It also shows the routes the ventilation network will take through the mine. Fresh air will be pumped into the mine via the routes shown in blue, while stale air will be pumped back out to surface along the routes shown in red. Historic underground mining infrastructure is also shown (grey lines).

DRAWING 3.4: Underground Mine Development

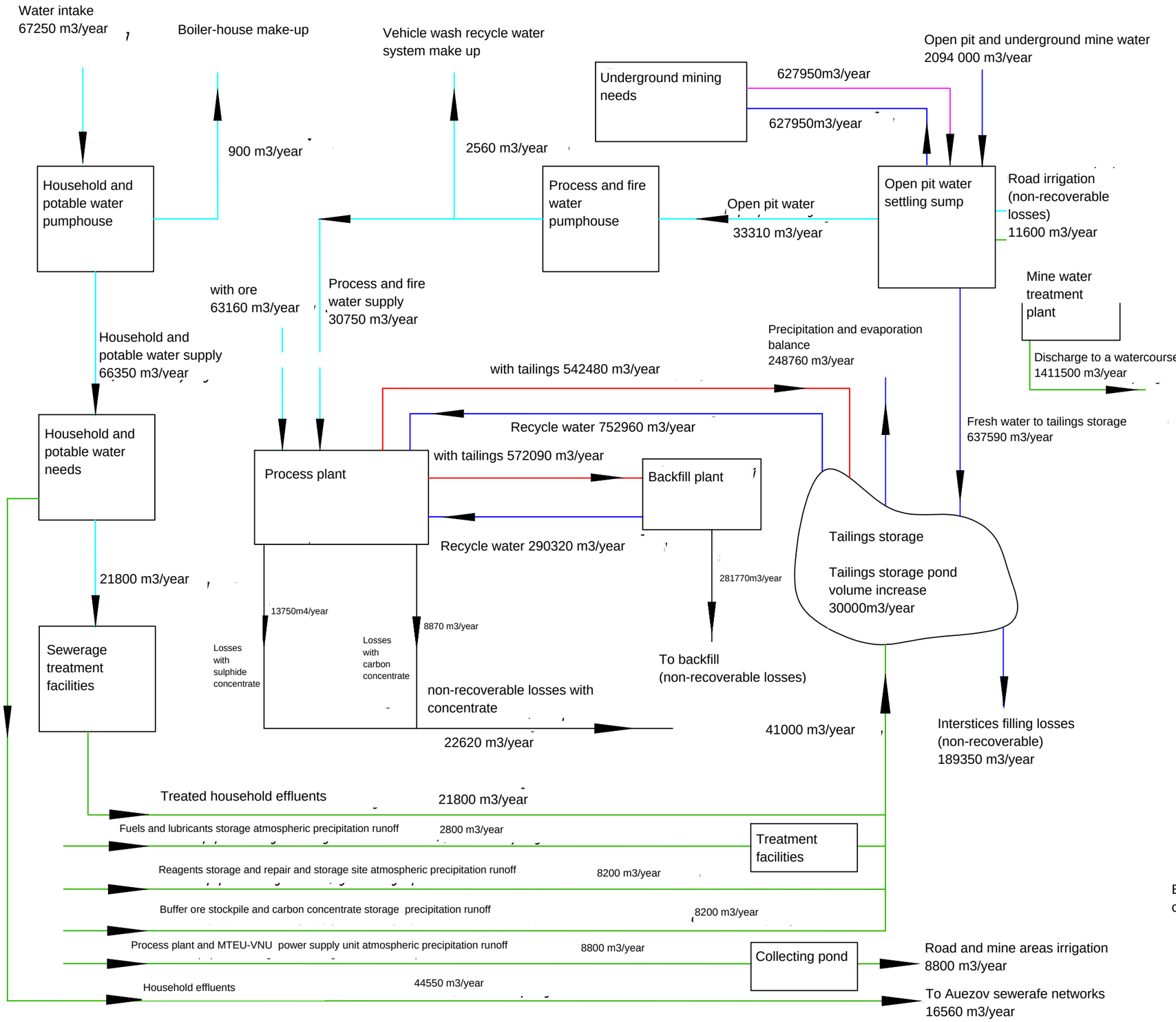


	,000 m3/year
1. Water, supplied to the mine and process plant, including:	947,47
– from Kyzyltu underground water intake	34,26
– with ore	95,00
– open pit water	413,00
– underground mine water	377,21
– Mine sites precipitation runoff	19,80
– buffer ore stockpile and carbon concentrate storage	8,20
runoff	
2. Mine and process plant effluents, including	51,07
– household effluents to the Auezov trearment plant	16,56
– Mine water to a water course	34,51
3. non-recoverable losses, including	866,40
– road and mine area irrigation	20,85
– tailings interstices filling	583,51
– losses with concentrate	34,11
– boiler house and vehicle wash recycle water	3,46
system make up	
– tailings storage evaporation	224,47
(precipitation and evaporation balance	
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
947,47=51,07+866,40+30,00

The balance is provided for 2025 at the process plant operation without concentrate selection

Drawing 3.5: Water consumption and diversion flow chart in the period of the deposit open pit mining



	,,000 m3/year
1. Water, supplied to the mine and process plant, including:	2252,41
– from Kyzyltu underground water intake	67,25
– with ore	63,16
– Open pit and underground mine water	2094,00
– Mine sites atmospheric precipitation runoff	19,80
– Buffer ore stockpile and carbon concentrate storage atmospheric precipitation runoff	8,20
2. Mine and process plant effluents, including:	1456,05
– household effluents to Auezov treatment plant	44,55
– Open pit and mine water to watercourse	1411,50
3. Non-recoverable losses, including:	766,36
– tailings storage evaporation (precipitation and evaporation balance)	248,76
– road and mine areas irrigation	20,40
– tailings interstices filling losses	189,35
– losses with concentrate	22,62
– losses in backfill	281,77
– boiler house and vehicle wash recycle water system make-up	3,46
4. Tailings storage pond volume increase	30,00

n.1=n.2+n.3+n.4
2252,41=1456,05+766,36+30,00

Balance is provided for 2027 at the process plant operation without concentrate selection

Drawing 3.6: Water Consumption and Diversion Balance Flow Chart in the Period of the Deposit Undergro

Akbakstay Bu

Waste Dump

Open pit

Auezov

Solnyechni

Tailings Storage Facility (TSF)

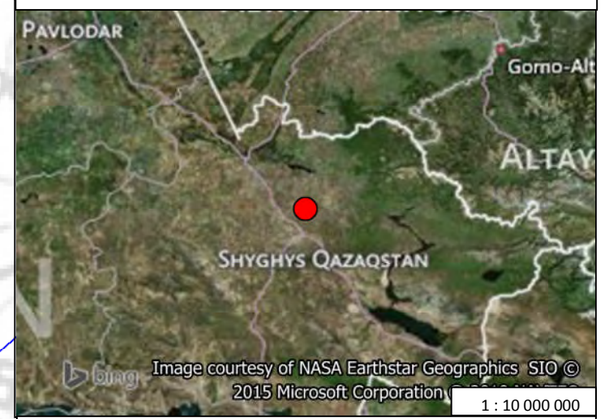
1:25 000 @ A3

Mine site process water supply
Process and fire water supply
Domestic wastewater pipeline
Pit de-watering pipeline
Backfill supply pipeline
Potable water pipeline
Household and potable water intake from Kyzyltu water intake

Process water supply by description

process plant supply from dam	(1)
return water	(2)
tailings	(2)
Plant areas	
Arsenic waste dump	
Carbon storage dump	
Top soil storage	

0 1,000
metres
Scale: 1:20,000



1 : 10 000 000

Grid Ref: 14541819 : 5510091
Long : Lat DD 81.580° : 49.721°

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water reticulation, pipelines, sources, for the project
ESIA Bakyrchik
Kazakhstan

Section_300_water | Drawing 3.7

1:30 000 @ A3

Holodniy Klyuch

Mayranbastau

Akbakstay Bulak

Zhumataybastau

Waste Dump

Open pit

Auezov

Solnyechni

Tailings Storage Facility (TSF)

0 1,000
metres
Scale: 1:30,000

Electrical Transmission

- 110 kV electical power line
- 35 kV electical power line
- 6kV electical power line
- Plant areas
- Arsenic waste dump
- Carbon storage dump
- Top soil storage
- Train line
- Kyzylsu boreholes

1 : 10 000 000

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Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Electrical power lines
ESIA Bakyrchik
Kazakhstan

Section_300_utlities	Drawing 3.8

1: 50 000 @ A3

Waste Dump

Open pit

Auezov

Tailings Storage Facility (TSF)

Solnyechni

0 2

kilometres

Scale: 1:50,000

- Previous land allocation areas
- Additional land allocation
- Geological allotment area
- Kyzyl project mining allotment
- SPZ
- Plant areas
- Topsoil storage
- Carbon storage dump
- Existing pit and waste dump

1 : 10 000 000

Grid Ref:	14541819 : 5510091
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Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Land allotment and authorisation areas
Bakyrchik
Kazakhstan

Section_300_project_description	Drawing 3.9

1:33 000 @ A3

Mausoleum

Original Grave Locations

SPZ

Settlements

Waste Dump

Pit Area

1

Auezov

Shalabay

Solnyechni

Tailings Dam

2

0 2

kilometres

Scale: 1:45,000

1 : 10 000 000

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Grave Relocations Map
Bakyrchik
Kazakhstan

Section_400_Social	Drawing 4.10.1

Auezov

Solnyechni

1:35 000 @ A3

Local Rail Network

Local Main Road Network

Local Road Track

Local Road Track

Settlement Buildings

1 : 18 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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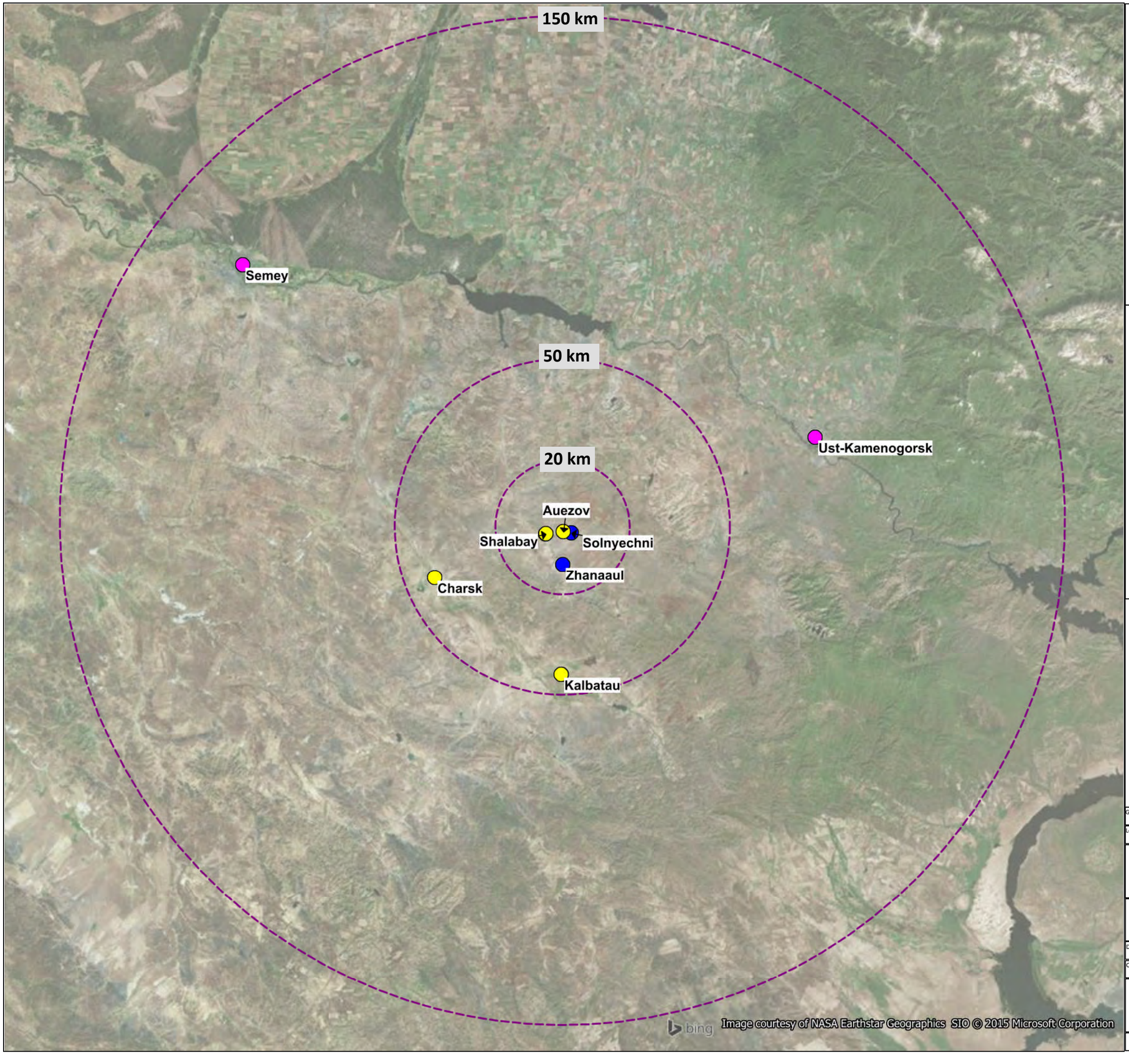
Local Roads and Rail Network
Bakyrchik
Kazakhstan

Section_300_Project_Description_Utilities	Drawing 4.11.1



Republic of Kazakhstan

Scale: 1:37,790,000

East Kazakhstan Oblast

Scale: 1:12,120,000

Legend

- Population > 1000
- Population < 1000
- Population > 100 000

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Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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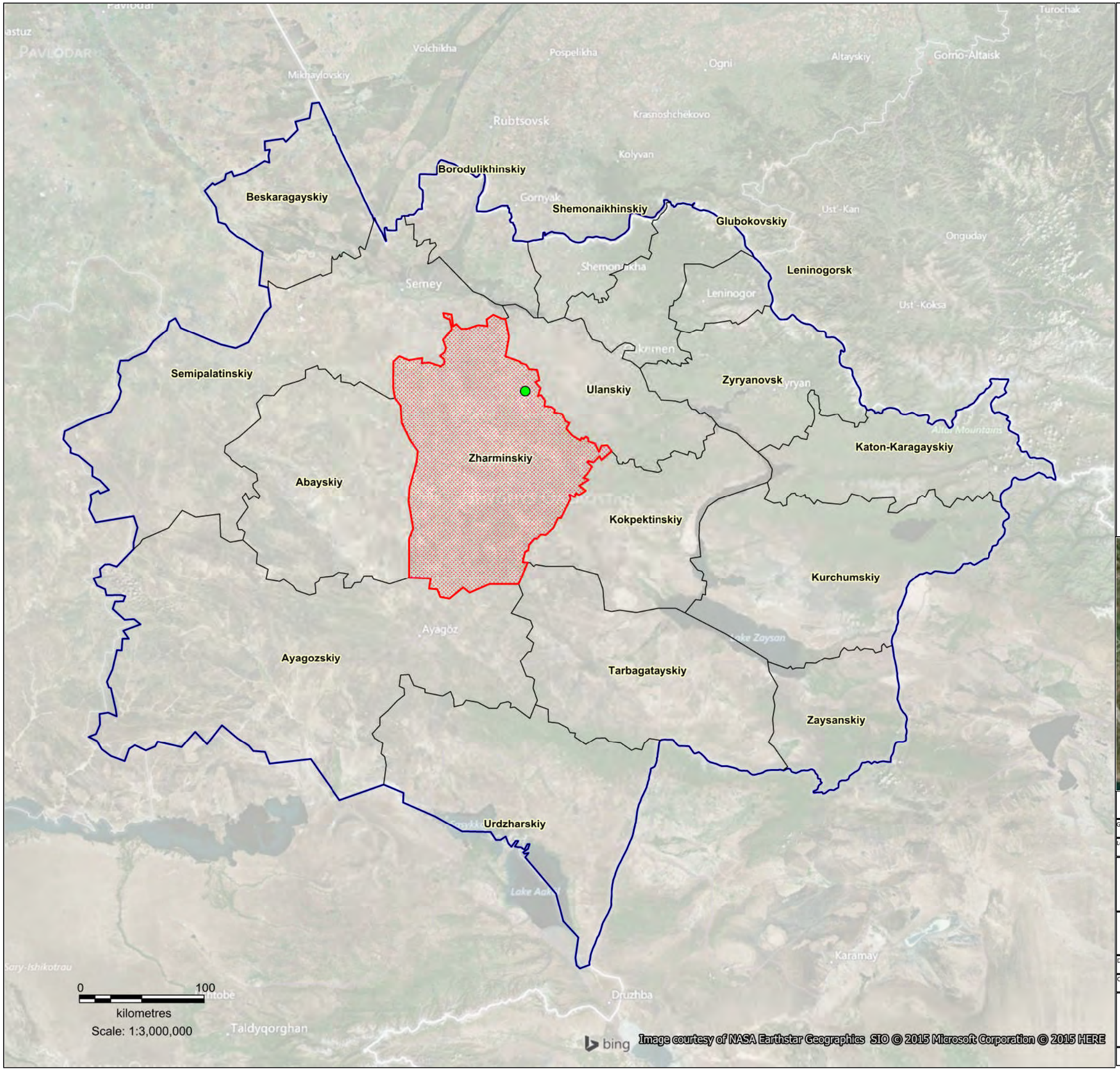
Social project area of influence
Bakyrchik
Kazakhstan

Section_400_Baseline	Drawing 4.12.1



Project Location

Zharminskiy Boundary

East Kazakhstan Boundary

1 : 10 000 000

1 : 3 000 000 @ A3

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East Kazakhstan Adminsitrative areas (Rayon)
ESIA Bakyrchik,
Kazakhstan

EastKazAdmin_V1_520156

Drawing 4.12.2

1: 7,500 @ A3

Auezov

Local restaurant
Toy shop
Supermarket
Bus station
Supermarket
Supermarket
Bakyrchik monument
War memorial
Middle of hockey rink
Clothing 'mall'
Local cafe

0 250
metres
Scale: 1:7,500

bing © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation © AND

Town Boundary
Pit Area
Pit Contours
Main Roads
Building Contours
Location of social interest

1 : 10 000 000

1 : 75 00
@ A3

Grid Ref: 14541819 : 5510091

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Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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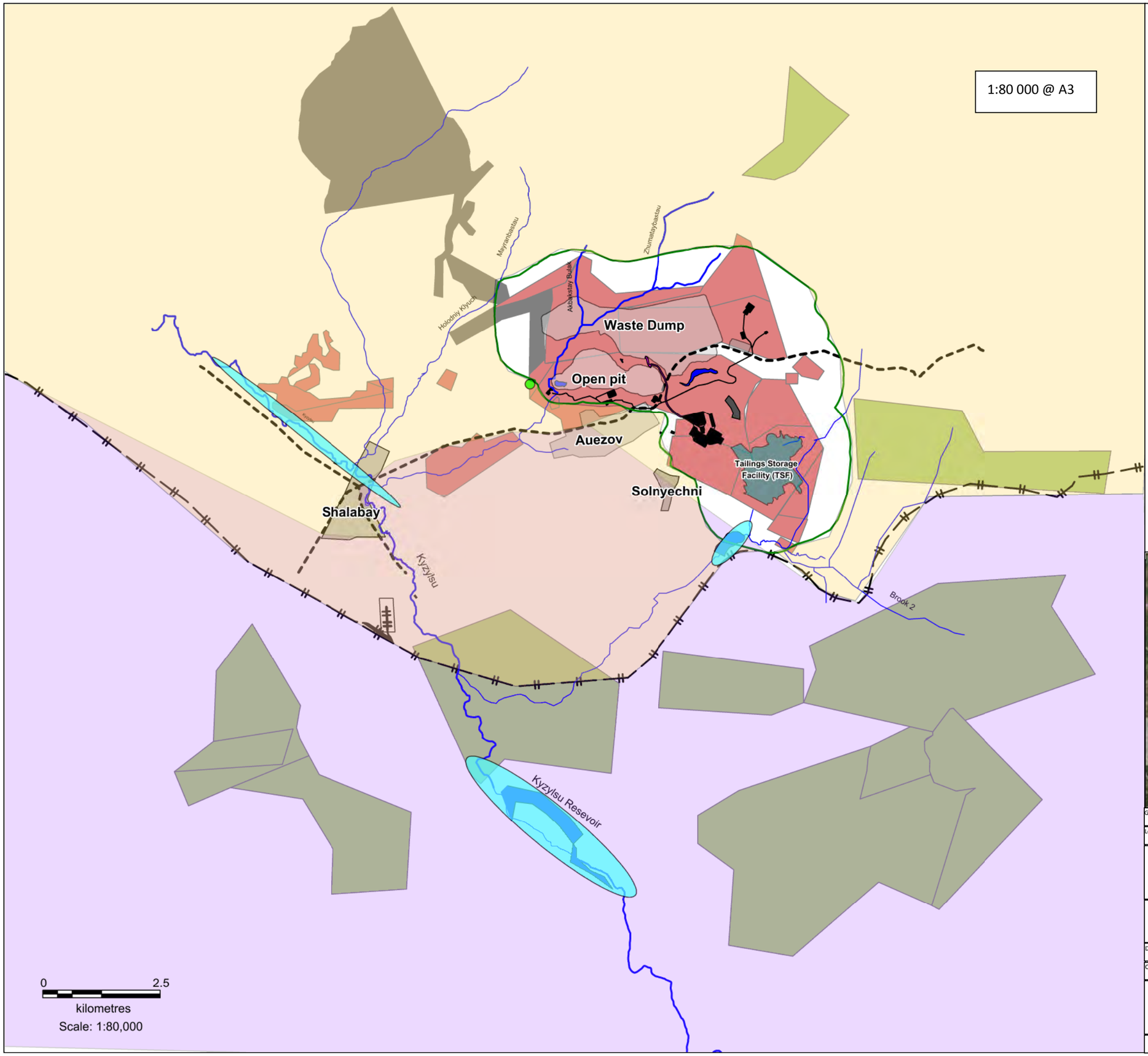
Social Waypoints Auezov
ESIA Bakyrchik
Kazakhstan

Social_Waypoints_V1_520156 | Drawing 4.12.3



Land use and tenure map

Agricultural	(11)
Industrial	(20)
all others	(2)
FIshing territory	
Herder territory	
Foraging territory	
Mixed Herder/Foraging territory	
SPZ	
New mine infrastructure	
Informal landfill	

1 : 10 000 000

Grid Ref:	14541819 : 5510091		
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Land area by useage
ESIA Bakyrchik
Kazakhstan

Section_400_biodiversity_studyareas

Drawing 4.12.4

Waste Dump

Open pit

Auezov

Solnyechni

Existing tailings storage facility

Tailings Storage Facility (TSF)

1 2 3 4 5 6 7 8 9 10 11 12 13

0 1
kilometres
Scale: 1:25,000

Atmosphere Control Points

Continuous Monitoring Location

New mine infrastructure

Top soil storage

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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Air quality monitoring locations
Bakyrchik
Kazakhstan

Section_400_air_quality | Drawing 4.4.1

1: 25 000 @ A3

July 2015 soil sampling points (1-34)

Soil monitoring points (M1-M18)

SPZ

Existing pit and waste dump

Auezov

Solnyechni

0 1

kilometres

Scale: 1:25,000

1 : 10 000 000

Grid Ref:	14541819 : 5510091
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Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Soil Sampling Map, existing infrastructure
Bakyrchik
Kazakhstan

Section_300_soils and land capability	Drawing 4.7.1

1: 25 000 @ A3

Waste Dump

Open pit

Auezov

Solnyechni

Tailings Storage Facility (TSF)

July 2015 soil sampling points (1-34)

Soil monitoring points (M1-M18)

New soil monitoring points (N1-N6)

SPZ

Plant areas

Topsoil storage

Carbon storage dump

Existing pit and waste dump

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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Soil Sampling Map, new infrastructure
Bakyrchik
Kazakhstan

Section_300_soils and land capability | Drawing 4.7.2

0 1
kilometres
Scale: 1:25,000

1:55 000 @ A3

ГП 1
ГП 2
ГП 3
ГП 4
ГП 5
ГП 6
ГП 7
ГП 8
ГП 9
ГП 10
ГП 11
ГП 12
ГП 13
ГП 14
GP18
GP25
ГП 3а
ГП 4а

Mayranbastau
Akbakstaubulak
Holodniy Klyuch
Kyzylsu
Brook 1
Solnyechni
Bezymyannyy (Brook 3)
Alaaigyr
Brook 2
Kyzylsu Resevoir
Existing Arsenic Waste Dump

0 2,000
metres
Scale: 1:55,010

Surface Water Monitoring Points
Existing Water Bodies
Existing Tailings Storage Facility
Main Road
Local River/Stream
Existing Pit and Waste Dump
Train Line

Note: projection system used ;

Gauss-Kruger [Pulkovo 1942]
GK Zone 14 [ESPG : 28414]

1 : 10 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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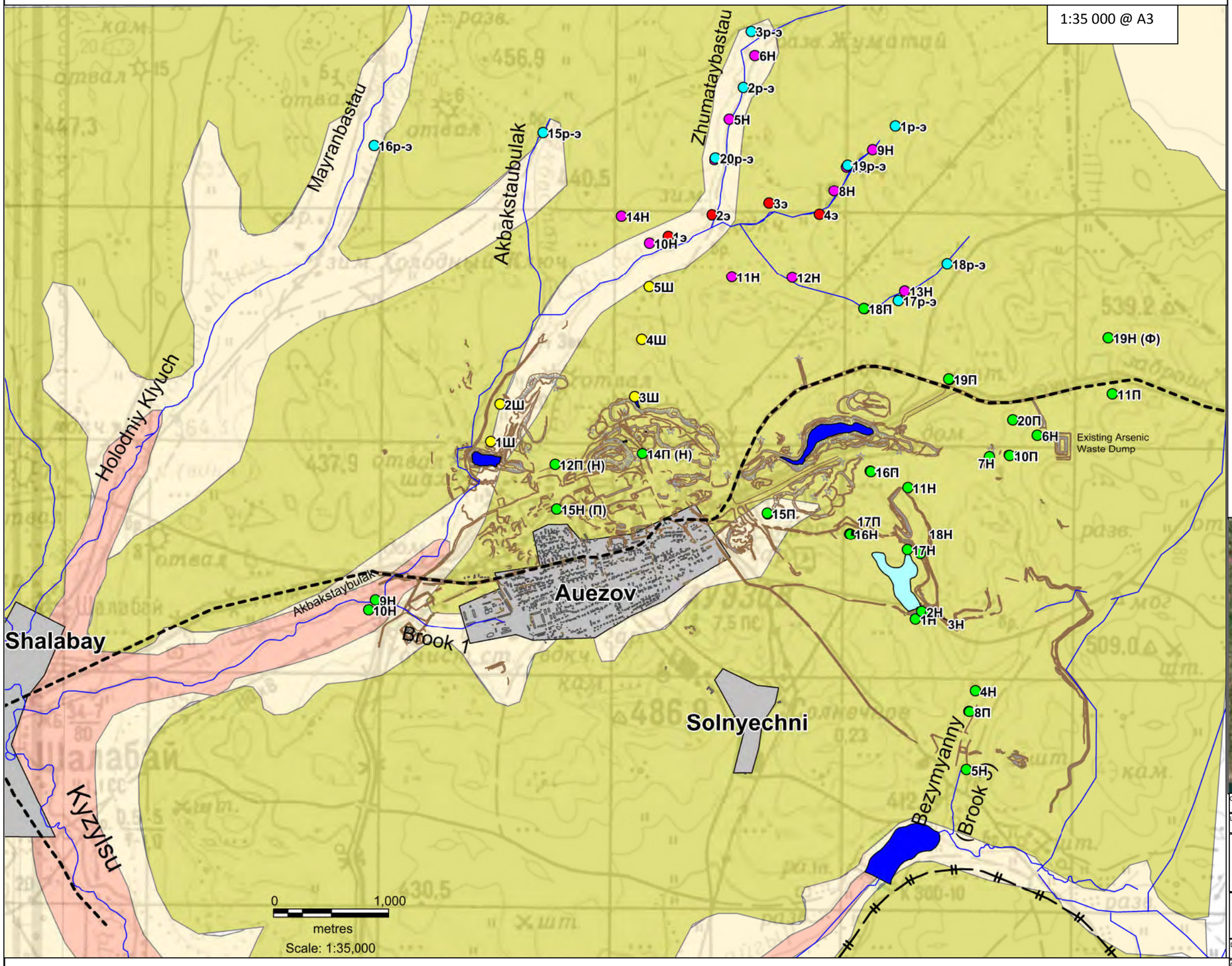
Surface Water Monitoring Points, existing infrastructure
ESIA Bakyrchik
Kazakhstan

Section_400_biodiversity_studyareas	Drawing 4.8.1

Hydro-Geological Map

1:35 000 @ A3



hydro geological map legend

- Superficial alluvial aquifer
- Pavlodar clay aquitard
- Bedrock aquifer
- Existing Tailings Storage Facility
- Existing water bodies
- Train Line
- Existing pit and waste dump
- Streams
- Main road

Groundwater monitoring points categories

EMP	(32)
Mine Water	(5)
Water - Monitoring	(11)
Water - Production in use	(4)
Water - Production not in use	(9)

Note: projection system used ;

Gauss-Kruger [Pulkovo 1942]
GK Zone 14 [ESPG : 28414]

1 : 10 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Hydro-geological map, existing infrastructure
ESIA Bakyrchik
Kazakhstan

Section_400_biodiversity_studyareas	Drawing 4.8.2

1:25 000 @ A3

Mayranbastau
Akbakstaubulak
Zhumatabastau
Akbakstaubulak
Brook 1
Auezov
Solnyechni
Existing Arsenic Waste Dump
Bezymyannyy (Brook 3)

16р-э
15р-э
3р-э
6Н
2р-э
5Н
1р-э
9Н
4Н
20р-э
7Н
19р-э
8Н
3э
4э
2э
14Н
1э
10Н
5Ш
11Н
12Н
18р-э
17р-э
13Н
18П
12Н
4Ш
19Н (Ф)
19П
13Н
11П
20П
6Н
7Н
9П
10П
15Н
16П
11Н
15П
16Н
17П
17Н
18Н
3Н
2Н
1Н
4Н
8П
5Ш
2Ш
3Ш
1Ш
12П (Н)
14П (Н)
15Н (П)
9Н
10Н

0 1,000
metres
Scale: 1:25,000

Groundwater monitoring points categories

EMP	(32)
Mine Water	(5)
Water - Monitoring	(11)
Water - Production in use	(4)
Water - Production not in use	(9)

Existing Water Bodies
Existing Tailings Storage Facility
Train Line
Existing Pit and Waste Dump
Main Road
Streams

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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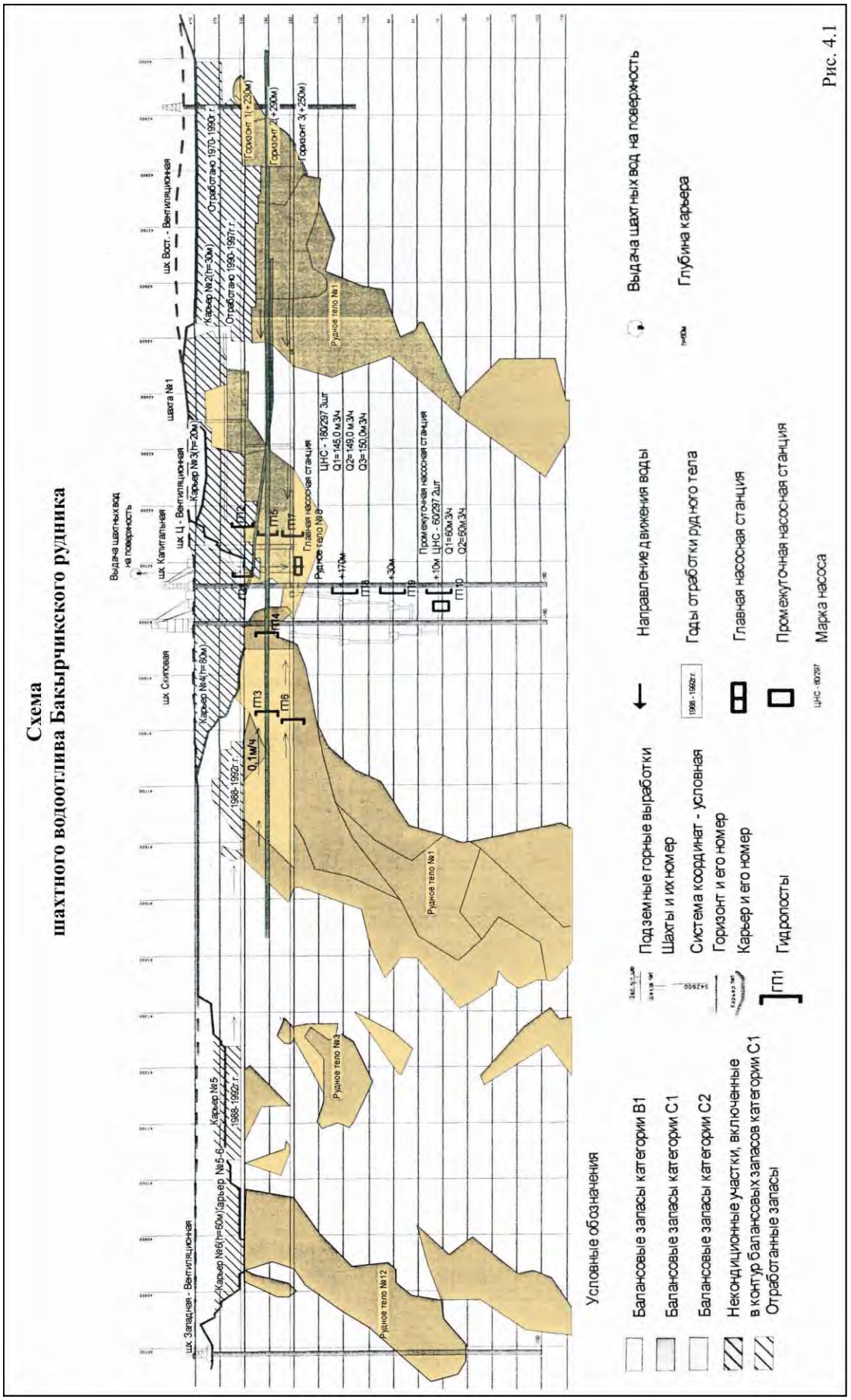
Groundwater Monitoring Points, Existing infrastructure
ESIA Bakyrchik
Kazakhstan

Section_400_biodiversity_studyareas | Drawing 4.8.4

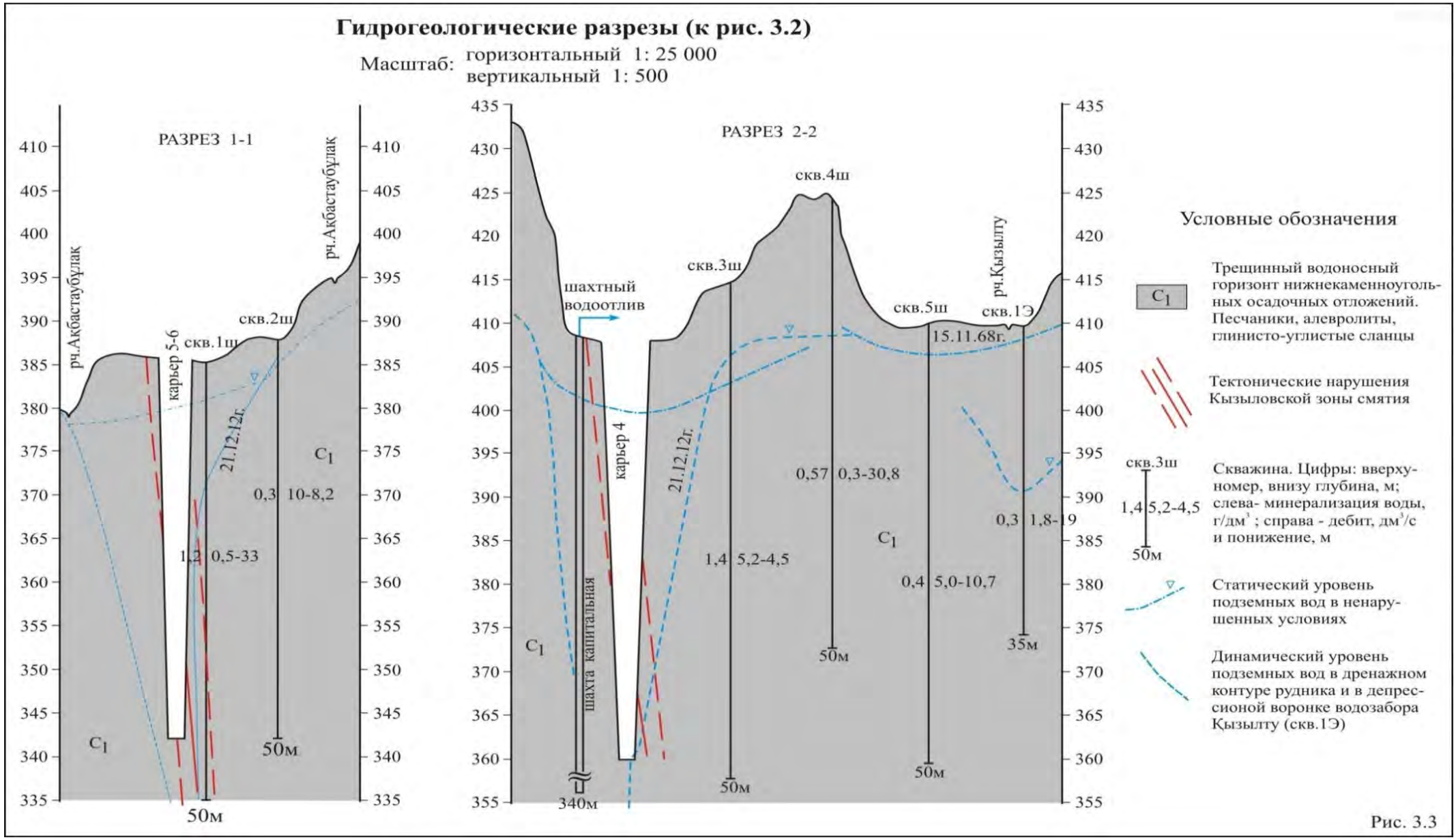
Drawing 4.8.5: Mine Drainage Layout Map



Drawing 4.8.6: Mine Drainage Hydrogeological Map

Рис. 3.2

Drawing 4.8.7: Mine Drainage Hydrogeological Section



Drawing 4.8.8: Mine Drainage Borehole Water Level Fluctuations

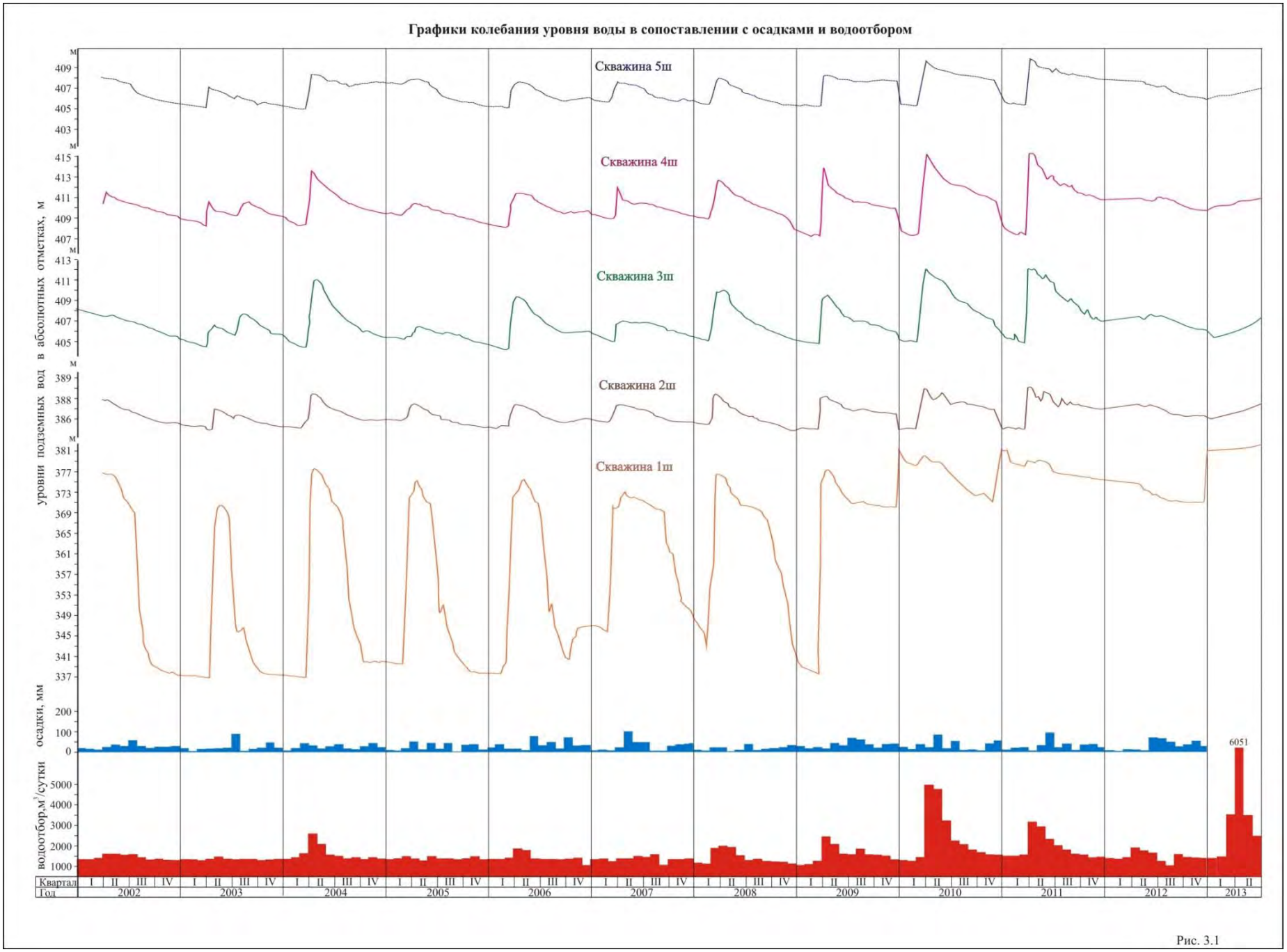
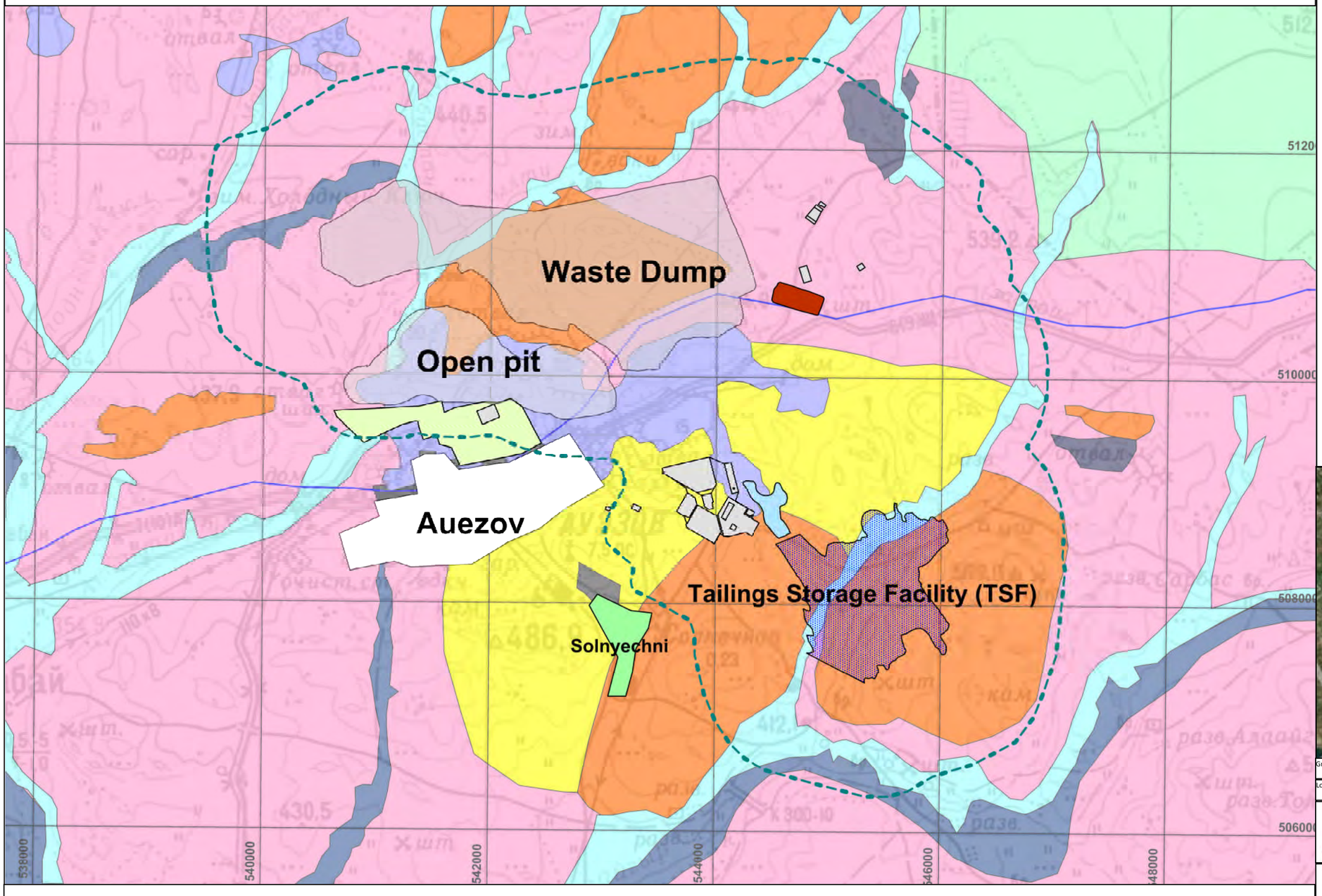


Рис. 3.1

Habitat Map

1:38 000 @ A3



Legend

- Residential area
- Industrial territory - waste dumps, open pits, industrial sites
- The valley of streams, kettles
- Roads
- Hummocks
- Grazing lands
- Disturbed grazing lands
- Agricultural land
- Declines and depressions in ground
- Solonetzic soils

1 : 10 000 000

Grid Ref:	14541819 : 5510091
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Habitat Map
Bakyrchik
Kazakhstan

Section_400_baseline	Drawing 4.9.1

1:60 000 @ A3

Aquatic fauna survey areas 2013

Breeding and migratory bird survey areas 2011

Flora and Fauna Survey Areas 2010

Faunal Transects 2011

Plant Areas

Tailings Dam

Waste Dump

Carbon Storage Dump Facility

Top Soil Storage

Existing Tailings Dam

Auezov

SPZ

Rivers/Streams

1 : 10 000 000

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Biodiversity Transects Map
Bakyrchik
Kazakhstan

Section_400_air_quality	Drawing 4.9.2

1:30 000 @ A3

Environmental study area
Plant areas
Arsenic waste dump
Carbon storage dump
Top soil storage

Waste Dump
Open pit
Auezov
Tailings Storage Facility (TSF)
Solnyechni
Shalabay
Kyzylsu
Kyzylsu Resevoir
Brook 2
Holodnyy Klyuch
Maymanbastau
Akbakstau Bulak
Zhumalaybastau

0 2,500
metres
Scale: 1:77,430

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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Environmental project area of influence
ESIA Bakyrchik
Kazakhstan

Drawing 5.1.1

1: 25 000 @ A3

Waste Dump

Open pit

Auezov

Solnyechni

Tailings Storage Facility (TSF)

Existing tailings storage facility

EM1
EM2
EM3
EM4
EM5

DSR 1
DSR 2
DSR 3
DSR 4
DSR 5
DSR 6

0 1
kilometres
Scale: 1:25,000

Emissions sources
Sensitive receptors
Continuous monitoring point location
New mine infrastructure
Top soil storage

1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

POLYMETAL

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Drawn By:	CD	Date:	28/09/2015
Checked By:	NR	Date:	28/09/2015

dust deposition areas; gaseous emission points
Bakyrchik
Kazakhstan

Section_400_air_quality | Drawing 5.6.1

1: 14 000 @ A3

Waste Dump

Open pit

Auezov

Existing tailings storage facility

0 500
metres
Scale: 1:14,000

Noise levels
in $L_{Aeq\ dB(A)}$

<	45
45 -	50
50 -	55
55 -	60
60 -	65
65 -	70
70 -	75
75 -	80
>=	80

Sensitive Receptors

Noise Source

Plant Areas

1 : 10 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Drawn By:	CD	Date:	16/12/2015
Checked By:	NR	Date:	16/12/2015

2016 Day and Night-time Noise Contour Plot
Bakyrchik
Kazakhstan

Section_300_soils and land capability	Drawing 5.7.1

1: 14 000 @ A3

Waste Dump

Open pit

Auezov

Existing tailings storage facility

0 500

metres

Scale: 1:14,000

Noise levels

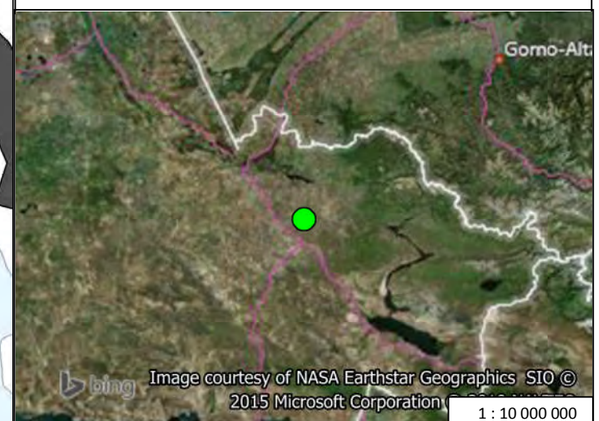
in $L_{Aeq\ dB(A)}$

	< 45
	45 - 50
	50 - 55
	55 - 60
	60 - 65
	65 - 70
	70 - 75
	75 - 80
	>= 80

Sensitive Receptors

Noise Source

Plant Areas



1 : 10 000 000

Grid Ref: 14541819 : 5510091

Long : Lat DD 81.580° : 49.721°

Long : Lat DMS 81° 34' 48" : 49° 43' 16"

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Drawn By: CD	Date: 16/12/2015
Checked By: NR	Date: 16/12/2015

2019 Day and Night-time Noise Contour Plot
Bakyrchik
Kazakhstan

Section_300_soils and land capability

Drawing 5.7.2

1: 14 000 @ A3

Waste Dump

Open pit

Auezov

Existing tailings storage facility

0 500
metres
Scale: 1:14,000

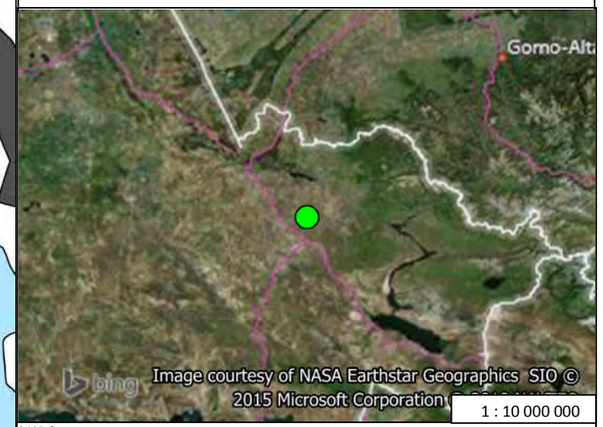
Noise levels
in $L_{Aeq\ dB(A)}$

	< 45
	45 - 50
	50 - 55
	55 - 60
	60 - 65
	65 - 70
	70 - 75
	75 - 80
	>= 80

Sensitive Receptors

Noise Source

Plant Areas



1 : 10 000 000

Grid Ref:	14541819 : 5510091
Long : Lat DD	81.580° : 49.721°
Long : Lat DMS	81° 34' 48" : 49° 43' 16"

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Drawn By:	CD	Date:	16/12/2015
Checked By:	NR	Date:	16/12/2015

2027 Day and Night-time Noise Contour Plot
Bakyrchik
Kazakhstan

Section_300_soils and land capability	Drawing 5.7.3