

Komi Aluminium
Komi Aluminium Programme

**Environmental and Social Impact
Assessment (ESIA)**

**PROPOSED EXPANSION OF THE MIDDLE TIMAN BAUXITE
MINE FROM 2.5 MTPA TO 6 MTPA**

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1. INTRODUCTION AND OVERVIEW

SUAL Group, the Russian-based integrated aluminium producer is currently contemplating a large-scale aluminium development in Komi Republic, Russian Federation (Figure 1). The development, which is known as the 'Komi Aluminium Programme', is made up of three separate projects namely:

- **Phase 1** –Expansion of the Middle Timan Bauxite Mine (MTBM)
 - 1a – continued expansion to 2.5 million tons per annum. The appropriate project documentation (including an OVOS) has been developed and a positive conclusion issued by the State Environmental Review (SER). All other necessary approvals have been obtained and the expansion started in 2003.
 - 1b – further expansion to 6,0 million tons per annum. The project documentation is currently being developed and will include an OVOS and ESIA. It is anticipated that the expanded capacity will be achieved in 2007.
- **Phase 2** – Potential establishment of an Alumina Refinery in the Sosnogorsk area with a capacity of 1,400,000 tonnes per year.
- **Phase 3** – Potential establishment of an Aluminium Smelter with a capacity of 300,000-500,000 tonnes per year. The final site selection has not been decided yet.

SUAL is currently assessing the technical, economic, environmental and social feasibility of the three projects and preparing a Bankable Feasibility Study for each. This will culminate in a Russian State Environmental Review (SER) for each of the three projects including Environmental Impact Assessment (or OVOS) documents. At the same time the International Finance Corporation (IFC) and the European Bank for Reconstruction and Development (EBRD) have been approached for loan financing for the programme. IFC's policy on environmental assessment (OP 4.01 – Environmental Assessment), and similar EBRD policy, states that all projects proposed for IFC/EBRD financing require environmental due diligence as part to ensure that they are environmentally and socially acceptable.

A feasibility study is currently underway to determine the viability of the integrated aluminium complex. The integrated aluminium programme includes the potential expansion of the Middle Timan Bauxite Mine (MTBM), the development of a greenfields alumina refinery and the development of a greenfields aluminium smelter. The integrated programme is one of the few underway in Russia at present and is certainly the largest being considered in Russia since Soviet times. If implemented, it will represent the most significant investment project ever undertaken in the Komi Republic.

The EA presented here is the first in a series required for the proposed Komi Aluminium Programme. This is an Environmental and Social Impact Assessment (ESIA) for the proposed MTBM expansion to 6.0 mtpa. It will be followed by the completion of full OVOS project documentation as required under Russian law, which will be submitted for SER. The document has been structured to present the operational context of the proposed project, the project itself, project alternatives, and environmental and social baseline description in the area in which the mine is situated. This information has then been used to determine potential impacts on the environment and their significance. These impacts have then been used in turn to define an Environmental and Social Action Plan (ESAP), which is presented as the final chapter of the document.

2. OPERATIONAL CONTEXT

The Middle Timan Bauxite Mine (MTBM) was established in 1996 in the northern part of the Knyazhpogost District, near the boundaries of the Ust-Tsilemski and Udorski Regions in the Republic of Komi (Fig. 1). MTBM is owned and operated by OAO Bauxite Timana (BT), which was registered on December 29, 1992 (Resolution No. 435, Knyazhpogostsky District). This registry was later updated to include the Komi Republic Government and SUAL. BT is now a subsidiary of the SUAL Group, a major Russian integrated aluminium producer currently controlled by SUAL International Ltd.

The mine has been operating since 1998 at a rate of up to 1.0 million tonnes per year. In November 2001, the mine submitted a full Environmental Impact Assessment (known as an OVOS in Russian) to regulatory authorities in order to expand operations. This OVOS was subjected to environmental review (known as an Expertiza in Russia) during 2002. A positive conclusion was provided by all reviewing regulatory agencies and the mine is currently permitted to mine up to 2.5 million tonnes per year. By the end of 2002 BT had mined almost 3 million tonnes (total from 1996) and mined approximately 1,000,000 tonnes in 2003.

As part of a larger, integrated approach to aluminum production, the feasibility of expanding the mine's capacity to 6 million tonnes per year is currently being investigated. The anticipated increase in production will take place in two phases. The first step (known as Phase 1a) is dedicated to ensuring that the mine can maintain a production of 2.5 million tonnes per year (what is currently permitted). It is anticipated that all the necessary measures will be completed by 2005 for this to occur. The second step of the expansion (known as Phase 1b) is looking to achieve the goal of mining up to 6.0 million tonnes per year. At this stage, it requires additional measures to be implemented prior to 2007 to ensure that the mine can sustain this high level of production and satisfy SER (*Expertiza*) requirements. The overall expansion will continue, if the economics support the project by constructing an Alumina Refinery at Sosnogorsk (Komi Republic) with proposed capacity of 1.4 mtpa. Additionally, an Aluminium Smelter with proposed capacity of 300-500 ktpa is under consideration for construction within the Komi Republic.

In conjunction with the proposed expansion, the European Bank for Reconstruction and Development (EBRD) and the International Finance Corporation (IFC) have been requested by SUAL Komi to extend a loan for the phased project. Based on IFC's safeguard policy and similar EBRD policies this Phase 1b projects proposed for IFC/EBRD financing requires an Environmental Assessment (EA) to ensure that they are environmentally and socially sound and sustainable. The breadth, depth and type of environmental assessment vary according to the type of the project. Each of the individual projects within the Komi Aluminium Programme are considered Category "A" Projects and each will require a full Environmental and Social Impact Assessment (ESIA).

It is important at this early stage to emphasise that the decision to expand the mine is contingent upon a number of factors including, adequate resolution of the groundwater and surface water items discussed in the impacts section of the report, a positive SER conclusion, a positive technical feasibility study for the refinery and EBRD/IFC approval of the ESIA for the refinery. If any of these requirements are not satisfied, then the refinery will not be built, and the mine will not expand production beyond the currently permitted 2.5 mtpa.

Komi Aluminium, IFC and EBRD have appointed the CSIR, a South African based research and development company with extensive experience in the aluminium industry, to conduct comprehensive Environmental Assessments for each of the three different phases of the Komi Aluminium Programme.

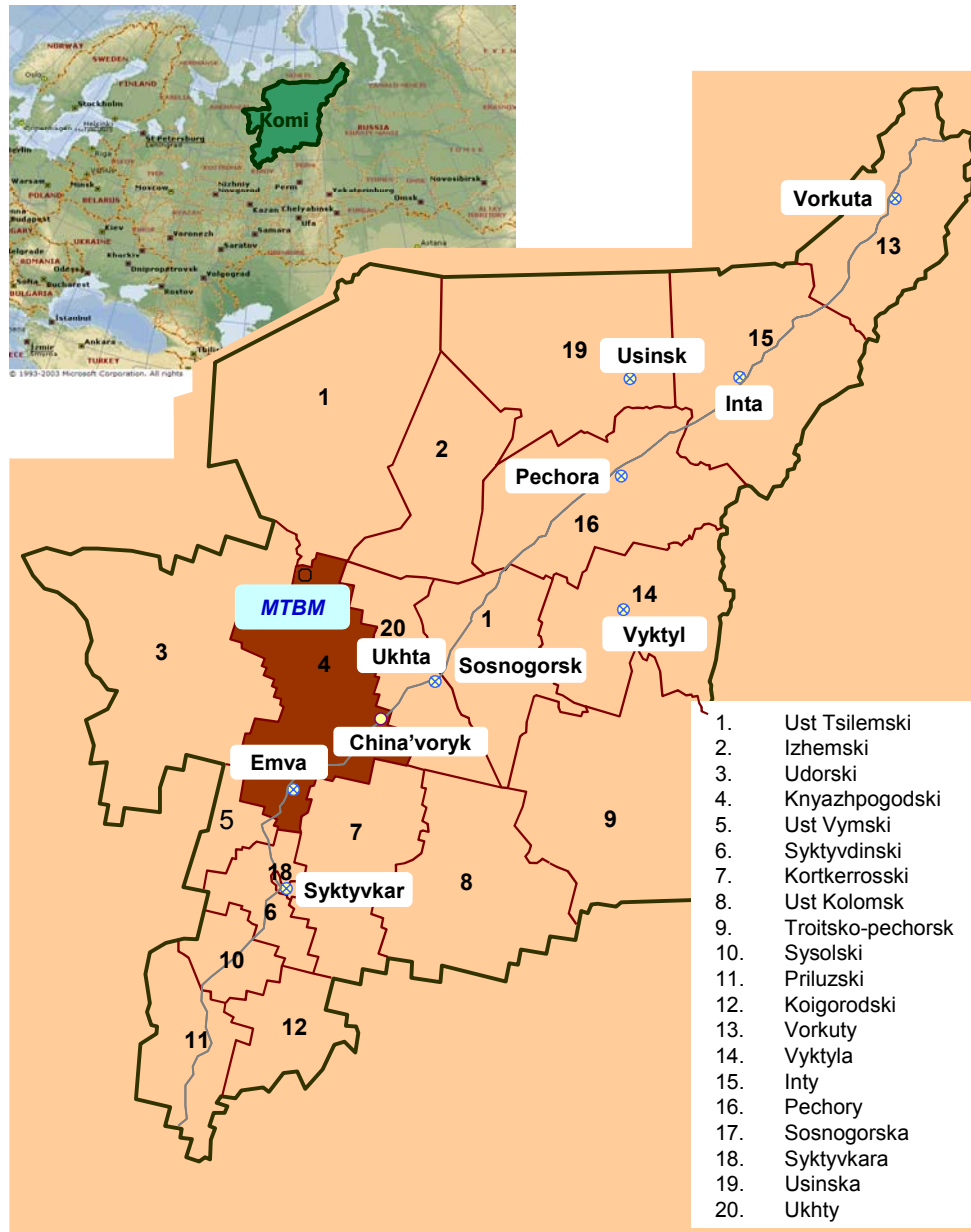


Figure 1: Map of the Komi Republic showing the position of the mine, the various districts in the republic (Knyazhpogost is highlighted) and major cities and towns.

In order to properly assess and predict environmental and social impacts associated with the project, several steps were completed before the development of the draft ESIA. These included:

- An environmental and social due diligence audit to evaluate the environmental and social consequences of the mine expansion project to 2.5 million tonnes per year. The environmental and social due diligence audit of the Middle Timan Bauxite Mine (MTBM) was completed and submitted for public disclosure in December 2003. The goal of the audit was to establish the current level of environmental and social performance of the mine, in advance of, and in preparation for, a proposed expansion of bauxite production up to 6.0 million tonnes per annum. The audit has been concluded with an environmental and social action plan (ESAP), developed to mitigate negative impacts and enhance positive impacts of the operations.

- Public Consultation and Disclosure Plan (PCDP): The PCDP is integral to the EIA process and provides an opportunity for all people to identify opportunities and concerns associated with development projects. The primary objective of public consultation is to provide a process to improve the decision making process whereby the public, technical specialists, the authorities and the developer work together to produce a better project through informed decisions than if they had worked independently. In addition, public consultation recognises that all people have environmental and societal rights and responsibilities. The initial PCDP has been updated for this phase of mine expansion from the current level of 1.0 mtpa up to 6.0 mtpa.

2.1 Purpose and need

The viability of the project is contingent on the refinery receiving bauxite of sufficient quality at a reasonable price. The current operations at MTBM are insufficient (at 1.0 mtpa) to provide raw materials to their current customers (other SUAL operations based in other areas in the Russian Federation) as well as to provide sufficient material to the proposed refinery at Sosnogorsk. The expansion is, therefore, on the critical path to ensure the long term success and viability of the overall Komi Aluminium programme. The expansion project will result in an overall production increase up to 6.0 mtpa and will be aimed at providing the existing customers of MTBM as well as providing for the proposed new smelter. The final decision on the level of production for the MTBM operations to supply bauxite to the refinery will be decided by the end of 2004, and may end up with a lower production than 6.0 mtpa.

2.2 Project investment

The project companies are OAO Bauxite Timana (an existing company) and ZAO Komi Aluminium (a new company) established to operate the planned integrated bauxite/alumina/aluminium project. OAO Bauxite Timana was established to run the Middle Timan Bauxite Mine in the Komi Republic of Russia, to which it holds the license. The project entails the expansion of the mine from the existing 1million tonnes of bauxite per annum to 6 million tones per annum and to start early works on the construction of the associated alumina refinery. This is the initial phase of the larger integrated project that includes the bauxite mine, an alumina refinery and an aluminium smelter and that will be one of the largest new investment projects in Russia, should it proceed.

The project sponsor is the SUAL Group, Russia's second largest aluminium producer and a major exporter. The Group's parent company is SUAL International Ltd (Bahamas) and its management company is OAO SUAL-Holding (Russia). The SUAL Group has an integrated aluminium operation, mining bauxite, refining alumina, smelting aluminium and produces semi-finished and some finished aluminium products. SUAL Group owns approximately 80% of OAO Bauxite Timana, with the remainder held by the Government of the Republic of Komi. ZAO Komi Aluminium is owned 100% by the SUAL Group. The total project cost is approximately US\$ 300 million. SUAL is seeking IFC and EBRD financing of US\$ 150 million of which US\$ 100 million will be disbursed for the mine expansion, and US\$ 50 million on the feasibility study and refinery earthworks.

2.3 Russian legal and institutional framework

The current mine (as well as any expansion projects) operate under Russian Federation and Republic of Komi environmental, social, health, and safety requirements. The following sections identify the major permitting requirements that the project must follow. The Russian and legal and institutional frameworks are based on a system that requires the proposed project to be presented to the Federal¹ level (Moscow) regulators. These regulators review the environmental impact assessment, along with the submitted opinions, and provide a conclusion on whether the project has been adequately assessed and can be

¹ Because the project involves foreign investment above \$ 500,000 and that it involves development of natural resources, environmental *expertiza* must happen at the federal level.

constructed. After the project has received approvals from Moscow, the local branch (municipal) of environmental protection provides all regulatory decisions, unless the local regulators request the assistance of Moscow regulators. Prior to operations, all projects are required to submit permit applications, and receive discharge limits. In accordance with Russian guidelines, all projects must report emissions, discharges and all waste disposal on a regular basis.

Regulatory agencies within the Russian Federation and Komi Republic include environmental, labour, mining, and other agencies that are responsible for compliance issues at the mine. The major mining, environmental, health, and safety offices that oversee the mine and the local, Komi, and Federal level are described in the following sections.

2.3.1 District of Knyazhpogost

The project is located in Knyazhpogost District, therefore, the following agencies have direct regulatory control of the project:

- Knyazhpogost Sanitary and Epidemiological Committee (Emva);
- Vymsk Fisheries Inspectors (Emva);
- Department of Hunting (Emva);
- Government Mining Technology Supervision (Vorkyta); and
- Knyazhpogost Environmental Protection Committee (Emva).

2.3.2 Republic of Komi

The primary environmental regulatory agencies located in Syktyvkar within the Komi Republic include:

- Federal Natural Resource Committee;
- Komi Department of Water Resources;
- Komi Fisheries Inspectors;
- Komi Department of Hunting;
- Government Mining Technology Inspectors; and
- Federal Emergency Management Agency.

2.3.3 Russian Federation

Federal level agencies located in Moscow include:

- Russian Federation Ministry of Natural Resources;
- Russian Federal Sanitary and Epidemiological Committee; and
- Government Mine Technology Inspectors.

2.4 Russian Environmental Permitting

The permitting process in Russia goes through steps that are similar to those in the West (except more detailed) that include preliminary assessment, environmental assessment, detailed engineering, and operational permitting. Each of those steps is further detailed in the following sections.

2.4.1 Preliminary Assessment

During development of a project, the preliminary assessment must include an Act of Site Selection (AoSS) and a Declaration of Intent (DoI). These documents are provided to the local regulatory agency to provide

the regulators with an idea on the direction that the project is going and helps avoid costly delays in project design. The information should include enough detail to allow a reviewer to determine the environmental risks associated with the proposed design and should evaluate the various alternatives associated with the design. The DoI is used for the local and/or federal regulators to give preliminary approval for the project design based on analogous sites and literature. The AoSS is provided to the local and/or federal regulatory authorities. This is a drawing with all of the facilities sited at proposed locations and should include potential alternatives for siting.

Based on these documents, the company will prepare a Scope of Work (*Technicheskaya Zadaniya* - TZ) for an Environmental Assessment. The TZ should incorporate all the requirements of development of an EA and include instructions to address any potential issues identified in the AoSS and DoI. The most recent EA guidelines (Order #372, Section 4) require that the approved DoI and AoSS be disclosed, along with the TZ, during public consultation to local interested and affected parties. A protocol should be incorporated into the TZ listing concerns or requests that arose during the public consultation.

2.4.2 Environmental Impact Assessment

In Russia, the Feasibility Study process is divided into two separate categories namely Investment and Construction. In the event of a foreign investor or joint-venture project, both documents are required and must be submitted to the federal government for review and differ only in their level of detail. The following sections outline the environmental requirements for each level.

2.4.2.1 Investment-level Feasibility (TEO-I)

An Investment-level Feasibility (TEO-I) is required to be completed in accordance with СП 11-101-95, "Order of Development, Approval, Confirmation, and Composition for the Basis of Investment in Construction of a Facility, Building, or Equipment" (1995). This feasibility study requires a preliminary design highlighting the basic engineering and safety designs that are proposed for construction and operation of the project. A separate volume is required for the TEO-I called an OVOS. The OVOS is a preliminary environmental impact assessment that is more detailed than the initial DoI and AoSS. It can be based on government background material, analogous site, and field studies.

The document must undergo review at the federal level (Moscow). Local regulatory agencies that review the OVOS are the same groups that approved the AoSS and DoI. Additionally, public consultation must be completed at the local level and a meeting protocol attached to the document prior to submittal at the federal level. The conclusions from the local review are provided with the OVOS to the Federal Ministry of the Environment and the Federal Mine Supervision Department. Positive Conclusions from the Federal-level Expertiza indicate that the basic design is acceptable and the project can continue to develop.

2.4.2.2 Construction-level Feasibility (TEO-C)

A Construction-level Feasibility (TEO-C) must be completed in accordance with СНиП 11-01-95, "Instructions on Development, Approval, Confirmation, and Composition of Project Documentation for Construction of a Facility, Building, or Equipment" (Moscow, 1995). This document is much more detailed than a TEO-I. The information is based on equipment and design parameters that will be installed during construction. The TEO-C requires a section (volume) on Environmental Protection. The Environmental Protection Section will be very detailed and contain information regarding the effective use of resources and reclamation/closure. The document is reviewed at the local (including public consultation) and federal level. A positive conclusion allows the company to begin construction. The mine is currently operating under the Phase 1a approvals that were received in 2003 (Approval No. 30, 1/30/03). This approval was given for a feasibility study that was prepared to expand the mine to 2.5 million tonnes per year. Given that the mine is an existing facility, where an extensive environmental assessment has recently been completed, it is only envisaged that an OVOS will be completed for the construction TEO only, and this should be done by September 2004.

2.4.3 Detailed engineering/operational permitting

During detailed engineering, all drawings are finalized and equipment parameters are provided to the regulatory agencies. As part of detailed engineering, the company is required to develop the following documents:

- Maximum Allowable Emission Limits;
- Water Use and Discharge Limits;
- Solid Waste Disposal Limits; and
- Reclamation and Closure Feasibility.

2.4.3.1 Maximum allowable emissions limits

The air pollution discharge permit limit is developed in accordance with the Federal legislation “Ambient Air Protection” (N96-F3, 5/4/99). It requires limits on a tonnes per year basis and grams per second. Air pollution discharges are reported on an annual basis (Form 2-TP, Air). The reported amounts are based on parametric monitoring and stack sampling. Pollution payments are paid on a quarterly basis based on discharge amounts calculated in the permit application. As discussed earlier, the mine already has approvals to mine up to 2.5 million tonnes per year. The mine has air emission permit № 09034 (dated 31.01.2003), which is valid for one year from date of issue. This permit is based on emissions calculated for operating at up to 2.5 million tonnes per year.

2.4.3.2 Water use and discharge limits

Surface water use permits must be received in accordance with the Russian Water Code (No. 167-F3, 11/16/95). The Russian Water Code requires that a user identify sources, discharges, uses, recycling, and requires limits on tonnes per year usage. Water discharge limits are developed in accordance with surface water protection laws (1991). Water pollution discharges are reported on an annual basis (Form 2-TP, Water). The mine currently has a Water Use and Discharge Permit which is valid for mining at 2.5 million tonnes per year.

2.4.3.3 Waste disposal

The Solid Waste Management Plan must be developed in accordance with federal law “On industrial consumption and generation of wastes” (No. 89-FZ, 6/24/89) and governmental decree “Guidelines for development and approval for waste generation and disposal” (No. 461, 6/16/00). These guidelines require that a user identify wastes, classify them in accordance with their toxicity and volumes, and develop a disposal strategy. Solid waste placement is reported on an annual basis (Form 2-TP, Wastes). The existing Solid Waste Management Plan was approved by the Knyazhpogost Environmental Protection Committee (Approval No. 04-09/1441 on 4/7/03) for the 2.5 million tonnes per year operation.

The regulatory guidelines require that a user identify wastes, classify them in accordance with their toxicity and volumes, and develop a disposal strategy. The waste classification was completed in accordance with the requirements set forth in Order No. 511 (promulgated on 6/15/01). This decree requires the categorization of all wastes in accordance with the requirements set forth in Table 1.

Table 1: Regulatory waste classification

Waste Classification	Potential Environmental Impact	Comments
Class I	Very High	Environmental system can be irreversibly impacted. No mitigation measures available.
Class II	High	Environmental system can be severely impacted. Impacts can last longer than 30

Waste Classification	Potential Environmental Impact	Comments
		years.
Class III	Average	Environmental system can be impacted. Impacts can last longer than 10 years.
Class IV	Low	Environmental system can be impacted. Impacts can last longer than 3 years.
Class V	Very Low	Very low possibility of environmental impacts. Requires special testing to be classified as a Class V waste.

2.5 EBRD/IFC/WBG assessment requirements

In the event that IFC and the EBRD continue to participate in this project, there is a range of environmental and social policies that are applicable to the proposed MTBM expansion. The applicable policies are shown in the following sections.

2.5.1 OP 4.01 Environmental Impact Assessment

IFC's policy on environmental assessment (EA) states that all projects proposed for IFC financing require an EA (including a social assessment). Under IFC and EBRD categorization, the proposed mine expansion is a *Category A* Project that will require a full Environmental Impact and Social Impact Assessment (ESIA) and a comprehensive Environmental and Social Action Plan (ESAP).

These documents must be completed 60 days prior to loan approval and be disclosed in the World Bank Info Shop. The EBRD Policy (April 2003) is similar to the IFC policy in scope and content. Typically, one document can be created that satisfies requirements for both EBRD and IFC. The contents of this document are intended to fulfil the requirements of IFC and EBRD for EIA preparation.

2.5.2 OP 4.04 Natural Habitats

This policy affirms IFC's commitment to promote and support natural habitat conservation and improved land use, and the protection, maintenance, and rehabilitation of natural habitats and their functions in its project financing. IFC does not support projects that involve significant conversion or degradation of critical natural habitats.

2.5.3 OP 4.11 Management of Cultural Properties

This World Bank policy is designed to assist in preservation of cultural properties. The management of cultural property in a country is the responsibility of the host government. However, before proceeding with any project that may entail destruction of a cultural property bank staff must (1) determine what is known about the cultural aspects of the proposed project site and, if necessary, (2) conduct a brief reconnaissance survey of the proposed project area.

2.5.4 Assessment and Management of Cumulative Impacts (DRAFT)

The successful management of cumulative impacts is essential to the sustainability of IFC projects. In conjunction with the EA process, it is necessary to consider cumulative impacts of existing, proposed, and anticipated projects. The EBRD has a similar requirement, operating as they do within the framework of EC requirements – which also prescribe the need for cumulative impacts to be assessed.

2.5.5 Hazardous Management Guidelines

These guidelines apply to facilities and activities involving the transportation, production, handling, storage, and disposal of hazardous materials. The key requirements of these guidelines are screening, management, preventative plans during operations, response plans in the event of an accident, and community involvement.

2.5.6 Public Consultation and Disclosure

In accordance with IFC requirements, a Public Consultation and Disclosure Plan (PCDP) has been developed for the Timan Bauxite Mine based on technically sound and culturally appropriate measures that can be implemented during project life to ensure timely and effective communications with affected stakeholders. The current PCDP outlines local and EBRD/IFC requirements for public consultation, identifies key stakeholders, discloses consultation schedules, reports past consultation events, describes implementation, and commits documentation and reporting.

2.5.7 Non-applicable policies

Additional IFC policies that do not specifically apply to the Timan Bauxite Mine include:

- IFC/MIGA Policy Statement on Forced Labour and Harmful Child Labour (applies anyway);
- OD 4.30 Involuntary Resettlement (applies anyway);
- OP 7.50 Projects on International Waterways;
- OP 4.10 Indigenous Peoples does not apply, but indigenous Komis are being addressed as a discrete grouping in the public consultation and disclosure process;
- OP 4.09 Pest Management; and
- OP 4.36 Forestry.
- Section 2.5, as previously requested, provide reference to EBRD policies relevant to EIA and PCDP. In regards to cumulative impacts, reference our requirement to comply with EU standards, the EU requirement for cumulative impacts to be assessed.

2.5.8 Other applicable policies

Because the company is attempting to secure financing for the project from the IFC and the EBRD, the environmental performance of the projects will be governed by a range of policies, guidelines, and procedures. The Base Metal and Iron Ore Mining Guidelines (World Bank's Pollution Prevention and Abatement Handbook, 1998) are applicable IFC guidelines for this project while the EBRD uses EU standards together with the various Integrated Pollution Prevention and Control (IPPC) directives of the EC.

2.5.8.1 Residual metals

The following are recommended target guidelines below which there is expected to be no risk for significant adverse impact on aquatic biota or human use. In cases where natural background concentrations exceed these levels, the discharge may contain concentrations up to natural background levels. Concentrations of up to 110% of natural background levels can be accepted if no significant impacts can be demonstrated. Table 2 provides the recommended WBG target guidelines and EC standards for residual heavy metals in effluent discharge.

Table 2: Residual heavy metals

Pollutant	Conc. (mg/l)		Pollutant	Conc. (mg/l)	
	WBG	EC		WBG	EC
Arsenic	0.1	-	Iron, total	3.5	-
Cadmium	0.1	-	Lead	0.2	-
Chromium (hex.)	0.1	-	Mercury	0.01	-
Total Metals	10	-	Nickel	0.5	-
Copper	0.5	0.04	Zinc	2.0	0.3

Note too, that the IPPC directive (96/61/EC) will apply which dictates that site-specific discharge conditions should be specified in the discharge permit for the installation.

2.5.8.2 Ambient air

Concentrations of contaminants, as measured at the project boundaries, should not exceed the limits presented in Table 3.

Table 3: Ambient air guidelines

Pollutant	Avg. Period	Conc. ($\mu\text{g}/\text{m}^3$)	
		WBG	EC
PM ₁₀	Annual	40	40
PM ₁₀	24-hour	50	50
NO _x	Annual	40	-
NO _x	24-hour	200	-
NO ₂	Hourly	-	200
SO ₂	Annual	50	-
SO ₂	24-hour	125	125
SO ₂	1-hour	350	350

2.5.8.3 Erosion and sediment control

Project developers are required to prepare and implement an erosion and sediment control plan. The plan should include measures appropriate to intercept, divert, or otherwise reduce the stormwater runoff from exposed soil surfaces, tailings dams, and waste rock dumps. Sediment control structures should be installed to treat surface runoff prior to discharge to surface water bodies. All erosion control and sediment containment facilities must receive proper maintenance during their design life.

2.5.8.4 *Reclamation and closure*

Project sponsors will prepare and implement a mine reclamation plan². The plan should include reclamation of tailings deposits, mine, mill, sedimentation basins, and any abandoned infrastructure. The main objectives of the reclamation plan are:

- Return the land to conditions capable of supporting prior land use or uses that are equal to or better than prior land use, to the extent practical and feasible; and,
- Eliminate significant adverse effects on adjacent water resources.

The mine reclamation plan will incorporate the following components:

- Conserve, stockpile, and use topsoil for reclamation;
- Slopes of more than 30% should be re-contoured to minimize erosion and run-off;
- Native vegetation should be planted to prevent erosion and encourage self-sustaining development of a productive ecosystem;
- Budget and schedule for pre- and post abandonment reclamation activities; and,
- Plan views that show areas cleared, mined, refilled, and re-vegetated during each of the next 5 years, and estimated activities at subsequent 5-year intervals.

² See Section 7.6 for a detailed description of the reclamation plan proposed for the expanded mine.

3. PROJECT SUMMARY

3.1 Introduction and overview

The MTBM was established in 1996 in the northern part of the Knyazhpogost District in the Komi Republic and now forms an important part of the district and regional economy. The company Timan Bauxite, which owns the mine, is located locally in Ukhta. In the past bauxite was transported by truck using a haul road that extended approximately 160 km from the mine. In 1998 a railway line was completed and bauxite is now transported by rail directly from the mine to Chin'avoryk over a distance of 157km and from there onto the Ural Alumina Refinery (1755km) and the Bogoslovsky Alumina Refinery (1815km). The nearest settlements are the Chin'avoryk railway station (at a distance of 142 km) to the south; and the City of Ukhta (located 150 km) to the southeast.

At present, the mine is permitted to extract 2.5 million tonnes per year and is currently mining around 1.0 tonnes per year. Phase 1a of the project, which commenced in 2003 is designed to increase the production at the existing operations to 2.5 mtpa. Phase 1b of the project is designed to expand the mining operations to the projected 6.0 mtpa by 2007. This includes extending operations to the north and south of the existing deposits.

Because the project is phased, the project description is divided into three components namely:

- Existing (permitted) activities;
- Phase 1a changes; and,
- Phase 1b changes.

3.2 The existing mine

The current mine configuration is illustrated in Figure 2 and includes mine pits, overburden stockpiles, a rail siding and central blending yard, railway line, access road and personnel camp including maintenance facilities. The first phase of mining, for which a mine plan was developed, was designed to last 20 years, commencing in 2004 with an annual production of 2.5 million tonnes per year of bauxite (1,900,000 tonnes of Bayer bauxite, 450,000 tonnes of agglomerated bauxite, and 200,000 tonnes of refractory bauxite). The total area to be disturbed by these activities was estimated to be approximately 400 ha and includes mining reserves from 4 separate areas, namely:

- No.1 MZhB (the existing mining area);
- No. 1 (ore body No. 1);
- No. 2 (orebody No. 2); and,
- No. 3 (orebody No. 3).

Because the mine is located far from any infrastructure, all supporting facilities are owned and operated by the mine. The current mine camp facilities consist of ten, single-story brick units that are each approximately 216 m³. All the units are connected by a series of double-insulated plastic corridors. The source of process water and drinking water for the mancamp is the water-bearing horizon of the Vorykvinsky and Pav'yugansky formations of the upper reef. The wells are two artesian wells from which water is pumped to 2 lift stations via reservoirs linked to the external network lines. The location of the wells excludes the possibility of chemical and bacteriological sources. The wells are capable of producing in excess of 1500 m³/day.

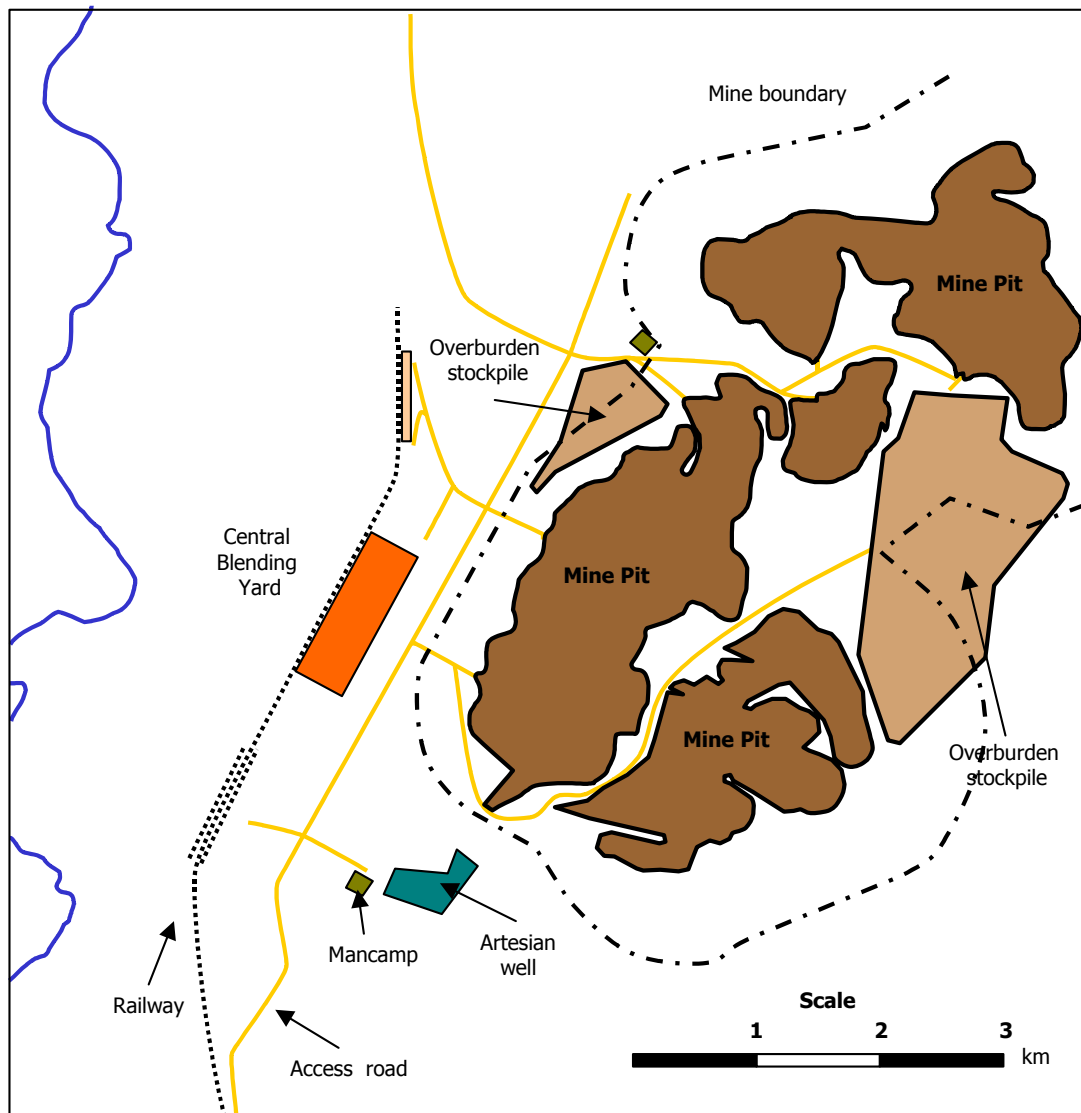


Figure 2: Layout of the existing mine showing the key features including the mining pits, overburden stockpiles, central blending yard, personnel camp and access road and railway. Note also the relative position of the Vorykva River to the west of the mine.

Power generation is via Cat diesel generators and the buildings are heating using individual electric heaters. Wastewater treatment is gravity separation, chemical neutralization and soak away. Included within the personnel camp is a large enclosed workshop where vehicle maintenance can take place together with an elementary engineering workshop. The vehicle maintenance area contains an inspection pit and lifting equipment. There is also an outdoor service area where vehicle and plant are repaired/maintained.

3.3 Land and deposit allocation

The deposits that are currently being mined and that are earmarked for the further expansion of the mine are shown in Figure 3. The area shaded in green denotes the overall currently permitted mining area to 2.5 mtpa (under the permit issued by the Federal mining inspectorate). The actual area being mined currently is the small orange area within the green shaded area. Note that the area currently being mined will be

expanded in small increments under arrangements with Knyazhpogost and Komi authorities until it reaches the limits of the permitted area. The remaining deposits have been granted to Bauxite Timana in the form of subsoil lease for completion of geological exploration under the license issued by the Federal Ministry of Natural Resources.

The land itself is owned by the Russian state. The license establishes an umbrella lease to all deposits that are being considered for the 6 mtpa expansion. The issuing of a mining permit for specific ore bodies follows this. Bauxite Timana currently has such a permit for the deposits required for the 2,5 mtpa expansion (the green area in Figure 3). The permit required for the mining of the 6.0 mtpa will be issued when geological exploration under the license is completed together with the necessary environmental approvals.

3.4 Project rationale

The integrated aluminium programme includes the potential expansion of the Middle Timan Bauxite Mine (MTBM), and the possible development of a greenfields alumina refinery and aluminium smelter. It also represents the most significant potential investment project ever undertaken in the Komi Republic. The viability of the programme is contingent on the refinery receiving bauxite of sufficient quality at a reasonable price. The current operations at MTBM are insufficient (at 1.0 mtpa) to provide raw materials to their current customers (other SUAL operations based in other areas in the Russian Federation) as well as sufficient material to the proposed refinery at Sosnogorsk. The proposed mine expansion is, therefore, on the critical path to ensure the long-term success and viability of the overall Komi Aluminium Programme. The expansion project will result in an overall production increase up to 6.0 mtpa and will be aimed at providing the existing customers of MTBM as well as providing for the proposed new smelter. The final production increase will be decided by the end of 2004 after completion of the feasibility study for the mine expansion. This is currently being completed by SLH (a joint venture between SNC-Lavalin and Hatch Australia) and SRK (Stefan Robertson and Kirsten).

3.5 Environmental assessment requirements

In parallel to the completion of the feasibility study, a series of environmental assessments (EA) will be completed on the proposed mine expansion. These EA's serve to address the lender's requirements (so-called 'Western' EA requirements) and Russian regulatory requirements (DoI, AoSS, OVOS/TEO). The Western EA is presented in this document with the completion of the various documentary requirements that will be submitted to the State Environmental Review (SER) currently scheduled for September 2004. Given that the mine has recently completed a detailed series of environmental assessments, only an 'expansion' OVOS ('EIA' in Russian) will be completed for the proposed 6.0 mtpa expansion.

Due to the fact that the expanded mine operation will commence at the earliest in 2007, additional investigations will be conducted prior to the start of the expansion to address some further EA requirements most notably in respect of the proposed mine dewatering. These EA requirements cannot be adequately considered presently due to a lack of information that can only be provided following further investigations. These further investigations are described in more detail in Chapter 6.

In addition the consultation and disclosure for the environmental assessments is detailed in a Public Consultation and Disclosure Plan (PCDP)³. The purpose of the PCDP is to ensure that ample opportunity is provided for stakeholders who have an interest in or who may be affected by the proposed mine expansion, to raise issues and concerns and to have these considered in the decision-making process.

The proposed mine layout is illustrated in Figure 4, the latter including the location of the new pits. It can be seen from the figure that a series of new pits will be established to mine the major ore bodies that exist in the area. The ore bodies that will be mined are summarised in Table 4.

³ The PCDP has been disclosed in a separate document and is available for review and comment

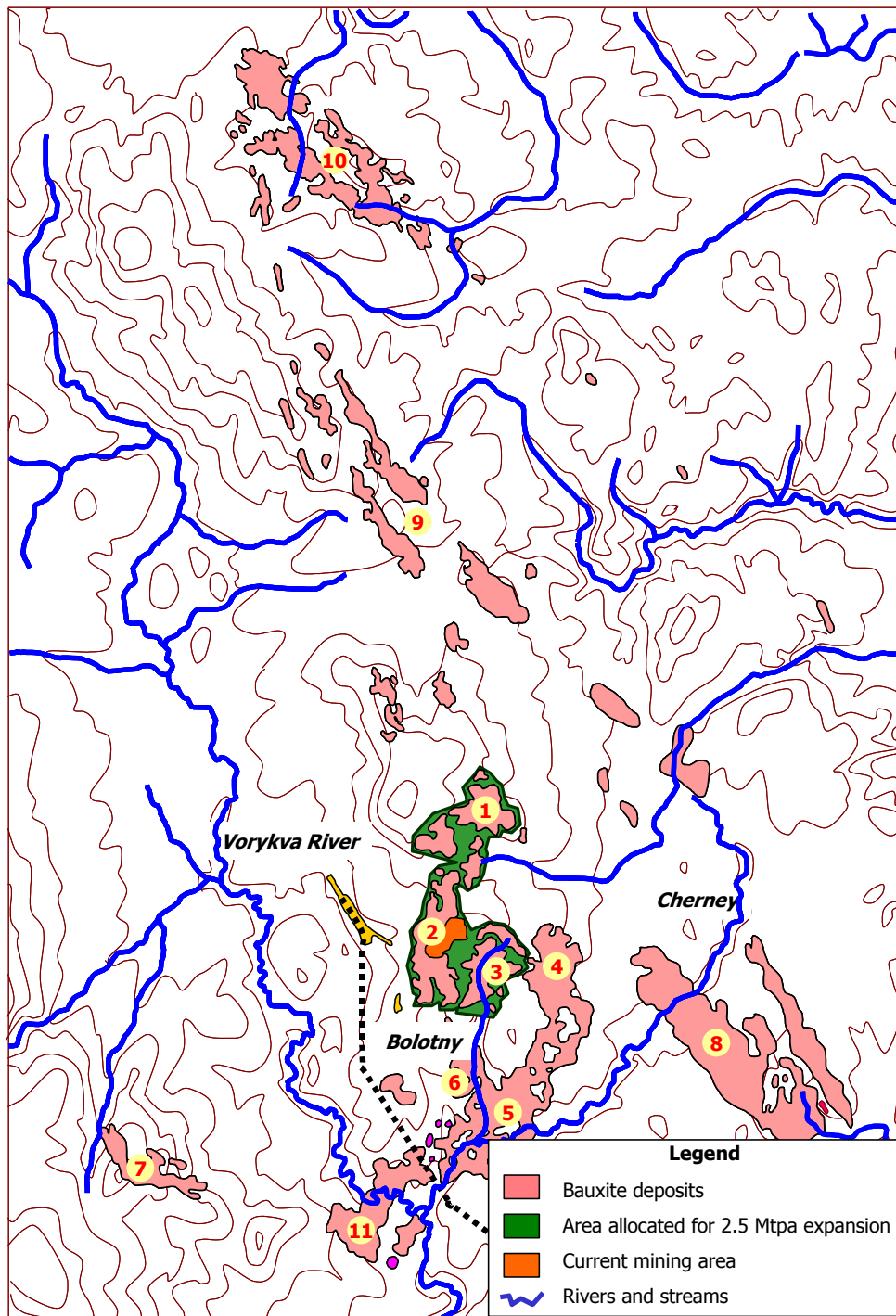


Figure 3: Map of the deposits being considered for the potential expansion of the Middle Timan Bauxite Mine, together with the major rivers in the area, the railway line that connects the mine to China's Vorkuta and the general topography.

Table 4: Summary of the various ore bodies to be mined together with an indication of the year during which they will be mined.

	Year																	
Deposit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15-29	20-24	25-29	30-32
Verkhne-Schugorskoye (N)																		
Verkhne-Schugorskoye (S)																		
Vezhayu-Vorykvinskoye																		
Vostochnoye																		
Verkhne-Vorykvinskoya																		

3.6 Mining Area

3.6.1 Existing Mining Areas

The mine currently has approval⁴ to mine up to 2.5 million tonnes of ore from the Vezhayu-Vorykvinskoye ore body. The total overburden to be removed from this area is 67,780,000 m³. Total ore to be mined is almost 48,000,000 tonnes (46,000,000 tonnes of Bayer grade and agglomerated bauxite and 1,800,000 of refractory bauxite). The final depth and area of these pits is provided in Table 5.

Table 5: Existing pit areas final depths.

Area	Pit Number	Area ^b (ha)	Max. Final Depth (m)
Vezhayu Vorykvinskoye	1 ^a	156	73
	2	155	57
	3	98	53

^aIncludes Pit 1-MZhB (low iron bauxite)

⁴ Following the completion of the required feasibility (TEO) documents and a positive conclusion by the State Environmental Review (SER).

^bArea is calculated assuming a “worst case” rectangular pit

3.6.2 Phase 1a mining

Phase 1a does not change the pits to be mined. The surface area of the pits and the maximum final depth do change under the new mining plan. Additionally, new mining equipment will be introduced into the process. The final depth and area of these pits is provided in Table 6.

Table 6: Phase 1a pit areas and final depths

Area	Pit Number	Area (ha)	Max. Final Depth (m)
Vezhayu Vorinkvinskoye	1 ^a	420	73
	2	307	57
	3	260	53

^aIncludes Pit 1-MZhB (low iron bauxite)

3.6.3 Phase 1b Mining

Phase 1b requires additional pits to be opened up in order to support mining of up to 6.0 million tonnes per year. The total overburden to be removed from these areas is approximately 2,61 M m³. Total ore to be mined from these areas is approximately 185,000,000 tonnes. The final depth and area of these pits is provided in Table 7.

Table 7: Phase 1b areas and pit final depths

Area	Pit Number	Area ^a (ha)	Max. Final Depth (m)
Vezhayu Vorinkvinskoye	4	263	140
	5	263	140
	6	25	30
Verkne-Vorykvinskoya	1	154	50
Vostochnoye	1	278	150
Verkhne-Schugorskoye – South	1	35	50
	2	40	75
	3	126	50
	4	91	50
	5	16	50
	6	28	50
	7	45	50

Area	Pit Number	Area ^a (ha)	Max. Final Depth (m)
Verkhne-Schugorskoye – North	1	139	200
	2	404	175
	3	39	50

^aArea is a best approximation based on proposed mining plan and access and assumes rectangular dimensions.

3.7 Mining process

The bauxite mining process consists of the following activities, each of which forms a component of a single continuous process:

- Development drilling
- Blasting
- Overburden stripping
- Bauxite mining

The major differences between the existing mining processes in Phase 1a and Phase 1b is the introduction of new equipment and the number of units in operation.

3.7.1 Developmental Drilling

Development drilling plays a key role in the mining process as the quality of the extracted bauxite is direct function of the area delineated for extraction. Development drilling on a regular grid spacing is used to delineate the ore body contours, derive the mineral resource, and provide estimates of tonnage and grade of the mineral reserve. Currently, the mine is permitted to operate four (4) drilling rigs simultaneously. Potential atmospheric emissions were based on the maximum drilling rate of approximately 165 meters/(day per drill). This equates to approximately 240,000 meters per year of drilling and a fuel consumption of 1440 tonnes per year.

Phase 1a does not expand upon the number of drills, but actually reduces the number to two. Phase 1b, due to the large number of pits that will be operating simultaneously, assumes that a maximum of ten drill rigs could potentially be operating simultaneously. Where and when the drilling occurs is highly dependent on weather conditions, the mine plan, and local conditions. The operators take all of these factors into account during operations. For impact assessment it is assumed that 35% of the drilling takes place in frozen overburden (under winter conditions when the density of material is assumed to be 2.2 kg/m³), 63% takes place during the summer months in overburden/waste (when the density of material is assumed to be 2.3 kg/m³), and less than 2% occurs in basalt (density is assumed to be 2.6 kg/m³). This means that a maximum of 600,000 meters of drilling per year will occur when the mine is operating at 6 million tonnes per year and the fuel consumption will increase to 3600 tonnes per year. All drilling is assumed to be dry with a dust suppression system that has an efficiency of 90%.

3.7.2 Blasting

In excess of 80% of all material will require drilling and blasting during the life of the project. The central bodies 1,2 and 3 are all shallow mining areas, with depths rarely exceeding 30m from surface and operating above the water table. All of the remaining areas, especially those further East will operate below the natural

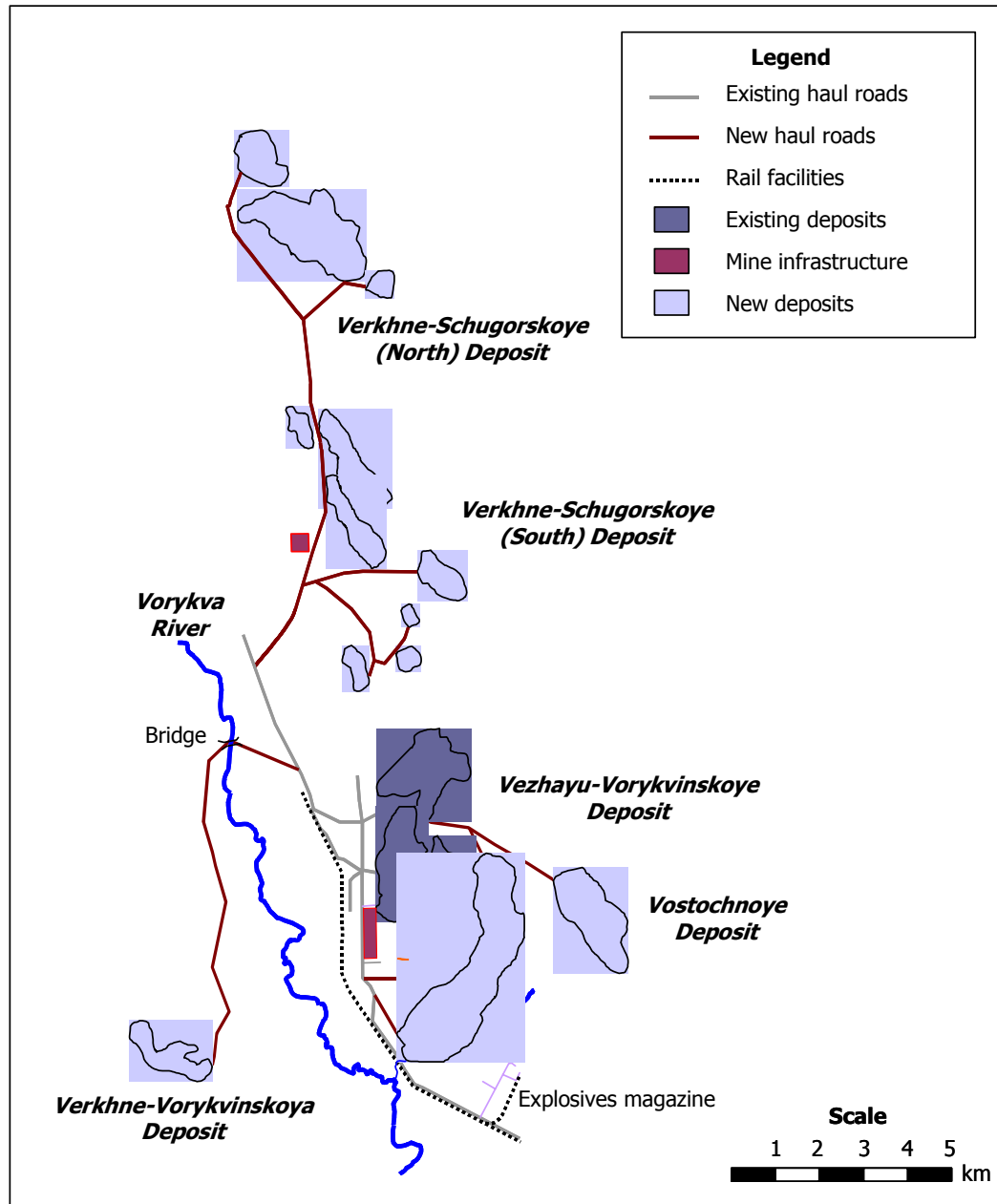


Figure 4: Current and future proposed mine layout

water table, but within the dewatering shadow. The majority of the workings will, however, be below 15m from surface and may attain 150m to 175m in depth.

Assuming average annual production of 80Mt (total) of which 85% would be 70Mt drill and blast (equivalent to 30Mbcms annual) total explosives of approx 33T explosives annually will be required (with a total to blast annually of 70Mt or 30Mbcms at an average drill hole of $5 \times 5 \times 10 = 350$ holes per day). Therefore MTBM especially as there are likely to be at least 3 to 4 areas open and in production at any one time, will be blasting at least every day (on average).

3.7.3 Overburden Stripping

Prior to overburden stripping, the trees are cleared from the site. This will involve felling trees and storing them on-site prior to removal. In the mining area, trees will be progressively removed as needed and no more than one year prior to mining operations. There will be opportunities for SME's to remove the trees for beneficial downstream use at no charge.

The process of overburden stripping consists of :

- Preparation of stripping faces, levelling of a line, clearing of the top ore body by bulldozers;
- Drilling and blasting operations with the purpose of loosening harder basalt overburden
- Excavation and loading of the overburden into trucks
- Transportation of rock mass to the overburden stockpiles.

In order to recover as much topsoil for restoration purposes as possible, soils will be transported to pre-designed and prepared soil dumps located adjacent to the excavation area. Soil storage areas will be designed at a height of no more than 10 m with a slope of 1:3. The slopes will be protected by peripheral catchment drains (that will route into stormwater control facilities) to prevent erosion.

Bulldozers are used to break the frozen peel and to provide access to the overburden faces. The main activity is simply excavating and loading the rock mass, which is carried out using excavators. The overburden material is transported using 30 and 42 tonne trucks, which transport the material to temporary external pit roads up to the overburden dumps. The topsoil and seed base is not separated from the overburden during current operations at MTBM but this will be changed as part of the overall reclamation plan that will be implemented.

3.7.4 Bauxite mining

Under existing operations, bauxite mining operations include:

- Drilling-and-blasting operations to break-up the ore mass; and
- Excavation and loading of bauxite ore onto trucks.

After overburden stripping operations, the surface is prepared for further drilling and blasting. Blasting takes place about three times a month per pit. As the mine is expanded there will be blasting every day for the various pits that are being mined. The material is loosened by the blasting and then loaded onto 30 tonne trucks by excavators for transport to the Central Blending Yard (CBY).

During Phase 1a, the operations will be similar except that there will be two excavators (1-13 m³ and 1-10 m³ shovels) instead of the current one (1). Additionally, the mine will use 8-100 tonne rear-dump haul trucks. During Phase 1b, the operations will simply increase the number of excavators (10-13 m³ and 5-10 m³ shovels) and the number of haul trucks (49 total during peak operations)

3.7.5 Dewatering

One of the most important potential impacts of the mine expansion is that on hydrogeology. Specific issues that need to be considered include the inflow of groundwater into the mining pits as these are excavated below the water table, and the inflow of stormwater into the pits and resultant need to pump water out of the pits (pit de-watering). Pit de-watering is required to stop the mine from flooding and to prevent the pit slopes from failing. It is also necessary to understand the relationship between the ground and surface water so as to ensure that pumping water from the aquifer will not impact on river flow conditions.

These processes are influenced by a number of factors including the relative position of the pits (excavations) to the water table and the characteristics of the geology and ground and surface water condition. As described in the Baseline Section (see Section 5.7 for full details), the aquifer units in the area

consist of (from youngest to oldest):⁵

- Quaternary unconsolidated settlements
- Carboniferous sediments (mainly limestones)
- Mid Devonian rocks comprising volcanogenic, terrigenous and residual soil horizons (including the bauxite)
- The basement rocks comprising the Riphean dolomites and Chetlasskaya and Anyuguskaya metamorphic rocks.

3.7.6 The quaternary aquifer

The position of the Quaternary aquifer relative to the proposed mining areas will result in localized inflows of groundwater into pits 1, 2, 3 and the northern part of 4 as a function of seasonal variations in water level and rainfall recharge. The aquifer will result in more significant flows into pits 5, 6, 8 and 11 and the southern part of 4. The aquifer is fairly thin in the area where pits 7, 9 and 10 will be established resulting in less significant inflows to pits 9 and 10 and no inflow to pit 7.

The quaternary aquifer is up to 40m thick in the area of pits 5 and 11 and there is evidence to suggest hydraulic contact with the surface water, most notably the Cherney River, which flows between the proposed positions of the two pits. Although the catchment of the Cherney does not appear to be large, there will be a need to at least divert the Cherney into a lined channel to reduce the potential inflow of water into the pits. The Cherney will be diverted around the pits via a hard surface drainage channel. The diversion channel will be designed to minimise effects on the long term hydrological characteristics of the Cherney. This will need to be determined as a function of the flow regime likely to be generated by the catchment. The flow rate of the Cherney varies between 3,500 m³ a day and 1,200,00 m³ and although it is not as large as the Vorykva, is still a significant surface water feature with important ecological significance.

Given that the elevation of the Vorykva River in the Vezhayu-Vorykvinskoye area is at an elevation of around 209m and that the lowest mining elevation for pits 4 and 5 is 140 to 125m there could be some leakage from the river into the pits unless there are efforts to significantly reduce the permeability of the riverbed (the distance between the river and the pits is between 2500 and 3500m). This has implications for both mine operations and the flow regime of the Vorykva River, which is a recognized ichthyological reserve.

3.7.7 The basement and carboniferous/devonian aquifers

The main source of pit inflow will be the Carbonaceous rocks of the basement Bystringskaya rocks across the whole of the potential mining area. The basement rocks are dolomite and limestone, which have variable hydraulic characteristics. The general direction of groundwater flow is from north to south, the same as the surface water systems, with a gradient of around 0.003. The aquifer is unconfined in the north and west but becomes confined with increasing head to the east and south. The hydraulic conductivity progressively decreases with increasing cover to the east and south. For example, the transmissivity is over 5000m²/day in the central area decreasing to 2200 to 3000m²/day east of the deposit and 120m²/day in the south in the carbonaceous schists.

The sudden change of transmissivity is due to the Kosyelsky fault, which brings the Anyuguskaya schists and quartzites against the dolomites creating an aquifer boundary to the south. The Chetlassky fault is a boundary to the west while a non- permeable boundary is created by the Vymisky fault east of the deposit. There are no hydraulic (aquifer) boundaries north of the deposit. The degree to which the Vorykva River

⁵ Note that the information presented in this section has been sourced from work that was done in the area previously. Please see Chapter 7 for a more detailed description of the source of the information, and its representativeness in defining the geo-hydrological condition of the area.

acts as a boundary to this aquifer is uncertain. A borehole in close proximity to the Vorykva is artesian (the water comes directly to the surface) suggesting that there is a relatively impermeable barrier between the river and the aquifer.

3.7.8 Anticipated inflows and mining plan

The anticipated flows into the mining areas are summarised in Table 8. These are the flows that would be expected once the full mining depth has been reached. In the early stages of the pit development there will have to be higher pumping rates to overcome the recharging of the aquifer and the initial storage of water in the aquifer. It is likely that progressive dewatering will lower the water table in tandem with the deepening of the mine. Pumping will need to commence well ahead of mining to enable the water levels to be lowered in advance of mining to a particular level.

Table 8: Estimates of potential inflows of water into the pits that will be established as part of the mine expansion and by implication what will need to be planned for as the quantities to be dewatered.

Area	Pit number	Maximum yield m ³ /day
Vezhayu-Vorykvinskoe	1	Nil
	2	Nil
	3	Low
	4	100,000
	5	150,000
	6	36,000
Verkhne-Vorykvinskaya	7	Nil
Vostochnoe	8	55,000
Verkhne-Schugorske (south)	9	48,000
Verkhne-Schugorske (north)	10	72,000
Vezhayu-Vorykvinskoe	11	-

Ore bodies 5 and 11 will be significantly influenced by the Vorykva River and potential inflows could be higher without specific remedial works. The figures given assume a significant contribution from the river through the alluvium and the basement rocks. The actual dewatering requirements are likely to be less than these estimates, but they do at least provide a first order estimate as to the quantities that can be expected.

3.7.9 Water pressure

Water levels in all formations are similar and around ground level in the low, marshy areas and close to the rivers, but up to 50m below surface in the higher ground. The phreatic surface has a shallow gradient of around 0.03 from north to south. The basement piezometric surface is confined below the sediments, volcanogenic rocks and the orebody rocks to the east and this surface corresponds broadly to the regional phreatic surface. In terms of slope stability and potential inflow, the pressure effects may not be seen until the pit is developed and much of the overburden removed.

	Year (anticipated year 1 is 2005 or 2007)																	
Deposit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15-19	20-24	25-29	30-32
Verkhne-Schugorskoye (N)																		
Verkhne-Schugorskoye (S)																		
Vezhayu-Vorykvinskoye																		
Vostochnoye																		
Verkhne-Vorykvinskoya																		

	Active mining
	Drilling and Commissioning
	Operating period

Figure 5: Anticipated mining programme illustrating the onset of the dewatering requirements.

3.7.10 Storm water

Calculations of storm water, which would flow into the pits are based on 39mm rain, which represents a 10% probability of exceedence in 24hrs. The areas of pit for north and south are 1.913km² and 1.879km² respectively giving 1036m³/hr and 1018m³/hr respectively. These volumes are significantly lower than the rates of groundwater abstraction for dewatering, but the water will require some settlement of suspended solids. It is likely that the storm water could be pumped into the settlement ponds provided for the borehole water and that settlement and dilution would be sufficient for discharge to the river. All settlement ponds have been designed to accommodate a 1:50 year flood event.

3.8 Haul roads

The existing haul roads will need to be expanded to include the new pit areas. During Phase 1a the additional land disturbance will be minimal. During Phase 1b a significant amount of disturbance will occur due to the addition of new haul roads. During this time, approximately 49 kilometers of new haul roads will be constructed with an average width of 25 meters. This translates into more than 122 ha of land disturbance spread out over the entire license area. The mine will review the corridor selection of these roads to ensure that the footprint is minimized.

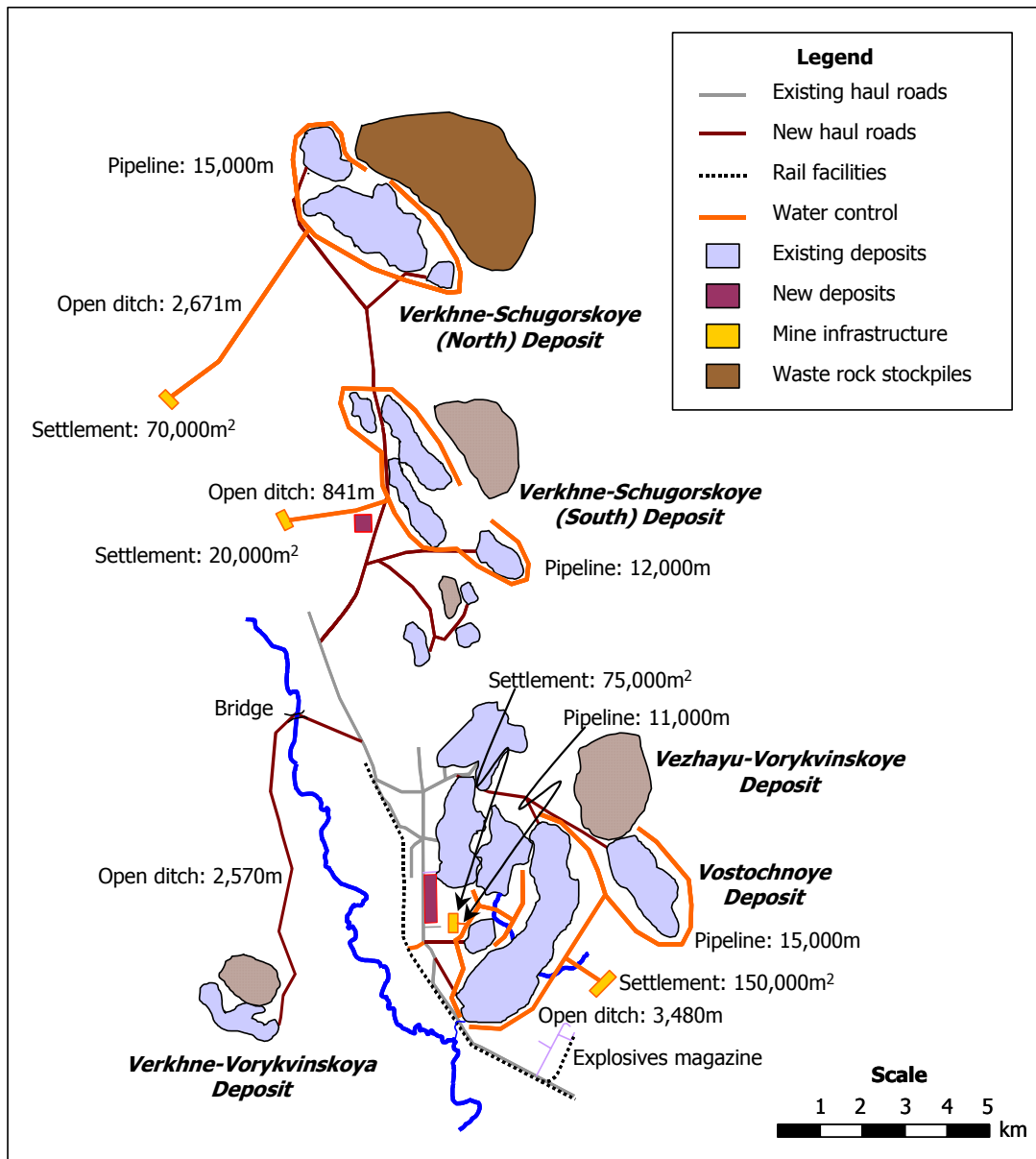


Figure 6: Mine layout showing additional mine infrastructure, including dewatering pipelines and settlement pits ('Settlement').

Fill material for the haul roads will be sourced from the waste bauxite removed from the pits. Progressive clearing will be required of trees as areas for haul roads are prepared. The haul road to the Verkhne-Vorykvinskoye deposit will require a bridge to be built across the Vorykva River. The bridge will need to accommodate 70 tonne trucks but will ensure that no disturbance to the river will occur. This will mean that no bridge supports will be built into the river bed or along the banks.

3.9 Central Blending Yard

Dumping of the bauxite at the Central Blending Yard (CBY) takes place at pre-defined sections on the unloading dolly way (there are a 100 such sections each 15m in length). The control master of the Quality Department specifies the sections where the ore is to be dumped and it takes approximately three minutes for a truck to dump its ore load. During Phase 1a of the expansion it is not anticipated that the CBY will need to be expanded. During Phase 1b, the size of the CBY will approximately double.

3.10 Crushing circuit

Phase 1a and 1b will implement a new crushing circuit designed to expedite blending of ore material. This crushing circuit will be located within the footprint of the existing facilities operations. The crusher will be housed in a building with an overhead garage door designed to operate year round. The crushing circuit will be equipped with a baghouse with a 99% efficiency for dust control. All operators working within the building will have adequate hearing and dust protection. The performance of the baghouse will meet apposite Russian regulatory, EU and IFC guidelines.

3.11 Ancillary facilities

Because the MTBM is not located near any existing town or facilities, the project is completely independent of all utilities. The following facilities will be constructed/expanded during the expansion project:

- Explosives storage;
- Maincamp;
- Fuel and lubricant storage;
- Power and heat supply;
- Administrative complex;
- Water supply; and,
- Wastewater treatment facilities.

3.11.1 Explosives Storage

The bulk explosives facility will be located South of the main workshop and maintenance area and approximately 3 kilometers away from the man camp. Raw materials used in the explosive manufacturing process will be brought to site by rail or road, and stored in silos at an on-site manufacturing facility site until required. This building will be brick built, 40m long by 10m wide by 4m high with adequate office and storage facilities and a large mixing and preparation room.

A detonator magazine (20m long x 5m wide x 4m high, either of concrete construction or with double brick thickness and surrounded by earthen screening mounds and security fencing) and small industrial explosive magazine (similarly constructed) will be required as separate units situated within close proximity of the main magazine complex, but all within an enclosed security fencing. The area will be well-lit and manned 24 hours per day with an armed guard. Only authorized persons will be allowed to enter the area and all materials will be kept under strict control as required by the Russian Ministry for Internal Security.

3.11.2 Mancamp

The current mine camp facilities consist of ten, single-story brick units that are each approximately 216 m². All the units are connected by a series of double-insulated plastic corridors. It is anticipated that all of these units will be renovated into new-use facilities described in the following sections.

During Phase 1a of the project, the mancamp must provide comfortable living accommodations for approximately 160 persons. It is anticipated that an additional 7 buildings will be built. These buildings will all be single-story, brick building with outside dimensions of 270 m². Each unit will contain a 3m x 6m room to be used as a recreation room. Additionally, each unit will have 8 bedrooms that are each 12 m². Each bedroom will have furniture for 2 occupants (except for the senior staff building). Every building will have washrooms and showers. All of these facilities (as well as the facilities constructed in Phase 1b of the project) will be located immediately adjacent to the existing facilities.

During Phase 1b of the project, the mancamp will be expanded by an additional 16 units that will bring the total number of persons at site to approximately 740 during peak periods. All of the units will be similar in

size and amenities. In addition to the sleeping quarters, a separate canteen and kitchen area will be constructed. It will be a brick built unit 30m long x 9m wide by 4m high, connected to the main office block and to the accommodation wing. This will consist of kitchen cooking area, washing area, food storage areas and dining areas. This unit will be operational on a 24 hour basis to cater for both operational shifts. There will be enough seating for 120 persons to eat at a single time.

The mine dry and laundry facility will be housed in two brick buildings near the maincamp. The mine dry will be large enough to accommodate 220 people. One shower, urinal and water closet will be required for every 20 people, and one locker for each person. The second building will house a centralised laundry, clothes washing and drying area and will be required to satisfy 500 sets of working clothes on a daily basis.

An additional recreational building will be separate from the living quarters. This building will be 30m long x 9m wide by 4m high, connected to the accommodation wing. This area will consist of a TV room, small gymnasium, sauna facilities, small games room and computer room. Drinking water is described later in Section 3.14.

3.11.3 Administration buildings

The main administration buildings will be located in the existing brick units (total of 7 units). Each unit is 216 m². As part of these facilities, 1 unit will house a medical facility, which will include 4 beds for injured patients, a clean area, a clinical treatment area, and covered parking for the ambulance and firetruck.

Another one of the units will house the laboratory. The laboratory will consist of an office for the chief analyst (2m x 4m), ablution and shower facilities (2m x 4m), 3 laboratory work areas, (1 to house small kilns, and furnaces, 1 to house analysis machines, 1 desktop laboratory) each approximately 5m x 4m. In addition a preparation and classification area is required as well as external, but covered storage areas for receipt of the samples (10m x 4m x 3m steel reinforced cladding with concrete 100mm base). One of the buildings will be used as the Mine Safety and Training Centre. It will be equipped with 2 large classrooms for mine safety training and general lectures.

3.12 Maintenance facilities

Mining operations at Timan will not operate from any one single pit location at any single time. Generally the Vezhayu-Vorykvinskaya (Central) deposits form the largest bauxite reserve and are likely to be mined for the duration of the project. Whilst the Verkhne-Schugorskoye deposit (North and South), situated between 7 and 14 kilometers respectively from the bauxite loading areas, will be mined in the middle and latter stages of the project.

Therefore, the main maintenance shop and administration facility will be constructed around the Vezhayu-Vorykvinskaya deposits, with a satellite refuelling and general repair shop being constructed adjacent to the Verkhne-Schugorskoye South Beds. The main building will be a 15m x 70m single-story structure. It will have large garage doors capable of admitting the large mining equipment. The entire facility will be vented and have fans to promote air turnover.

There will be a total of 9 bays that include:

- Central 7 bays (8m wide by 15m long) each serviced by a 6.5m wide x 6m high door for access of 100 tonne dump trucks, three of the bays to be fitted with inspection pits;
- One of the outer bay (8m by 15m) divided into 2 offices (Workshop manager & maintenance clerks), no main outer door required; and,
- The second outer bay should be set aside for engine rebuilds, welding etc.

The entire bay will be concreted with a 1 degree slope towards a sump in the middle that is equipped with an oily water separator. Additionally, there will be an auxiliary workshop near the main maintenance facility. This facility will consist of:

- An auxiliary area consisting of 8 bays and an office area;
- Light utility service bays (2);
- 4 bays for bulldozer servicing;
- 2 bays for large, wheeled equipment; and,
- A machine shop area.

The facility will also include a welding area as well as a parts cleaning area. The entire maintenance facility will be on concrete and have a slope towards a sump that is equipped with an oily-water separator.

3.13 Power generation

During Phase 1a, the existing generator will be replaced with three (3) 250 kW generators. Two will act as primary power and one will be used as back-up. During Phase 1b, an additional 250 kW generator will be added. All of these generators will be housed in a brick building near the man camp. The power plant will be water-cooled and include a heat recovery system. The existing generator will be retained as a stand-by/emergency generator. Low sulphur diesel will be sourced if this is available in the area.

3.14 Facility water supply

The source of process water and drinking water for the maincamp is the water-bearing horizon of the Vorykvinsky and Pav'yugansky formations of the upper reef. The wells are two artesian wells from which water is pumped to 2 lift stations via reservoirs equipped with sterilization equipment, and linked to the external network lines. The location of the wells excludes the possibility of chemical and bacteriological sources. The wells are capable of producing in excess of 1500 m³/day. During Phase 1a, the site will have approximately 160 persons. Water consumption (based on Russian methodology) is provided in Table 9.

Table 9: Estimated water consumption during Phase 1a

Facility	Consumers		SNIIP 2.04.01-85		Consumption ^a	
	Units	Value	Units	Value	m ³ /day	m ³ /yr
Laboratory	Person	4	l/day	460	1.84	672
Offices	Persons	25	l/day	16	0.4	146
Showers	# showers	10	l/day*shower	500	5	1625
Laundry	Kg/day	100	l/kg	75	7.5	2738
Kitchen	meals/day* person	4	l/meal	16	10.24	3738
Total					25.00	9118

^aThe consumption is estimated for potable water use only and excludes process water (washing of equipment, dust control, fire water, and other industrial uses).

During Phase 1b, the man camp will increase to approximately 760 persons - or approximately 5 times the amount in Phase 1a. This will increase the daily water consumption to approximately 125 m³/day and to more than 45,000 m³/year. Drinking water quality is summarised in Table 10.

Table 10: Quality of drinking water supplied to the mine (water quality is monitored on a quarterly basis)

Parameter	Russian drinking water quality standard – MPC	Maximum recorded value
Chemical parameters		
pH	6-9	8.02 mg/l
BOD	–	2.4 mg/l
COD	–	24 mg/l
TSS	–	–
Oil	0,1 mg/l	<0,005 mg/l
Total N	–	0,43 mg/l
Total P	–	<0,002 mg/l
As	0,05 mg/l	< 0,00001 mg/l
Cd	0,001 mg/l	< 0,0001 mg/l
Cr ⁶⁺	0,05 mg/l	–
Cu	1 mg/l	0,0033 mg/l
Pb	0,03 mg/l	0,0002 mg/l
Hg	0,0005 mg/l	–
Ni	0,1 mg/l	0,001 mg/l
Se	0,01 mg/l	-
Ag ⁺	0,05 mg/l	<0,001 mg/l
Zn ²⁺	5 mg/l	<0,005 mg/l
CN ⁻	0,035 mg/l	-
Cl (total and free)	0.3-0.5 and 350 mg/l	Not required**
(F ⁻)	1,2-1,5***	0,476 mg/l
Phenols	0.25 mg/l	Not measured
Sulphides	–	Not measured
Al	0,5 mg/l	<0,04 mg/l
Co	0,1mg/l	< 0,01 mg/l
Pb	0,03 mg/l	<0,0002 mg/l
Mo	0,25 mg/l	<0,04 mg/l

Parameter	Russian drinking water quality standard – MPC	Maximum recorded value
Mn	0,1 mg/l	<0,01 mg/l
Ca	–	27,25 mg/l
Mg	–	15,8 mg/l
Na+K	200 mg/l (for Na only, K is not regulated)	8,43 mg/l
NH ₄ ⁺	2 mg/l	0,05 mg/l
Fe	0,3 mg/l	<0,1 mg/l
CO ₃ ²⁻	–	Not detected
HCO ₃ ⁻	–	173 mg/l
Cl ⁻	350 mg/l	1,1 mg/l
SO ₄ ²⁻	500 mg/l	5,31 mg/l
NO ₂ ⁻	3 mg/l	<0,02 mg/l
NO ₃ ⁻	45 mg/l	0,90 mg/l
Hygienic (microbiological and parasitological) parameters		
Thermotolerant coli	Not allowed in 100 ml	Not detected in 100 ml
Total coli	Not allowed in 100 ml	Not detected in 100 ml
Total microbe number****	<50 CFU in 1 ml	0 CFU in 1 ml

*This parameter is not analyzed in Russian environmental monitoring practice.

** Monitoring of Cl content in drinking water is required only if it is chlorinated in the process of water treatment. Since chlorine is not used at the mine water supply system, environmental services do not monitor this parameter.

*** The parameter is different for various climatic zones.

**** Total microbe number is measured by a total number of bacterial cells forming separate bacterial colonies in a specific volume of water (1 ml); measurement unit is named *colony forming unit* (CFU).

Russian standards for drinking water quality are regulated by SanPiN 2.1.4.1074-01. Drinking water. Hygienic water quality standards for centralized drinking water supply systems, Quality control.

3.15 Wastewater Treatment

Grey and black water from the man camp (including all liquid effluents such as domestic sewage (i.e. toilets, water from kitchen and wash facilities) will report to the sewage treatment plant that will be located adjacent

to the man camp. The total maximum amount of sewage effluent that will be processed by the sewage treatment plant is 150 m³/day (54,750 m³/year). This water is processed thru an aerobic tank, an anaerobic tank, a rotary biological contactor, a settling tank, and finally a polishing tank (where chlorine is added). This water is then pumped to the Vorykva for discharge. The design of the facility will be such as to ensure that applicable Russian, IFC or EU discharge standards are met. In addition given the fish diversity and populations in the VSIR (including salmon) the receiving water standards specified by the EC for salmonid waters will also be taken into account in the design of the waste water treatment facility, to ensure that the discharge will not exceed these requirements (see Section 7.7.6 for these standards).

3.16 Landfill

Solid waste generated from the mine plant site, including ancillary buildings, will primarily be domestic and industrial non-hazardous waste, but will include hazardous waste. The waste types that are currently generated at the mine and which will be generated during the 6.0 mtpa operation are summarised in Table 11. A comprehensive Waste Management Plan will be developed for the project that will detail more accurate quantities of waste generated, how it will be disposed, waste tracking and monitoring. MTBM has committed to the principle of the waste reduction at source, followed by recycling and ultimately safe disposal, where no options for prevention or recycling exist.

Table 11: Types and estimated quantities of waste that will be generated by the mine when it is operating at 6.0 mtpa, together with disposal strategy planned for the expanded mine.

Hazard grade	Waste type	Approximate quantity (tpa)	Planned disposal
1	Waste mercury lamps	0.02	Recycled
2	Oil sludge generated during reservoir cleaning	17.0	
3	Waste oils and oil products	60.0	Burned in the boiler
3	Oily rags	5.0	
	Accumulator acid	4.0	
	Domestic waste/municipal solid waste	12.0	Landfill to be established at the mine during expansion to 2,5 mtpa
	Scrap metal	Unknown	Sold to a scrap metal merchant
	Used tyres	230.0	Disposal strategy required
	Construction waste (scrap wood, metal and concrete)	Unknown	Building rubble disposal to waste rock piles ⁶
	TOTAL	Approx 320.0	

⁶ This is a generally accepted method in the mining industry.

3.17 Fuel storage

Above ground fuel storage facilities will be installed to maintain a minimum of 4 weeks fuel supply – equivalent to 3MI of diesel. The storage facilities will be bunded, with hard surfaces and refuelling taps protected against accidental collision. Facilities will also be established to ensure that any spillage during tank refilling can be captured and prevented from being discharged to the environment.

3.18 Transportation

The existing rail facility (from the mine to Chin'avoryk) will be upgraded to accommodate the mine expansion. The upgrade will be necessary to ensure that the proposed increase in rail usage from the current 1 train per 24hrs to the required 3,76 trains per 24hrs is catered for. The rail routing is reflected in Figure 7.

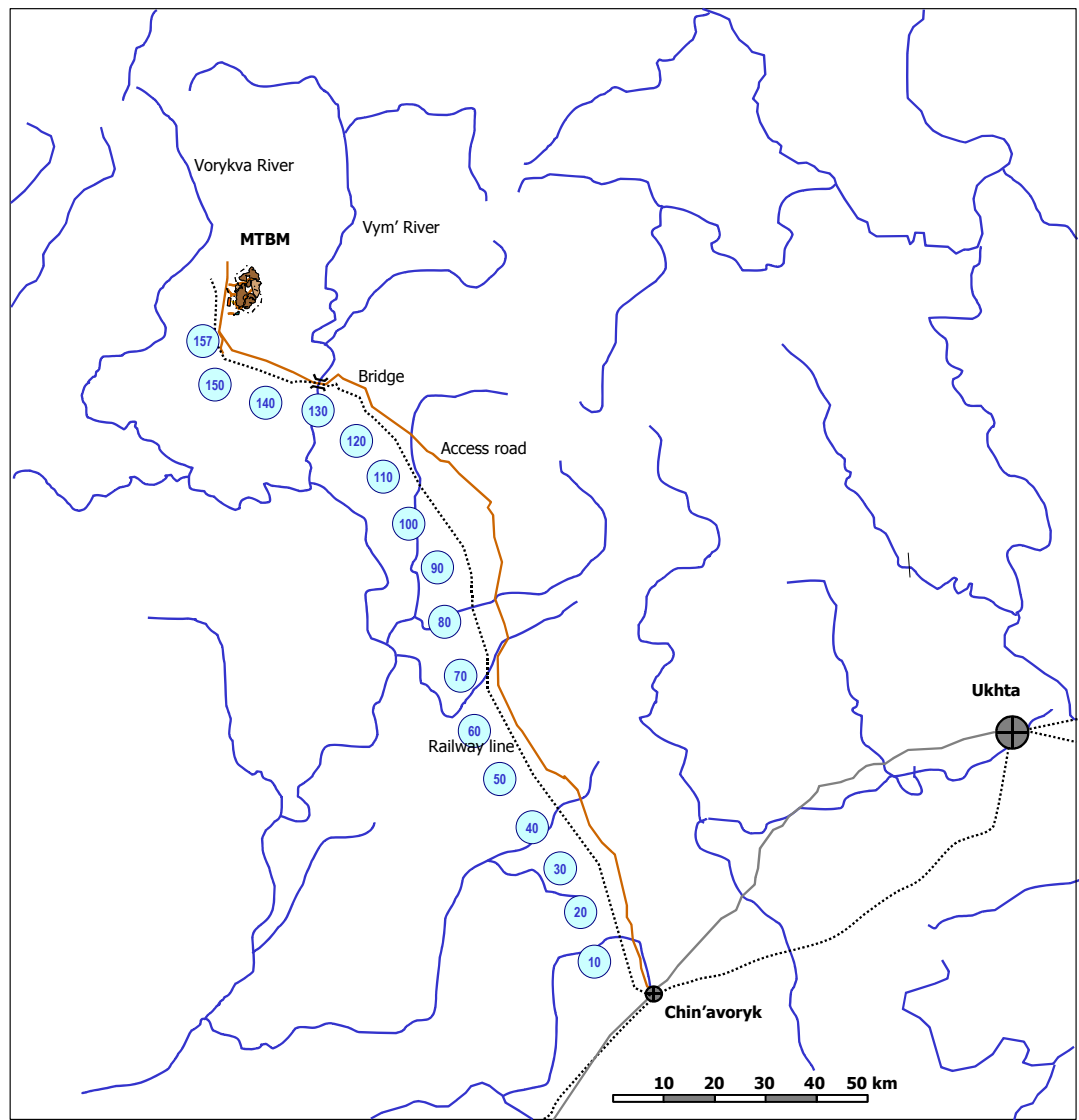


Figure 7: Railway system routing map.

3.19 Manpower

The estimated manpower requirements (management and operating staff) are summarized in Figure 8. The manpower estimates are based on 2x12 hour operating shifts per day for 7 days per week, with 2 crews remaining on site for 2 weeks before being replaced.

3.20 Current mine rehabilitation

The current practice at MTBM is not yet to rehabilitate *in situ*. In other words excavated overburden material is not returned to the pit once the bauxite has been excavated. This is because the mine is still relatively new. *In situ* rehabilitation will be started once enough of the mine has been excavated to allow for the material to be returned to the pit without affecting mining operations⁷.

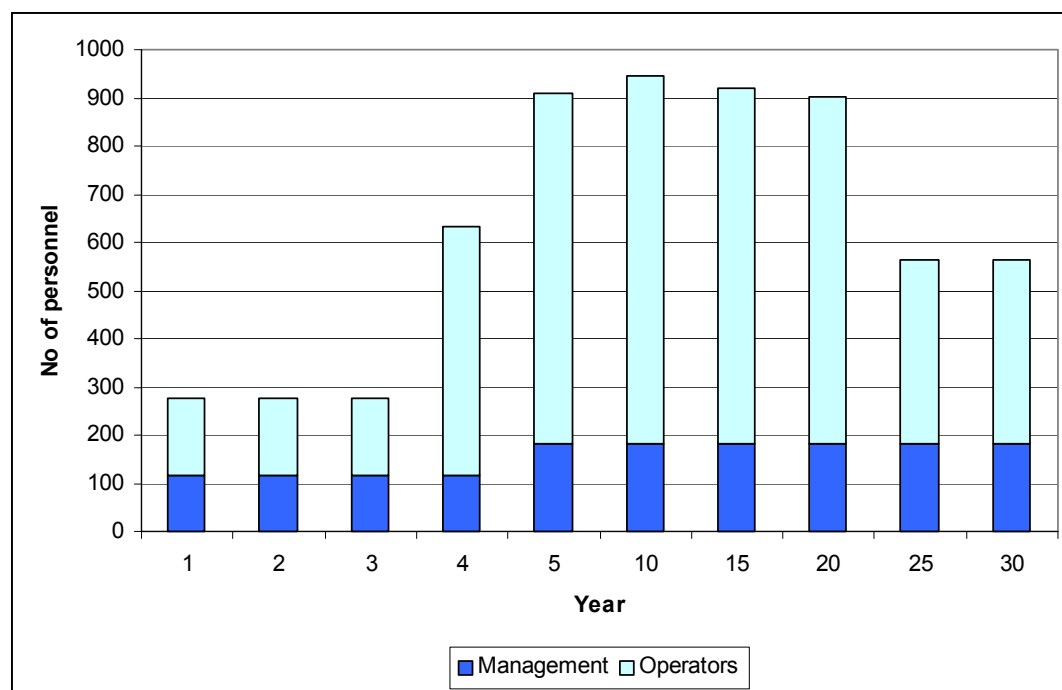


Figure 8: Summary of the manpower estimates required for the proposed mine expansion. Note that as the pits get deeper there is progressively less overburden. This means a reduction in the equipment required and fewer personnel to operate the equipment.

The current practices are not satisfactory but MTBM has agreed to enhance its rehabilitation activities in the context of the development of a Mine Reclamation and Rehabilitation Plan (MRRP) that will be prepared as part of the proposed expansion (Phase 1b). MTBM recognizes the importance in bauxite mining to have the reclamation/revegetation stages closely integrated with the mining stage. When new mining equipment will be available it is anticipated that mobile equipment will be close at hand to carry out that work. Significant planning work and capacity building is required at MTBM/ Komi Aluminium to address this issue.

⁷ Please see section 7.6 for a more detailed description of how the rehabilitation will be conducted.

4. ALTERNATIVES

4.1 'Do nothing' alternative

The first alternative to consider is the so-called 'do-nothing' alternative, where the mine would not be expanded beyond the currently permitted 2.5 mtpa. It is clear that the benefit of not expanding the mine would mean that the potential impacts associated with the mine expansion would not occur. The most significant of these impacts is undoubtedly those associated with the required dewatering, which is only required for an increased capacity of more than 2.5 mtpa.

At the same time important benefits associated with the proposed expansion, would not realize if the do-nothing alternative is pursued. These are detailed and listed below.

- Lack of proper rehabilitation of the deforested areas and mined areas if the MTBM mine does not operate with sufficient economic returns.
- Loss of basalt aggregate – one of the by-products of the mine expansion will be basalt aggregate. The basalt aggregate will be sourced from the overburden that is removed, and separated for sale within the Russian Federation. There is currently a lack of availability of this material, which is required for road building, railways and general construction (as a key requirement for concrete). The only way to respond to the large demand for the material is to open up borrow pits/quarries that will have environmental impacts in their own right.
- Loss of employment opportunities – the additional jobs that will be created by the mine expansion to 6.0 mtpa would also obviously not be realized. The additional spending, brought about by the increased employment, that would otherwise have benefited the local economy would also not be manifest.
- Loss of opportunity to extend the supply chain to SME service providers and provide business/technical skilled training and working experience for the people of the Komi Republic.

4.2 Alternative sources of bauxite within the region

A second alternative is to find alternative sources of bauxite in the region that could be used as a raw material for the refinery. It is clear that the region has extensive bauxite reserves, and these reserves may well occur in environmentally less sensitive areas. There are two key reasons for this not proving to be a viable alternative.

4.2.1 Information

The extension of Middle Timan Bauxite Mine is technically and economically viable due to the extensive exploration work that was conducted in the area in the late 1970's and early 1980's. This exploration resulted in the information that is currently being used to develop a viable mine plan for the proposed expansion. There is simply not equivalent information for other deposits in the area, and the process of developing the same level of information for other deposits would take at least several years. For the proposed refinery and smelter to be viable, there has to be the assurance that the raw material requirements of both can be met, and that is an exercise that cannot be completed given the information that is available for the proposed expansion.

4.2.2 Mine footprint

One of the benefits of expanding an existing mine, versus establishing a new mine is the availability of existing infrastructure and existing land footprint. In the case of MTBM this is especially true of the railway line that connects the mine to the main line. The footprint of that connecting line, and indeed the mine access road, would have to be extended or possibly created elsewhere for the mining of other deposits in the region. Although there will be a need to extend the mine footprint for the expansion including the establishment of haul roads to transport the bauxite, the existing railway line will still suffice for transporting the ore from the mine to the main line (from where it will be railed to other customers).

The potential impacts of extending the mine footprint include:

- direct transformation of the landscape and resultant vegetation and habitat loss,
- additional dust sources
- additional sources of erosion and sediment loading in runoff water
- additional access to areas of forest that would otherwise be more difficult to access
- potential impacts on surface water systems should there be a need to traverse the same with roads and/or railway lines.

4.3 Alternative pit excavation schedule

A third alternative is to reschedule the order in which the various pits will be excavated, and to change the rate at which pits are excavated. In other words, a single pit could be excavated more rapidly, rather than excavating two or even three pits in parallel. The greatest potential advantage of this alternative is reducing the amount of dewatering that would be happening at any one time, and thus reducing the regional groundwater extraction rate, as well as the quantity of water being pumped into the Vorykva River.

Additionally, the existing mine plan counts heavily on the ability to blend material. The single greatest advantage of the new plan is the ability to have maximum flexibility. The concept of maximizing ore from one pit will have a large impact the entire project (mine/refinery/smelter) and the economics of the project. Such flexibility could be accommodated in the future mine plan. At this stage it is not yet clear as to the degree to which an alternative pit excavation schedule is technically and economically feasible, nor the degree to which such a changed schedule will result in reduced dewatering quantities. As such it is not possible at this stage to indicate with any certainty how impacts would be reduced under this scenario.

4.4 Alternative mine layout and schedule

While it is recognized that the mine layout is most fundamentally a function of the positions of the deposits, some alternatives may exist for changing the positions of the siting of the proposed man camps, the haul roads, the overburden stockpiles and perhaps, most importantly, the position of the bridge that will cross the Vorykva River to access the Verkhene-Vorykvinskoya deposit. Alternative positions for the bridge can be used to minimize the risk of increased turbidity and the resuspension of solids within the river during the construction of the bridge and ensure that the bridge is not established in a position of reduced streambank stability.

The positions of the overburden stockpiles can be optimized to ensure that the risk of erosion and sediment loading in stormwater is reduced, especially in terms of minimizing the risk to the Vorykva. This is also true of the positions of the haul roads. In addition the haul road corridors must take account of the barrier they will create to the lateral movement of water. Drainage in the area tends to be poor and any restrictions to the lateral flow of surface water may result in damming of water and resultant forest die back.

Potential impacts can also be reduced by alternative scheduling of the construction of the infrastructure needed for the mine. The bridge for example should be established as far as practically possible during the low flow condition of the river to reduce potential downstream impacts. Also grubbing and clearing should take place during the early winter when the risk of rainfall and erosion is reduced. The risk of erosion will be at its highest during construction of the various infrastructural requirements when the surface will be unconsolidated.

4.5 Mine expansion using Russian technology

The new mine plan relies heavily on Western equipment and technologies. This is due to the reliability and maintainability of the equipment. In the short term, the mine will have to undergo extensive training of new operators (as opposed to manning Russian equipment). The overall benefit of the implementation of Western technology is that the operators will be trained on best equipment available. This will allow for

transfer (if necessary) between operations and an overall better trained workforce. Additionally the Russian equipment (or similar equipment sourced from former Soviet Union countries) used for mining does not meet EU and/or WBR requirements in terms of worker safety, occupational health, effluent treatment and/or disposal and air emissions. This will translate into increased pollution and contamination and different LTI rates due to manning and safety issues.

4.6 Alternative mine capacity (4.0 mtpa)

The ongoing technical feasibility study will further determine whether the expansion should only increase operations to 4.0 mtpa rather than the current evaluation to 6.0 mtpa. It is likely that the viability of a 4.0 mtpa operation will be determined by June 2004. Should the expansion only increase to 4.0 mtpa, it will result in a reduction of key impacts including:

- Loss of biological resources resulting from clearing and general land disturbance;
- The quantity of water that will need to be discharged into the surface water and its impact on the Vorykva River protected area;
- Erosion and drainage impedance risk as a result of a lesser haul road distance
- Dust resulting from stockpiles, mining pits and waste rock dumps; and
- Voids (from disturbed areas).

It should be noted, however, that even if the capacity of the mine were reduced to 4.0 mtpa there would still be a requirement to ensure adequate bauxite quality. As a result the overall mine footprint will not necessarily be reduced in proportion to the reduction in the capacity. If the decision is made to reduce the proposed mine capacity to 4.0 mtpa every effort must be made to minimize the mine footprint accordingly.

The greatest potential benefit of the two or three alternatives that have been described above is reducing the overall mining footprint as well as potential impacts on the Vorykva River. In finalising the mine plan all the alternatives presented here will be investigated to ensure that the overall mine footprint is kept as small as possible. At the same time, any potential impacts on the Vorykva, including pit dewatering, water and effluent discharge, increased risk of erosion, impacts on the river morphology and so forth will also be minimized through the judicious use of the alternatives described above.

4.7 Alternatives to the Komi Aluminium Programme

The Komi Republic is blessed with the ingredients required for an integrated aluminium industry. This includes:

- Ample bauxite deposits in the Timan region;
- Plentiful and cheap gas, important to provide process heat for refining the bauxite into alumina;
- Large quantities of low-cost electricity, needed for energy-intensive process of smelting alumina into aluminium

There is therefore probably an economic and financial case to develop this integrated project but the environmental and social dimension should be properly assessed to implement a sustainable project.

5. ENVIRONMENTAL AND SOCIAL BASELINE

5.1 Introduction

The mine has been operating since 1998 and is currently fully permitted to mine up to 2,500,000 tonnes per annum of bauxite. Baseline studies were originally compiled for a Russian Environmental Impact Assessment (OVOS) that was submitted for SER in 2000. Additionally, the site has maintained an on-site monitoring program that covers the full spectrum of existing impacts. In particular the mine monitors:

- Soils;
- Hydrogeology;
- Surface water hydrology;
- Water quality;
- Vegetation; and,
- Fauna.

In addition to the on-site monitoring, the mine has collected regional data for weather data and sociology up until the end of 2002. All of this data has been collected during the operations and are described in this report.

5.2 Off-site infrastructure

The key off-site infrastructure is the access road and railway line that connect the mine to China'yoryk. The railway line is privately owned and extends for some 157 km and includes a bridge crossing over the Vym River in close proximity to the mine. The railway line is built on a raised embankment that is between 2 and 3 m above ground level. The road is some 160 km between the mine and China'yoryk but it is only the very last section that is limited to mine personnel use only. The road is also built on a raised embankment that is between 2 and 3m above ground level. Finally Timan Bauxite has their head office in Ukhta. All senior management including the mine ecologist, is accommodated at the head office and travel to the mine only on as needed basis. Transport between Ukhta and the mine occurs by motor vehicle, special rail car and/or helicopter.

5.3 Climate

The Middle Timan Bauxite Mine is located at high latitude (64°20'). It has a moderately continental climate with moderately severe winters and cool summers that are formed under the influence of an intense Western transfer under conditions of limited amounts of solar radiation during the winter and heightened amounts of solar radiation in the summer. The transport of the warm sea breeze is associated with the transmission of cyclones from the Atlantic and frequent intrusions of arctic wind from the Arctic Ocean add large instability to the weather during the year – especially during transition times (spring and fall). Additionally, the Timan mountain range and its extension, the Kanin Kamen', provides a noticeable influence on the weather conditions of the region. These influences include: less annual precipitation, average wind speeds are reduced, and there is a change in the windrose (during the course of the year the wind direction is south/southwest). The average annual temperature of the region near the MTBM is negative and is -2.0°C.

Average monthly and yearly temperature for the reference weather station (Levkinskaya) for the last 10 years and for all periods of measurement are shown in Table 12 (the data for long-term monitoring is from the Komi Republic Weather and Hydrology Bureau). The territory has all four (4) seasons with winter being the longest season. The period when the average daily temperature is below zero is for 190-192 days per year. Winter begins (approximately) during the middle 10 days of October and lasts until the middle of the last 10 days of April.

The time period when the average daily temperature is below -5°C is (on the average) from the 30th of October until the 2nd of April (155 days). The time period when the average daily temperature is below –

10°C is (on the average) is more than 120 days (from November 21 until March 20). Extremely cold weather with temperatures less than -15°C lasts 61 days (December 22 – February 18). The coldest months are December thru February. The average monthly temperatures for the last 10 years are -15.0°C, -20.1°C, and -14.2°C, respectively. Stable frozen ground conditions at the mine are observed from October 30 until May 29. The maximum depth of ground freeze (on the average = 1.5 meters) occurs during the last 10 days of March.

Snow cover in the region lasts 204 days. The average day that total snow cover occurs is the 21st of October and lasts until May 4th. The earliest recorded data for snow cover is September 11th. The latest recorded data for snow cover is November 22nd. The earliest recorded data for snow melt is the middle of April. The latest data recorded for snow melt is during the last 6 days of May. The maximum snow cover occurs during the middle 10 days of March (on the average 46 cm). The maximum amount of snow recorded was 73 cm. The minimum amount of snow recorded was 30 cm. Snowstorms occur from October thru April. The average number of days with snowstorms is 38 with a maximum recorded of 61. Most of the snowstorms occur from January until March (averaging 7-9 days with snowstorms per month) and slightly less in November and December (5-6 days with snowstorms per month). October and March have the least amount of snowstorms (2 days per month).

The total number of days with average daily temperatures above zero is, on average, 173 to 175 days per year (from the last 10 days of April thru October 13). The period when the average daily temperature is above +5°C is approximately 120 days (May 25 – September 22). The total number of days with temperatures not dipping below freezing is 89 days (up to 132 maximum days). The intrusion of the Arctic wind is responsible for the frequent and sharp fluctuations of air temperatures and can create delayed springs (as late as June 7th) and early fall frosts (as early as August 8th). Frosts are possible during any of the summer months. The absolute minimum temperatures observed during June – August are -7°C, 0°C, and -4°C, respectively.

Summer is cool and lasts 74 days (June 15 – August 27). During this period, the average daily temperature holds above +10°C. There are 29 days that have an average daily temperature of greater than + 15°C (July 2- 31). The warmest month of the year is July. The average monthly temperature for the last 10 years is +15°C (+14.5°C for long term data). The absolute maximum air temperature recorded is +34°C in June and July. Days when temperature reach + 20°C to + 25°C occur from May until September (an average of 45 days). On the average, there is 1 day in July when temperatures exceed + 30°C.

Average annual precipitation for the region is 541 mm (492 for the last 10 years). The amount of variation of precipitation from year to year varies greatly from the average value. During the driest year only 410 mm of precipitation fell and during the wettest year 576 mm of precipitation fell. The distribution of annual precipitation for the reference weather station (Levinskaya) is shown in Table 12. During the warm periods, most precipitation falls between July and September (66-67 mm monthly) and during cold periods, most precipitation falls in November (42 mm). During the cold months approximately 26-29% of the precipitation falls in the region.

During the course of the year, the dominant wind direction is South/Southwest (20%-22% frequency). The frequency of winds from the north (14%) is slightly more than the frequency of winds from the northeast and east (11%, 10% respectively). During the winter, most of the winds are from the south and southwest (21% and 32% respectively during the season). During Spring and Summer, winds from the south, southwest, north, and northeast are encountered most (frequency fluctuates by month from 11% to 21%).

The average annual wind speed is 2.3 meters per second (m/s). The strongest winds (2.5-2.7 m/s) are noted in March-June, and October. The probability of wind speed is shown in Table 12. Data in inter-yearly wind speed frequency distribution is provided (along with calms data) in Table 14. The probability of calms is high and occurs 21% of the time. They mostly occur in November – January (monthly probability of calms is 24%-29%).

Table 12: Average monthly and yearly air temperatures (°C)

Average Monthly and Yearly Precipitation (mm), Avg. monthly wind speed (m/s)

Near the Middle Timan Bauxite Mine

From the Levinskaya Weather station

Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Air Temperature (°C)	-20.1	-14.2	-7.2	-2.8	4.6	13.0	15.0	11.1	5.6	-1.0	-13.2	-15.0	-2.0
Precipitation (mm)	26.3	22.6	20.1	29.9	43.4	51.4	55.1	80.2	51.0	51.8	28.1	32.1	492.0
Wind Speed (m/s)	2.0	2.4	2.6	2.6	2.7	2.5	2.2	2.2	2.1	2.5	2.8	2.0	2.3

During the year there are, on average, 28 days of fog. During the period from October to March there are 17 days and from April to September there are 11 days. The largest number of recorded days with fog for a year is 50. The average length of fog duration is 3.5 hours.

Table 13: Wind speed frequencies

(% of Total) Near MTBM

Levinskaya Weather Station

Month	0-1	2-3	4-5	6-7	8-9	10-11
I	44.2	35.6	15.7	3.9	0.6	0.04
II	34.0	41.1	19.4	4.6	0.9	
III	28.9	43.0	22.0	5.0	1.1	0.04
IV	29.3	44.2	20.8	5.0	0.7	0.04
V	25.3	44.8	24.2	5.4	0.3	
VI	27.4	48.3	20.0	4.0	0.3	
VII	33.4	47.3	16.8	2.3	0.2	0.04
VIII	34.6	47.0	15.6	2.5	0.3	0.04
IX	37.1	45.6	15.2	1.9	0.2	
X	25.1	50.9	20.4	3.3	0.3	0.04
XI	47.0	37.9	12.8	2.2	0.1	
XII	39.9	42.0	15.0	2.6	0.5	
Year	33.8	44.0	18.1	3.6	0.02	

Table 14: Wind frequency distribution (%)

Month	N	NE	E	SE	S	SW	W	NW	Calm
I	13	12	5	7	21	28	5	9	29
II	9	9	4	8	30	26	8	6	18
III	9	8	7	8	25	28	9	6	14
IV	14	14	9	8	19	16	9	11	14
V	18	11	7	7	11	17	14	15	10
VI	17	16	8	6	14	16	11	12	11
VII	21	14	7	8	18	13	8	11	15
VIII	19	17	18	5	14	17	10	10	15

Month	N	NE	E	SE	S	SW	W	NW	Calm
IX	16	13	7	6	20	19	10	9	19
X	10	7	5	9	21	28	13	7	11
XI	10	8	5	9	20	32	10	6	28
XII	7	6	5	10	31	29	8	4	24
Year	14	11	6	8	20	22	10	9	21

5.4 Ambient air quality

There were never any “true” baseline ambient air quality measurements taken prior to commencement of operations. But, in accordance with a recommendation made by the Head of the Geophysical Observatory (letter No. 1454/25 dated 12/9/96) background concentrations were used based on regulatory requirements for small towns and villages with populations of less than 10,000 persons. The values used for previous impact assessments are provided in Table 15.

Table 15: Calculated background concentrations for MTBM.

Pollutant	Concentration ($\mu\text{g}/\text{m}^3$)
Sulfur dioxide (SO_2)	16
Carbon monoxide (CO)	1.8
Total suspended particulate (TSP)	220
Nitrogen dioxide (NO_2)	39

5.5 Geology

The area around MTBM has been explored since 1969 and consists of the Vorykvinskoya group of bauxites that developed along the axis of the northwest-southeast trending Timan topographic ridge. The deposits have formed on the north eastern flank of an anticline - an arching of the rock layers. Other bauxites, the Svetlinskoye, Valodinskoye and Zaostrovskoye groups are situated to the north west of the Vorykvinskoya group, also located on the northeast flank of the anticline.

The bauxites have formed by very intensive weathering of Pre-Cambrian basement rocks aged between 1300 and 1600 million years old. At the time of weathering, these rocks had already been eroded into a platform with a typical Karstic topography. This is because they consist of dolomites with around thirty percent of clay. Dolomites are carbonates and therefore soluble and their erosion results in a topography with sharply defined platforms, ridges and hollows which, in the Vorykvinskoya region, result in sharp topographic cliffs and a variation in elevation of the buried basement surface of up to three hundred meters.

The bauxite is not a continuous layer but a series of lenses up to ten, but generally around one to three kilometers long and from a few hundred meters to a kilometre wide. The long axis tends to have formed parallel with the anticlinal axis, (i.e., trending northwest). Ridges in the topography in the Devonian times seem to be responsible for the gaps between the lenses. This is not because they actually protrude above the bauxite layer, but is probably because they produced ridges in the water table at the time and bauxite will only form above the water table.

The thickness of the bauxite layer varies up to fifty meters but averages from four to eleven meters for individual lenses. The very thick formations have formed over depressions in the basement dolomite and are up to three hundred meters long and two hundred wide. Elsewhere the thickness tends to vary considerably with the thicker parts also formed over valleys in the basement surface. In cross sections the bauxite appears as an undulating layer of widely varying thickness.

5.5.1 Tectonics

The area of Vorykvinsk group of bauxite deposits is located in southeast periclinal bedding of Chetlass horst-anticline and has a clear two-tier structure: with folded basement, made up of upper riphean substituted and dislocated rocks and sedimentary cover of flat Paleozoic sediments. The lower structural floor includes Baikal folded complex as part of the Bystrinsk series of sediments with total thickness over 5,000 m. The bottom lift rocks are folded and sheared by faulting of northeast, northwest and sub-latitudinal trending into large blocks with different dislocation relative to each other, and general plunge trending northeast.

The Schugorsk anticline is easily mapped by the marker horizon of carbonaceous shales of the Paun suite. The Chetlass series sediments are developed in the fold core, the flanks are composed of rocks of Vorykvinsk and Pavyugsk suites. The western limb of the fold is flatter, dipping from 10-15 to 30-45°, while the eastern limb of the fold is steeper, dipping from 15-20 to 60-70°. Anticline is complicated with folding of a higher order.

The Vorykvinsk syncline adjoins the Schugorsk anticline from the west and allows good mapping only in the northwest part of the deposit on intersected in the core phyllitic and carbonaceous shales of the Paun suite. The Vorykvinsk and Pavyugsk argillaceous-carbonate rocks dip from 5 to 30° on the syncline flanks. The fold plunges are undulating. The axis trending changes from northwest in the northern area of the Vorykvinsk ore field to north or northeast in the southern area of the Vorykvinsk ore field. The bottom floor is broken by a series of subparallel faults, running like upthrusts with fault planes dipping southeast at 70-30°.

5.5.2 Geochemical composition

In addition to bauxite, the deposit contains a range of other minerals which are summarized in Table 16.

Table 16: Partial listing of average chemical composition within the deposit area.

Component	% by weight	Component	% by weight
Al ₂ O ₃	49.03	K ₂ O	0.23
SiO ₂	8.77	P ₂ O ₅	0.22
Fe ₂ O ₃	22.00	Ga	0.0067
FeO	3.42	V ₂ O ₅	0.043
TiO ₂	2.78	Na ₂ O	0.13
MgO	0.52	C	0.10
MnO	0.31	CO ₂	0.34
CaO	0.34	S _{total}	0.02

5.6 Soils

Soil cover is formed primarily on morainic glacial, sandy-loam sedimentation. Additionally, there are other parts that are even sandier. On those sections, where bedrock daylights, the soil types are elluvial-deluvial sedimentations of bedrock. These sedimentations are represented as sandy loams and loams, including detritus and splinters of bedrock. The thickness of the soil layer is 30 centimetres and greater. On the morainal sandy loams are developed combinations of gleyey podsols and peatey podsols. Peatey soils are present in the upper and lower reaches of the valley. The riverbeds are developed alluvial-turf and alluvial-peatey soils.

The gleyey podsolic soils are formed under conditions of good drainage of the sandy loamy soils in the pine groves. The soil profile of the gleyey podsolic soils is divided into:

- Thin layer of coarse humus horizon (A0) with a thickness of 4-7 cm;
- Gleyey podsolic horizon (A2G) of 6-8 cm;
- Illuvial horizon (B) is brown, compact clods;

(C) horizon is more compact and differentiated by structure and colour.

The chemical composition of the gleyey podsolic soils are characterized as acidic and a presence of iron in the A2G horizon. The gleyey podsolic soils form in combination with peatey-podsols-gleys and peatey-podsols-clay soils which develop in the lower elevations under conditions of poor filtration. The overall soil structure is shown in Figure 9.

5.7 Hydrogeology

The aquifer units from the youngest to the oldest comprise:

- Quaternary unconsolidated sediments
- Carboniferous sediments (mainly limestones)
- The Mid Devonian rocks comprising volcanogenic, terrigenous and residual soil horizons including the bauxite.
- The basement rocks comprising the Riphean dolomites and Chetlasskaya and Anyugskaya metamorphic rocks (Figure 10).

5.7.1 Quaternary aquifer

The Quaternary sediments range in thickness from 0.5m on the higher ground of the watershed (areas 1 and 2) to around 15m on the slopes (areas 3,4 and 6) and over 40m in the valleys (area 5). The composition varies from clays to gravels and the coarser sediments tend to be in the river valleys. The coarser sediments also get thicker to the east where they overlie the carboniferous rocks. There are perched water tables in places but the unit is generally permeable with water levels from surface in the river valleys to depths of up to 50m on the higher ground. Groundwater flow is to the south in a similar direction to the surface water flow.

Pumping tests show that the greatest infiltration potential is adjacent to the Vorykva River in the coarse sands and gravels. The alluvial sediments have a direct hydraulic connection with the underlying dolomites of the basement in the area of the river but further south no connection was determined when pumping from the dolomite, although regular borehole observations show there is a connection around orebody 5. It can be concluded that there are areas of poor vertical connection but overall, the two units will be hydraulically connected for dewatering purposes in the western and northern sections but not connected to the south and east where the thickness of the terrigenous sedimentary bed increase to the east.

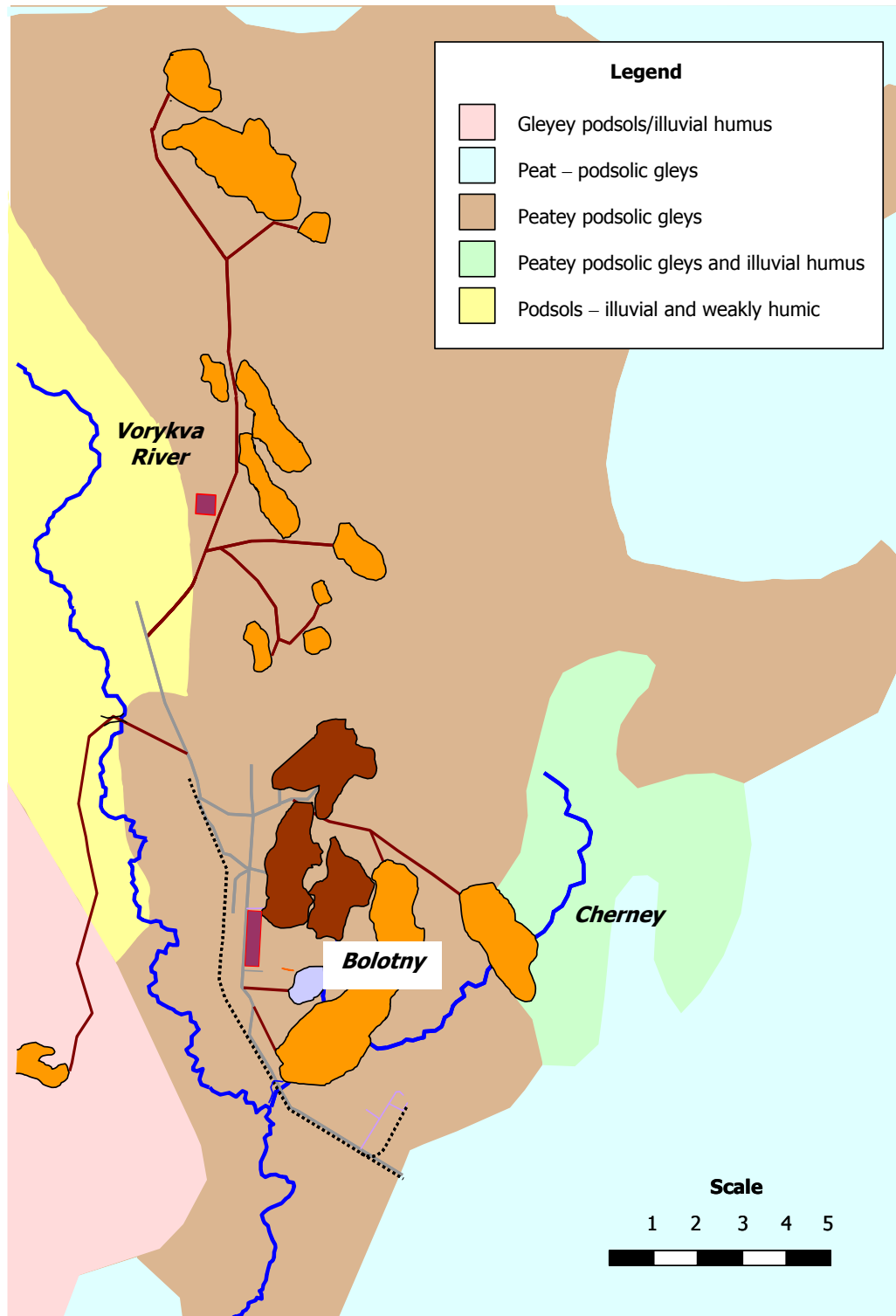


Figure 9: Map showing the distribution of soils in the area that will be effected by the proposed mine expansion.

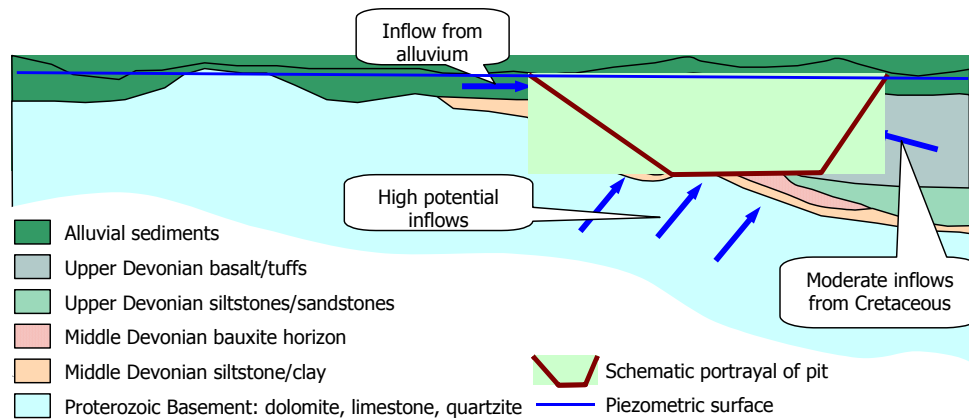


Figure 10: Schematic illustration of the various inflow potentials of ground water into the pits

The hydraulic connection from the Vorykva River itself to the alluvial sediments, is variable and often restricted by clays and silts. The river levels and aquifer water levels correspond under hydrostatic conditions but actual leakage has not been quantified. The quaternary aquifer is recharged from rainfall as well as from the underlying artesian aquifer and discharges to the rivers in the lower, marshy ground.

5.7.2 Carboniferous aquifer

The carboniferous sediments lie in the eastern part of the deposits and comprise limestones, dolomites, claystones and marls. They increase in thickness from zero in the area of suboutcrop on the western side and progressively thicken to 350m to the east. Basalts in turn underlie these rocks.

5.7.3 Devonian rocks

There are three units, namely the volcanogenic formations, terrigenous sediments and the residual soil formations. The volcanogenic formations and the terrigenous sediments increase in thickness eastwards from zero to a total depth of around 340m. There appeared to be no hydraulic connection between them and this is illustrated by the different piezometric levels between them. The volcanogenic formations are basalts and tuffs, which vary significantly in their aquifer characteristics. Some of the basalts are massive with low fracture permeability and some of the tuffs are high porosity (up to 34.9%). The thickness of all the formations increases to the east. Borehole yields are variable and specific yields range from 0.49 l/sec to 2.49 l/sec. The water is a calcium-magnesium bicarbonate with a TDS of 146-250mg/l.

The terrigenous formations comprise clayey sediments at the base of the volcanogenic rocks and form local confining horizons. The permeability is variable and borehole yields tend to be lower than the other formations. It appears that there is overall hydraulic connection between the Quaternary aquifer and the underlying Devonian aquifer and down to the basement aquifer. The water is a calcium-magnesium bicarbonate with a TDS of 127mg/l.

The residual soils include the bauxite ore horizons and they vary in thickness from 0 to 70m and are irregularly distributed across the area. The lithology is very variable depending on the nature of the original rocks and range from clayey materials to gravel and sand. The underlying dolomites tend to decompose to clayey products. The variability of materials also result in a wide range of permeability giving borehole yields ranging from 0.3 l/sec to 9.2 l/sec. There is hydraulic connection above and below. The water is a calcium-magnesium chloride/carbonate type with a TDS of 146 to 166mg/l.

The basement rocks comprising dolomites and limestone appear to have a wide range of hydraulic conductivity. Although not clear from the initial review, the limestone is likely to display high hydraulic conductivity along the line of the major structures.

5.7.4 Basement rocks

The Riphean Bystrinskaya carbonate rocks form the most extensive and important aquifer as it cover the whole area except the extreme southern, eastern and western parts where they are faulted out against the Chetlas and Anyuga metamorphic rocks. These faults behave as barrier boundaries to the artesian aquifer. The carbonate unit comprises dolomites, limestones and carbonaceous schists and is 1100 to 1200m thick and subcrop close to surface to the west of the deposits but dip down to the north-east, east and south east, giving a progressively thicker cover of weathered clastic rocks and basalt over the bauxite units. These basement rocks are fissured and karstic although the greatest karst development is in the area where there is some cover by the quaternary sediments and where the basement surface starts to drop down to the east.

All the rock units appear to have some hydraulic conductivity, although the basement limestones and some of the karstic carboniferous limestone to the east, are generally much higher permeability and provide the majority of potential inflows. The permeability of the limestone does decrease at depth towards the east which will tend to reduce groundwater flows from the east when dewatering. The most permeable zones are in the upper 100 to 200m of the formation and piezometric levels are close to surface. This means that the potential piezometric head in the east where the basement is under deep cover, will be around 350m (borehole cluster 12 in ore zone 8). The Transmissivity and borehole yields are variable. Transmissivity is around 5,000 to 6,000m²/day close to the Vorykva river and in the central part of the ore deposits but decreases to 2,200m²/day in the east and 120m²/day in the south.

Although there are places where the aquifer is confined and gives true artesian pressures, the aquifer is generally hydraulically connected to the overlying aquifers. The water of the basement aquifer is a calcium magnesium carbonate type with a TDS of 189 to 274mg/l with a pH of 6.65 to 8.18. The basement aquifer is the main source of water for mine dewatering.

5.7.5 Aquifer characteristics

The various lithological units are generally permeable and have a wide range of hydraulic Conductivity. The transmissivity will also vary according to the aquifer thickness and permeability.

5.7.6 Piezometry

The available records show that the general groundwater level is fairly flat. This means that it is very close to ground surface in the lower lying ground but up to 50m below surface on the higher ground. The indicated groundwater level is in the basement rocks or the overlying, thin quaternary sediments in the western part of the area. Close to the rivers, the quaternary thickens up to 40m in places and potentially provides direct hydraulic communication between the river and the basement aquifer.

Test work has shown that the river is 'perched ' above the groundwater level in areas to the north but this is less clear in the lower ground to the south except that drilling in group test 2 suggested that the borehole was artesian when penetrating the basement rocks through the alluvium. Further east, the basement rocks are confined by the lower permeability weathered rocks and the bauxite unit. This confinement is clearly illustrated by the drilling records, which show that the majority of the boreholes drilled through the Devonian and carboniferous rocks, intersect the main water at the base of the bauxite or weathered unit, as the borehole intersects the basement. The piezometric pressure then rises to near surface and in some holes is slightly artesian and flowing at the surface.

It is clear therefore that ore deposits 1, 2, 7 and part of 3 are above the water table and groundwater inflows will be limited to local recharge to the more permeable horizons. There is a potential for gravity drainage from various horizons overlying the bauxite but more importantly, the confined nature of the basement aquifer below the remaining ore bodies means that there is a potential for floor heave and inflows through pit floors in some areas, where there is insufficient thickness of low permeability material to counteract the head in the basement. From a volume and pressure point of view pre-dewatering ahead of mining will be

necessary to mine safely.

The overall ground water flow in all the aquifers is generally southwards with some flow to the west and the east conforming to the surface drainage. The rivers receive groundwater in the river valleys, which are characterised by extensive marshy areas, pools and springs. The natural hydraulic gradient varies from around 0.003 in the north to 0.0007 in the south.

5.7.7 Aquifer boundary conditions

Hydraulic boundary conditions will govern the availability of groundwater as well as govern the extent of possible drawdown effects in the region. To the east of the mining area, the basement dolomites dip down below a cover of Palaeozoic rocks and rapidly reduce in permeability. They are eventually faulted up against the schists, which should restrict the flow of water from the east.

To the west, the Vorykva River provides a recharge boundary within the alluvium and underlying basement rocks, but further to the south-west and south east, there is a non permeable barrier against the basement rocks. To the north, there are no specific hydraulic boundaries in the basement rocks. The Palaeozoic rocks are good aquifers although lower permeability than the basement dolomites. They subcrop near the Vorykva river and dip and thicken to the east. The bauxite horizons are at the base of this unit and together with other low permeability materials, provide a reduced permeability. This means that the effects of dewatering the Paleozoic rocks will probably be limited west of the subcrop.

5.7.8 Water chemistry

The groundwater of all the aquifers is a calcium magnesium carbonate type with a Total Dissolved Solids (TDS) generally between 100 to 250 mg/l and is suitable for drinking and industrial use. The groundwater in the Carboniferous sediments is also a calcium magnesium type but with a higher TDS of 478mg/l and is suitable for drinking and industrial purposes.

Depending on the distribution of water quality across the site and the receiving water quality requirements for discharging the dewatering water, there may not be any significant constraints on separating the water abstracted from the dewatering boreholes. This means that there should be no particular requirements for chemical treatment of water abstracted from the dewatering system, before discharging to the river.

5.8 Surface water hydrology

The surface water bodies near the site consist of the upper reaches of the Vorykva River (a right tributary of the Vym River) a left tributary of the Vorykva and two streams, the Cherney and the Bolotny, which flow into the Vorykva. The Vorykva River, Cherny and Bolotny are all categorized as small, relatively flat, waterways but their ecological importance is significant. The waterways are further described in the following paragraphs.

The Vorykva River begins on the southern slopes of the Chetlassky Range and flows south past the existing site. As it passes west of the existing site, it defines the boundary for the zone of impact for approximately 34 kilometers. The overall length of the river is 174 kilometers and the total catchment area is 256.4 km². The river has a total elevation loss of 68.6 meters giving an average slope of 0.002 km/km. The river channel is very winding (with a coefficient of sinuosity of 1.66) and can reach widths of up to 10-15 meters (on the average the width is 5-8 meters). The height of the banks does not exceed 1 meter.

The riverbed consists of boulder/pebbly sedimentation with patches of sand/pebbly areas. The depth of the river during low flow does not exceed 0.7 meters however there are pools that are as deep as 1.5-2.0 meters. The water level and flow characteristics are dependent on climatic characteristics and surface water runoff. These variables are cyclical and are dependent on the time of the year. Therefore, the river has various cycles (spring runoff, summer low flow periods, and winter ice covers). Spring runoff typically begins in the last ten days of April and lasts for approximately 2 months. During this time, the river peaks and ebbs

based on the amount of snowmelt and rainfall. Similarly, the summer/fall low flow period is unstable due to the extreme variations caused by rainfall events. Ice appearance has been noted to occur during the middle ten days of October with a total ice cover occurring in November (when temperatures drop below -15 °C).

The river velocity during summer low-flow is 0.3 to 0.74 meters per second (m/s). The minimal average monthly flow (95th percentile) for the winter is 0.43 m³/s. The minimal average monthly flow (95th percentile) for the summer is 0.72 m³/s. The Cherny is a small stream that constitutes a left tributary of the Vorykva River. It intersects the left flank of the bauxite deposit and confluences with the Vorykva River 33.3 kilometers from the Vorykva headwaters. The entire length of the creek is 13.7 kilometers with a total catchment area of 53.4 km². The Bolotny is in turn a right tributary of the Cherny.

5.9 Surface water quality

The water quality of the streams near the mine is dominated by magnesium or calcium but in general the total mineralization of the streams does not exceed 0.1-0.3 grams per liter (g/l). The mineralization in the Vorykva River exhibits seasonal fluctuations, but remains largely consistent along the length of the river. Mineralisation peaks in the middle reaches of the river at some 452.95 mg/l during the summer months). The lower reaches of the Vorykva River indicated similar conditions with total mineralization between 177 mg/l (spring) and 328 mg/l (summer) and a pH between 7.8 and 8.48.

Water quality for Cherny Creek is similar to the water quality in the Vorykva River. The total mineralization ranges from 0.03-0.5 g/ml. The water is very soft and has a pH ranging from 6.9-8.3. There have been some exceedances of the Maximum Allowable Concentrations for iron (as high as 0.9 mg/l) in the upper reaches of the creek and petroleum products (up to 1.34 mg/l) during summer low-flow periods.

Table 17: Surface water quality for Vorykva River

Indicator	MAC (mg/l)	Background (2002)		EC Standards (mg/l)
		High Flow (mg/l)	Low Flow (mg/l)	
Total mineralization	1000	60	182	
PH	6.5-8.5	7.1	8.1	6-9
COD (mg O ₂ /ml)	<15	-	5	
Suspended solids	10	<2	1.7	25
Petroleum products	0.05	0.039	<0.05	No visible film on surface water or produce harmful effects in salmon
Ca	180	-	25	-
Mg	40	-	25	-
Na	120	-	4.4	-
NH ₄ (N)	0.5(0.4)	0.1	<0.05	0.04
Iron _{Total}	0.1	0.21	0.23	-

Indicator	MAC (mg/l)	Background (2002)		EC Standards (mg/l)
		High Flow (mg/l)	Low Flow (mg/l)	
NO ₂ (N)	0.08(0.02)	-	0.02	0.1
NO ₃ (N)	40(9.1)	-	0.22	-
Cl	300	-	0.66	0.005
SO ₄	100	2.7	1.2	-
Al	0.04	<0.01	0.04	-
Mn	0.01	-	0.01	-
Cu	0.001	0.003	0.001	0.04
Ni	0.01	<0.002	ND	-
Zn	0.01	0.009	ND	0.3
Pb	0.006	<0.005	ND	-
Cd	0.005	<0.0005	ND	-
Sr	0.4	-	0.01	-
Ba	0.74	-	0.03	-
Cr	0.02	0.014	0.004	-

All of these values are similar to the long-term monitoring that has been conducted at the various posts along the Vorykva River. Water quality for the Cherny is similar to the water quality in the Vorykva River. The total mineralization ranges from 0.03-0.5 g/ml. The water is very soft and has a pH ranging from 6.9-8.3. There have been some exceedances of the Maximum Allowable Concentrations for iron (as high as 0.9 mg/l) in the upper reaches of the creek and petroleum products (up to 1.34 mg/l) during summer low-flow periods.

5.10 Vegetation

The investigated area is characterized by a dominance of pine forests and marshland. Of the total area, almost all of it is characterized as pine forests (more than 94% of the forested area). A characteristic of the pine forests is that the ground cover contains species such as cowberries, Bog bilberries and cloudberry, which are typical for marsh shrubbery. There are also species present that are unique to tundra ecosystems. The northern taiga spruce forests are naturally mosaic (with patches of shrubs, mosses, and different distributions of flowering vegetation and mosses) and extremely non-uniform. The landscape is dotted with varying combinations of mosses, lichens, shrubs, grasses, and groves of trees. The type of moss-spruce forest is dependent on the shrubbery present and can be divided into:

- Mixed shrubbery;
- Bilberry;
- Black crowberry/bilberry;

- Cowberry;
- Black crowberry/cowberry; and,
- Bog bilberry.

The major types of trees that dominate each terrain are described in the following sections.

5.10.1 Birch

Overall, forest groves that can be characterized with birch being the dominant feature make up 3% of the entire of the vegetation composition. Forest groves that are composed purely of birch trees are rare near the site. Normally, they are interspersed with spruce trees and have commercial value. Most birch groves are typically found in combination with bog vegetation, in combination with spruce and underlain with peat moss and/or grasses. Along the areas near the river terraces, birch forests have ground cover consisting of green moss species.

5.10.2 Pine

Pine dominated forests occur typically in the low-lying areas and the middle reaches of the property. It is rare that a pine-dominated forest is found at the higher elevations. Pine dominated forests also make up only 3% of the entire ground cover. Along the drainage passages, pine forests are often interlaced with spruce trees.

5.10.3 Marshlands

Marshlands make up slightly more than 10% of the territory around the site with the number increasing slightly to the northeast of the site. Marshy vegetation is often characterized by an abundance of shrubbery with underlying berry bushes. Additionally, the marshlands are often covered with the lichens and mosses typically found in the northern taiga.

5.10.4 Meadows

Meadows are not found in great abundance around the minesite. The most prominent areas are found along the thin, level belts of the catchment of the Vorykva River. Additionally, meadows can be found as the 1st level revegetation after an area has been denuded for production. This means that some areas around the wasterock piles can be classified as meadows. It is anticipated that it will take in excess of 20 years for a representative distribution of species of vegetation return to these areas.

5.11 Rare or endangered floral species

Most of the rare or endangered species within the Komi Republic are located south of the project area. Nonetheless, it is possible for several species to grow within the ecosystem of the Vym and Vorykva River basins. Species that could be found within these regions are listed in Table 18.

Table 18: Rare or endangered floral species that could potentially be located within the impact area of the MTBM.

Species		Status ^A Type	Ecosystem	Limiting Factors
Vascular plants				
Catchfly (Silene nutans L.)	4(1)	Meadows, birch waterways Rocky areas		

Quarrier (<i>Saxifraga sibirica</i> L.)	3(R)	Rocky areas/tundra	Natural resource development construction
Common Milkwort (<i>Polygala vulgaris</i> L.)	3(R)	Meadows/shores waterways	Agricultural development (hayfields)
Dragonhead (<i>Dracocephalum ruyschiana</i> L.)	3(R)	Meadows/rocky areas	
Epipactas (<i>Epipactus atrorubens</i> Bess.)	2(V)	Coniferous forests Mixed forests Shrubby areas/ rocky areas	Forestry Resource development/ recreation
Meadow calypso (<i>Calypso bulbosa</i> L.)	2(V)	Coniferous forests Banks of waterways	forestry recreation
Bogflower (<i>Nymphoides peltata</i> O. Kuntze)	4(1)	Marshes/meadows Water edges	amelioration plowing
Ural Gypsophilia (<i>Gypsophalia uralensis</i> Less.)	2(V)	Water edges Rocky areas/ tundra	Natural resource development. construction
Peony (<i>Paeonia anomala</i> m.)	2(V)	Mixed coniferous Mixed forests/meadows Water edges Rocky areas	Forestry/plowing Natural resource development recreation
Bryophyta			
Crestfish (<i>Lophozia ascendens</i> (Warnst. Schust).	3(R)	On tree rot In pine forests or pine/birch combinations	forestry
Cephalozia macounii	2(V)	On tree rot Mixed forests	
Cephaloziella elachista	3(R)	In hummocky areas Grassy marsh areas	amelioration

Seligeria trifaria (Brid.) Lindb.	4(1)	In humid cool places	Natural resource development
Schistostega pennata Hedw.	3(R)	Silty areas Coniferous and mixed Forests	Forestry
Scleropodium ornellatum	3(R)	In spruce forests Water edges	

3(R) is rare species with a small population with a thin environmental amplitude

2(V) rare, vulnerable species with very small numbers

4(1) species of undefined status requiring more study.

5.12 Ichthyology

The ichthyofauna (excluding Agnathas) of the Vym River basin consists of 20 different species from 9 different families. These include:

Sterlet	Common Dace	Bream
Atlantic Salmon	Ide	Bearded Loach
Nelma	Urasian Minnow	Burbot
Siberian Whitefish	Chub	Perch
European Grayling	Gudgeon	Ruffe
Pike	Bleak	River Bullhead
Roach	Crucian Carp	

The composition of fish listed above is fairly typical for mountain streams along the Western and Southern slopes of the Timan mountain range. Additional characteristics that can impact the diversity of a fish population within this region include geomorphology, hydrological characteristics of the stream, and adaptability of each fish species to the unique environmental habitat of the study region.

The lower regions of the Vym River are dominated by carp and perch while the core of the middle and upper sections is the Atlantic Salmon (this is considered to be the fish that has the greatest economic value to the waterway). Additionally, the amount of European Graylings and Siberian Whitefish in the upper reaches of the Vym River varies greatly depending on the feeding habitat. A more detailed study was completed in 2003 for the upper reaches of the Vym and Vorykva rivers.

5.12.1 Migration patterns

Fish that migrate include the Atlantic Salmon and the Siberian Whitefish. The Nelma also ascends the Vym River for reproduction but via the Vychehda and the deltas of the Severnaya Dvina, where it feeds. The spawning migration of these species occurs in September (the beginning of low-flow is usually during the last

10 days of August but is weather dependent).

The Atlantic Salmon spawns at nesting sites that are typically gravel bottomed depressions in the main branch of the river. The newly hatched salmon (known as alevins) emerge in May or June of the next year and remain in the rapid water sections of the river until they are 65mm long. After 3 years the salmon are ready to return to the sea while other species migrate during their 1st year of life. A part of the Nelma and Siberian Whitefish remain and forage within the lower reaches of the river.

The indigenous species of the river also migrate (to a very small degree) during the course of the year for foraging, spawning, and wintering. These species tend to spawn in October and live nearby the nesting area until the eggs hatch. The exception is the non-migratory Whitefish that nests in Spring, right after ice break-up, in the upper reaches of the river and returns in the Fall to the lower reaches for wintering and foraging.

5.12.2 Spawning habits

Within the River Vym and its tributaries, there are two types of fish spawning habits. The 1st type is the fish that spawns in the spring during ice break-up (up until the middle of June). This includes the European Grayling, Sterlet and the Bream. The 2nd group is fish that spawn in October. This group includes the Atlantic Salmon, the Nelma, and the Siberian Whitefish.

The spawning areas for the middle and upper reaches of the Vym River are located 244-406 kilometers from the mouth and includes: the Kedva, Koin, Ropcha tributaries as well as potentially the Chin'yavoryk, Pyvva, Elva, Chisva, E. Vidz'yu, and the Pok'yu tributaries. The migratory Siberian Whitefish nests approximately 162-172 kilometers from the mouth of the Vym River and spawns in areas with a sandy bottom and slow moving currents (up to a depth of 2 meters). The Nelma nests anywhere up to the Koin confluence while the European Grayling nests with the main river as well as its tributaries on rocky/gravelly ground.

5.12.3 Fisheries categorization

Due to the presence of the Atlantic Salmon, as well as other species (Nelma, Siberian Whitefish, and the European Grayling), the Vym watershed has been classified as a Category I Fisheries (in accordance with GOST 17.1.2.04-77). The significance of this waterway as a Category I Fisheries is underscored by the fact that there is also an ichthyological sanctuary (*Vymski State Ichthyological Reserve (VSIR)*). The reserve serves to protect the habitat of the various fish species described above. The following activities are prohibited within the area of the reserve⁸:

- Commercial fishing
- Commercial forestry
- Any land disturbance
- Storing and or using poisonous substances such as chemical fertilisers and/or pesticides without special permission
- Disposal of industrial and municipal waste
- Discharge of *untreated* industrial and municipal liquid waste into 'ground waterways'
- Construction of 'capital' tourist facilities

The provisions of the reserve allow a range of recreational activities including the gathering of berries and mushrooms, 'haymaking', sport hunting (in accordance with rules governing hunting), sport fishing using a fishing rod in specially demarcated areas, establishing tourist paths and the use of small boats on the river. A special provision is also made within the decree, for the ongoing operations of the MTBM including transport infrastructure, geological surveys and mining using *'the most environmentally friendly technologies and*

⁸ As defined in the *Annex to the Decree of the Head of the Republic of Komi, 16 January 2001*

methods, in accordance with the requirements of the current legislation and having a positive SER conclusion'.

Although effluent discharge into the rivers is not expressly prohibited, it is clear that the spirit of the provisions is to protect the ecological integrity of the reserve and maintain an aquatic environment that supports the fish populations that are found in the river. To this end any impacts arising from expanded mine operations that threaten fish diversity and/or populations in the reserve should be considered significant. In the sections that follow impacts that may have a bearing on the sustainability of fish diversity and populations are described, including:

- Changes in river system hydrology (flows)
- Changes in river hydraulics (altered energy loading and changes in sediment transport and channel dynamics)
- Changes in the physical (especially temperature and sediment loading), chemical (mineralization and other possible pollutants) and nutrient properties of the river.

Based on the protection status of the Vorykva river and its tributaries under the VSIR, it appears not compatible to discharge important quantities of pumped groundwater, water runoff and effluents to the Vorykva.

Based on the classification of the river and the closeness of the ichthyological reserve, it can be stated that all the fish are protected within this watershed. Additionally, the River Bullhead is listed in the Komi Red Book and the Russian Red Book.

5.13 Fauna

The Komi Republic is a large area with concentrated population densities. It is home to a large variety of birds and animals. This includes several rare and endangered species. The area around the site is much less attractive as a habitat (due to noise and other existing impacts) but may contain some of the species listed below.

5.13.1 Birds

Birds use the area as a habitat (nesting), hunting ground, migratory route, and wintering area. Of the 112 species of birds identified during field surveys and literature studies, there is (1) Gaviiformes; (19) Anseriformes; (12) Falconiiformes; (4) Galiformes; (1) Gruiformes; (13) Charadriiformes; (1) Columbiformes; (2) Cuculiformes; (7) Strigiformes; (1) Apodiformes; (3) Piciformes; and (48) Passeriformes. Of the bird species present, there are (13) species that are protected under the Komi Republic Red Book which are mentioned in Table 19.

Table 19: Birds that could potentially be impacted that are listed in the Russian Red Book

Lesser White-fronted Goose	Common Crane
Whooper Swan	Great Snipe
White-tailed Sea Eagle	Snowy Owl
Golden Eagle	Northern Eagle Owl
Peregrine Falcon	Great Gray Owl
Osprey	Ural Owl
Willow Ptarmigan	

5.13.1.1 Bird densities

The primary habitat near the site for birds is the spruce forests and the forests of mixed spruce and birch. Approximately 40 species of birds with an average density of 250-300 head per square kilometre can be noted in this type of habitat. Based purely on numbers and species type for all types of habitats found near the mine, Passiformes are dominant. Based on biomass, Galliformes are dominant. The region near the mine hosts a greater number of commercially valuable birds (5-6 times greater) than other regions of the Komi Republic.

5.13.1.2 Migratory routes

The Spring migration of birds along the valleys of the Vym and Vorykva Rivers begins in the middle of April thru May. Fall migration begins during the middle days of August and lasts until the end of September. There are several species that migrate as late as October. Most of the migrating birds use the large marshlands and river catchments that connect with the Vycherogosky and Pechorsky basins for rest and eating during their migration route. The Spring and Winter migration routes in relationship to the existing site are shown in Figure 11.

5.13.2 Amphibians and reptiles

The area around the mine site is habitable to three species of amphibians, 1 species of reptiles and 35 species of mammals. There are an additional 112 species of birds that could potential be affected by the mine expansion due to impacts to their habitat, impacts to migration routes, or impacts to their nesting potential. The amphibian and reptile species are:

- The Siberian Salamander;
- The Moor Frog;
- The European Common Frog;
- Common Lizard



Figure 11: Bird migratory routes.

Of these species, the Siberian Salamander is listed as a Komi Republic Red Book species (but not endangered by IUCN designation).

5.13.3 Mammals

Mammals typically avoid population centres and stay in areas with less noise (e.g., away from the existing operations). Within the region, a large number (35) of mammals can be found. The 35 species of mammals include both large and small animals of commercial value. The list is presented in Table 20.

Table 20: Mammals that could potentially be found within the impact area.

European Mole	N. Birch Mouse	Marten
Eurasian Common Shrew	Field Mouse	Wolverine
Masked Shrew	Muskrat	Ermine
Pygmy Shrew	Bank Vole	Least Weasel
Eurasian Least Shrew	Red-backed Vole	European Mink
Equal-toothed Shrew	Wood Leeming	Otter
N. Water Shrew	Water Vole	Northern Lynx
Northern Bat	Tundra Vole	Moose
Arctic Hare	E. European Vole	Wild N. Reindeer
Eurasian Flying Squirrel	Wolf	N. Marten
Red Squirrel	Red Fox	Squirrel
Siberian Chipmunk	Grizzly Bear	

Of these species, the European Mink is listed as both a Komi Republic Red Book species and protected under IUCN designation.

5.13.4 Mammal densities

The presence of many of the species listed above at the proposed site expansion is unlikely due to the existing impacts and availability of other more suitable habitat within the region. Nonetheless, because the site falls within the contour of known habitat, the site is included in the “potential habitat”. For the smaller mammals, a field survey was completed. For the larger mammals, data was collected for the entire region and extrapolated across the site. For most species, the numbers vary from year to year based on the conditions of the area and the availability of suitable foraging areas. Tables 21 and 22 list the densities of small and mammals throughout the region.

Table 21: Small mammal densities in the upper catchment area of the Vym River

Species	Captured/100 days	Head/km ²
Red Backed Vole	1.73	250

Species	Captured/100 days	Head/km ²
Bank Vole	0.17	25
Tundra Vole	0.40	60
East European Field Vole	0.10	15
Northern Birch Mouse	0.01	1
Eurasian Common Shrew	0.50	60
Pygmy Shrew	0.03	3
Common Shrew	0.01	1
Total	2.95	415

Table 22: Large mammal densities (head/1000 ha) in the Knyazhpogost Region^A

Species	Limits	Avg.	Notes
Marten	0.14-0.57	0.32	Has commercial value
Wolf	0.003-0.064	0.022	
Ermine	0.40-1.34	0.77	Found throughout entire region. Has large population variations by year
Least Weasel	-	1.8	Found in forested areas and river catchment areas
Grizzly Bear	-	0.08	Can be found throughout taiga in older forests
Moose	0.57-1.45	0.88	Largest mammal found in the region
Squirrel	0.24-11.42	5.32	
Northern Lynx	0.006-0.043	0.03	Rarely seen within the region
Wolverine	0.003-0.026	0.02	Common, but rarely seen.
Red Fox	0.07-0.18	0.125	
Reindeer	0.04-0.152	0.097	Average is low but project region is above average
Arctic Hare	5.58-1.09	2.87	
European Mink	-	0.2	Found in river beds and rarely found at site

^AData provided by the Hunting Division, Komi Republic

5.13.5 Endangered species

There are 15 species that are listed in the Komi Republic Red Book (endangered or protected). Of these, one is an amphibian (Siberian Salamander), one a mammal (European Mink), and 13 species are birds. The following section provides a description of habits, range, and distribution of the endangered and/or protected species.

5.13.5.1 *Siberian Salamander*

The Siberian Salamander possesses a very wide geographical range (12 million km²) and lives in Russia, the north of Kazakstan, Mongolia, China, Korea, and Japan. The northern margin of the range extends from the Russian Plain (Arkhangelsk Province) eastwards to the Arctic part of the Urals (Tyumen Province) through the south of the Taimyr Peninsula (Krasnoyarsk Region) to the north of Yakutia and the Chukotka peninsula. The southern margin of the range runs from the north-east of Kostroma Province through Kirov and the Perm Provinces of Russia to the southern Urals and Northern Kazakstan.

The species inhabit wet conifer, mixed, deciduous forests in the taiga zone and riparian groves in tundra and forest steppe. At the margins of its range, the existence of populations depends on the presence of permanent stagnant pools in the valleys of rivers. The species is most numerous in the taiga; population sizes may reach a few thousand animals. The abundance of species seems to decrease gradually southwards and northwards, attaining the lowest level in the tundra and steppe zones. Populations of the Siberian Salamander are in relatively safe condition on the major part of its range. They are most in jeopardy in the extremal conditions of the tundra, forest steppe and steppe. The species is listed in the Komi Republic Red Book but is not listed with the IUCN (Red List).

5.13.5.2 *European Mink*

The European Mink is found in densely shaded banks of fresh water creeks, rivers and lakes. They are trapped for commercial purposes and have thus, declined due to ecological and commercial purposes. They are found throughout Europe. They are now considered endangered by both the Komi Republic Red Book and IUCN.

5.13.5.3 *Lesser White-fronted Goose*

The Lesser White-fronted Goose is found in wet tundra lowlands and forest tundra; on sea-shores and inland bodies of water in various habitats during migration. It is the most common goose in Russia. It nests in areas of low-bush tundra with many lakes and rivers. It builds nests on dry sites; high river banks and small hills. The range and distribution of the Lesser White-fronted goose is the tundra and forest tundra in European and Asian regions of Russia. In winters it can be found in Western Europe, West Asia, China and Japan.

5.13.5.4 *Whooper Swan*

The Whooper Swan inhabits lakes of forest tundra and taiga. It is a migratory bird that stays near the coast during migration. They nest in pairs in remote, large lakes. The range and distribution of the Whooper Swan is the northern regions of European Russia, Western and Eastern Siberia (except tundra zones). There are also isolated colonies known on the lower Duna and Dnieper rivers, on the northern shores of the Caspian sea, in Kazakstan, Mediterranean, Iran, India, and southern China. It is forbidden to hunt the Whooper Swan and it protected in the Komi Republic Red Book.

5.13.5.5 *White-tailed Sea Eagle*

The White-tailed Sea Eagle is found in a variety of habitats from tundra to desert, but prefers to be near water. It can be found most often in river valleys, sea-and lakeshores with trees or rocks. It is non-migratory or nomadic – except in the north. It builds massive nests that are placed high in trees that are used for many years in a row. The range and distribution of the White-tailed Sea Eagle is over most of Russia except for the tundra and deserts. It winters in Southern Europe, Egypt, India, China, Korea, Japan, and the southern parts

of Russia. The White-tailed Sea Eagle is protected in the Komi Republic Red Book. Although the white tailed sea eagle is listed by the IUCN as 'lower risk' (i.e. is not endangered or vulnerable) it is considered 'near threatened', implying that it is close to qualifying as 'vulnerable'.

5.13.5.6 Golden Eagle

The Golden Eagle is a large eagle with broad wings and a long tail. It is found in the mountains, forests, and deserts. It usually settles in areas where cliffs or tall forests alternate with open spaces; in the taiga, it prefers river valleys. It is nonmigratory or nomadic. The range and distribution of the Golden Eagle is the greater part of Russia except for the northern regions. It usually winters within its nesting range. The Golden Eagle is protected in the Komi Republic Red Book.

5.13.5.7 Perigrine Falcon

The Perigrine Falcon is found in a variety of habitats from tundra to mountain to deserts. It prefers open spaces with small forests or cliffs. It is nonmigratory or nomadic. Although rare, it can be found in the tundra. The range of the Peregrine Falcon is throughout Russia and winters in Southern Russia. The Perigrine Falcon is protected in the Komi Republic Red Book.

5.13.5.8 Osprey

The Osprey can be found in a wide variety of habitats except tundra, steppe, and alpine zones. It usually settles near large bodies of water (sea, river, lakes) and very rarely migrates. In addition to most of Russia, it can be found in Kazakhstan.

5.13.5.9 Willow Ptarmigan

The Willow Ptarmigan can be found in the tundra, forest-tundra, taiga, forest steppe and mountains. It is nonmigratory or nomadic. The Willow Ptarmigan normally nests in thickets in plains and hilly tundra, near mossy swamps and in birch groves. It can be found in the northern half of European Russia, the northern part of Kazakhstan, and Siberia. The Willow Ptarmigan is protected under the Komi Republic Red Book.

5.13.5.10 Common Crane

The Common Crane can be found in a variety of habitats from forest-tundra to desert and mountains. It is found in open or wooded, swampy places. This is a migratory species. It can be found in the greater part of European Russia (except the tundra and southern regions), Kazakhstan, and parts of Siberia. It winters in Africa, West Asia, Iran, India, and Southeast Asia. The Common Crane is protected under the Komi Republic Red Book.

5.13.5.11 Snowy Owl

The Snowy Owl is found in the tundra and arctic prairies. During nonbreeding season it can be found in forest-tundra, steppe, and forests. The Snowy Owl is nomadic. The range and distribution of the Snowy Owl is the tundra from the Kanin Peninsula to the Chukotski Peninsula. It winters south of its breeding range. The Snowy Owl is rare on the whole and is protected under the Russian Red Book.

5.13.5.12 Northern Eagle Owl

The Northern Eagle Owl is found in a variety of habitats from the taiga to deserts and mountains. It inhabits all unpopulated, remote areas, and avoids contact with people. The Northern Eagle Owl is non-migratory or nomadic and is considered rare. It can be found anywhere in Russia except for tundra, the basin of the Anadyr River, and the Kamchatka Peninsula. The Northern Eagle Owl is protected under the Komi Republic Red Book.

5.13.5.13 The Great Gray Owl

The Great Gray Owl can be found in remote sections of mature forests (particularly coniferous). The owl is nonmigratory or nomadic. It nests from mid-April to the beginning of May and occupies old nests of large

raptors. The range and distribution is within the taiga zone of Russia. The species is rare and is protected under the Komi Republic Red Book.

5.13.5.14 Ural Owl

The Ural Owl is found in mature coniferous or mixed forests. The owl is nonmigratory or nomadic. It nests in tree hollows, in old nests of raptors, or on the ground. It can be found in the forest zones of north and central Russia from Belorussia to the Kiril Islands. The species is rare

5.14 Aesthetics, visual resources, noise and vibrations

The region around the deposit is void of any population centers. It is not a tourist destination for nationals or foreigners. Areas beyond the existing mining operations remain in relatively pristine condition with ample opportunity to enjoy natural conditions. Baseline levels of noise and vibration should be considered near natural levels due to the fact that there is no other industry within the area of impact for the mine.

5.15 Socioeconomics

5.15.1 The Komi Republic

The MTBM is located in the Komi Republic (KR), an autonomous entity within the Russian Federation, situated on the north-eastern side of European Russia (the Republic is described in more detail in Chapter 2). The Komi people are descended from the inhabitants of the Volga, Kama, Pechora and Vychegda River basins. Russia annexed the territory in 1478 and the number of Russians in the region increased. Copper and silver ores were discovered in 1491 and the territory gained importance as a mining and metallurgical center. Oil was discovered in the territory in 1697, as well. The Komi were renowned as skilled traders on the routes between Arkhangelsk and Siberia. Fish, furs and game animals were key products in the 17th century and coal, timber, iron ore and paper were important later. The Komi Autonomous Oblast was established on August 22, 1921 and elevated to ASSR in 1936. The Komi Republic declared sovereignty on August 30, 1990 and adopted a new constitution on February 17, 1994. Komi is Russia's second largest fuel and energy base.

The area forming the Komi Republic was originally inhabited mainly by ethnic Komis and Russians to a lesser extent, but it is now a melting pot of people originating from different areas of the former Soviet Union. During Soviet times, a workforce was brought in to participate in the industrial development of the area, from other regions of Russia, and from Ukraine, Bielorrussia, and some of the Caucasus or Central Asia SSRs. The harsh climate and sparse rural population made Komi an ideal location for the Soviet government to establish labour camps for criminals and political prisoners from the early 1930s. People arrested for criminal or political reasons were brought into forced labour in work camps or internally deported. Ethnic Germans from Russia and Ukraine were also massively deported to the area in the thirties and after 1941 as a result of the Stalinist policy of repression and deportation of certain nationalities considered disloyal.

Ethnic Russians currently make up almost 60 per cent of the population of the Komi Republic, with Komi (about 23 %) and Ukrainians (8 %) being the other major groups. The Komi, who call themselves Komi Mort (Komi person) or Komi Voityr (Komi people), speak Komi or Zyrian, a language with several dialects that belongs to the Permian group of the Finnic division of the Ural-Altaic languages. The Komi Republic is currently governed by the Head of the Komi Republic, Vladimir Torlopov, and the Government of the Komi Republic. The official languages of the Komi Republic are Komi and Russian.

5.15.2 Knyazhpogost district

5.15.2.1 Overview and Demographic Profile

The Middle Timan Bauxite Mine is situated in the Knyazhpogost district of Komi Republic. The district occupies an area of 24,600 km² and has a population of 33,100 spread throughout 53 settlements. The district capital is the city of Emva. Knyazhpogost District is principally rural with no cities – the main

settlements are the villages of Sindor, Tract, Meschura, Vet'yu, Chin'yavoryk, Seregovo, Shoshka and Knyazhpogost.

The administratively recognized inhabited settlement closest to the mine is the village of Chin'avoryk, which has a population of 1,272 people and is located at a distance of about 160 km from MTBM. However, two other small settlements (administratively belonging to posiolok China'voryk) are closer to the mine: Shomvukovo (population: about 210) and Kas'en Kedva (population: about 210). These two settlements are in fact penitentiary "colonies" administered by the Ministry of Justice, where convicts are kept in a semi-freedom regime. Finally, MTBM maintains and operates a railway siding along the railway (Makarov's halt) but it is not inhabited

The main demographic characteristics of the District are the following:

- The population is decreasing at a rate of 1.4% per year (over the last three years).
- The natural balance of population is negative, with natality at 8.5 for one thousand and mortality at 18.1. In addition, the migratory balance is also negative with more people leaving than settling (balance: - 280 individuals per year).
- The life expectancy at birth is 57.9 years for males and 67.7 years for females.- The distribution of the population by age is shown in Figure 12.

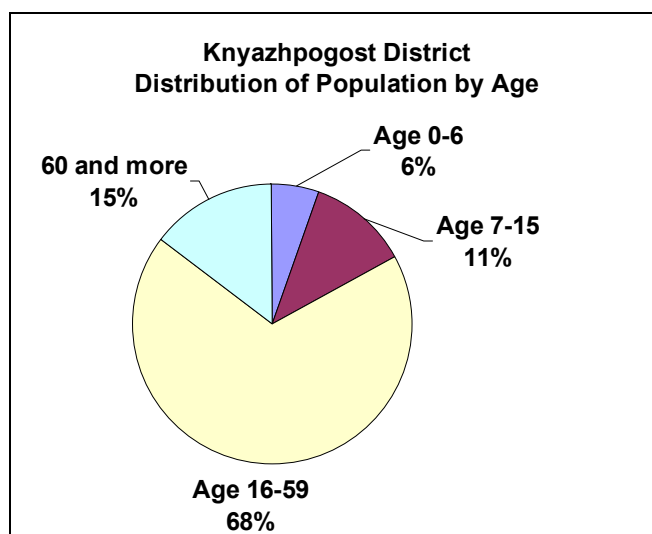


Figure 12: Distribution of population by age in the Knazhpogost district.

5.15.2.2 Economic overview

Key industries in the district are forestry and timber production, which make up some 85% of the total production. Other industries include food production (4,5%), light industry (6,5%), machinery and metal-working (3,1%). There are 75 businesses registered with the Knyazhpogost Administration including MTBM and five departments of M-222 enterprise (a state enterprise under the Ministry of Justice that manages labour in three labour settlements of the area, see § 6.8), with 20 SMEs and 634 individual businessmen registered. The official level of unemployment is 3,5% (630 persons) which is higher then the average level in Komi Republic (2,1%).

5.15.2.3 Employment and Unemployment

The actual working population is 67% of the population in working age. About 6.7% of the working age population is officially registered as unemployed. The distribution by age and gender of the unemployed population is shown in Figure 13.

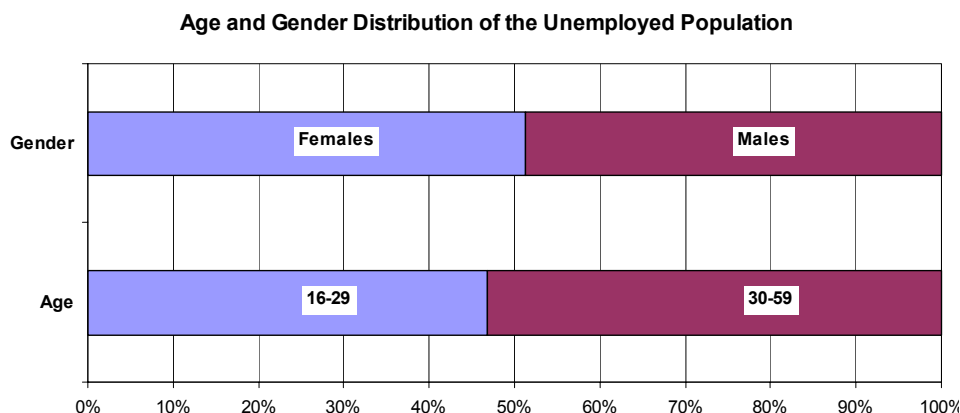


Figure 13: Age and gender distribution of the unemployed population in Knyazpogost.

5.15.2.4 Main sectors of activity

The distribution of the employed population in the various economic sectors (year 2002) is shown in Figure 14. Industry and Government institutions in the field of health, education and administration are by far the main providers of employment. As in other districts of the area, SMEs are weak.

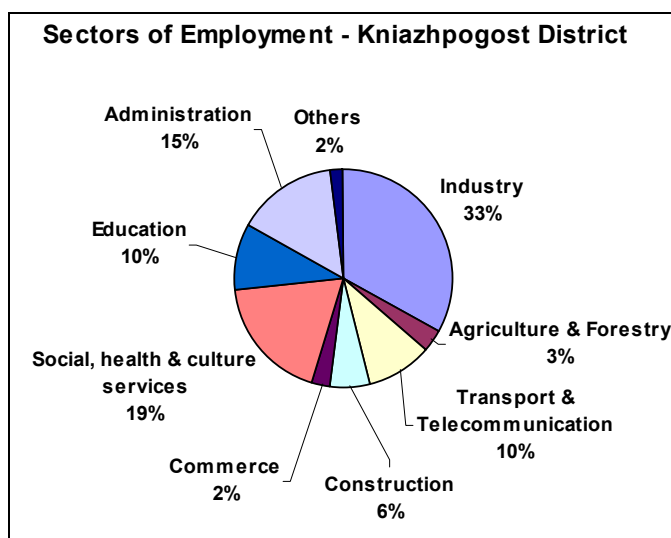


Figure 14: Employment sectors in Knyazhpogost.

5.15.2.5 Small and medium businesses

As of January 2003, there were 22 registered small businesses in District of Knyazhpogostsky. About half of these are engaged in industry (36% of the total number) or trade (about 14%). Small businesses provide employment to about 324 individuals. In addition, about 626 individuals are engaged in independent work («individual working activity») in 2002.

5.15.2.6 Incomes

Wages

The average salary in the District was 4,460 Rubles per month in 2002 (about 159 USD), 29% higher than that of 2001. Monthly wages in the main sectors of activity were as shown in Figure 15.

Pensions

There are about 7,182 pensioners in District of Knyazhpogost (about 24% of the total population). The

average pension is 1,579 Rubles per month (56 USD).

5.15.2.7 Social and educational services

Health Services

The District has 4 hospitals with a total of about 225 patient beds, and 6 other health centers of different types (polyclinic, «medpunkt»). These medical facilities are manned by 63 medical doctors and 260 medical staff. The total number of registered cases was 19400 in 2002.

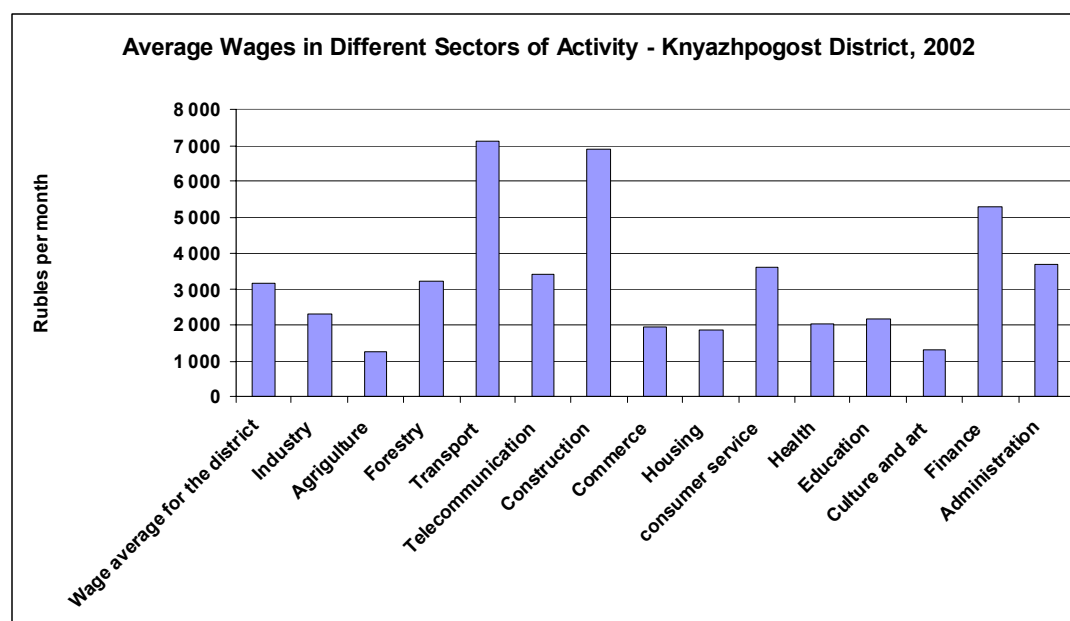


Figure 15: Average wages for different sectors of the Knyazhpogost economy.

5.15.2.8 Education services

The situation of public education services in the District of Knyazhpogost is summarised in Table 23.

Table 23: Summary of public education services in the District of Knyazhpogost.

Type of Facility	Number of Facilities	Number of Pupils/ Students	Number of Education Staff
Kindergartens	20	1064	158
Primary Schools	23	3892	380

5.15.3 “Posiolok” China’voryk

China’voryk is located at the junction of the federal railway and highway with the railway branch and the access road to the mine. According to information received from the village administration, the population of Chin’avokyk is about 1,416 people (banished population excluded), with 1,272 in the main settlement, and 144 in three small settlements. The population has been decreasing in the recent years, although a few newcomers (12 in 2003) have reportedly settled.

The village has one primary and secondary school (1st to 11th class), with 219 students, with another smaller primary school in the settlement of Kasyan Kedva. The village has one “medpunkt” with one assistant doctor. To receive more elaborate medicine care that cannot be delivered in this medpunkt, people have to go to the district centre Emva. One of the main issues stressed by the local population is that they

cannot go to Ukhta (about 60 km) to receive medical care and have to travel to Emva (about 130 km), to which they are administratively attached.

The main employer is by far State Enterprise M222 (see § 6.8), with the railway and now “Boksit Timana” with a workforce of 65 from China’voryk. China’voryk has a few small businesses (9 shops and 4 coffee shops). The unemployed population is officially 24, but according to the local administration the real number would be closer to 50. There is some social housing in the village (apartment blocks), which is reportedly in poor condition.

5.15.4 State enterprise M222

State Enterprise M222 is a State commercial enterprise under the Ministry of Justice of the Russian Federation. Its headquarters are in Mikun in the RK, one of the main branches being the Chin’avoryk one, and personnel includes members of the military. M222 provides labour to convicts (“banished”) after Justice convicts them in a judgment that may include prison then banishment or banishment only. Usually, sentences are for 3 to 10 years of banishment. Banished convicts are held in a semi-freedom regime: their internal passports are withheld, they have no right to move outside the settlement where they are held, but in most cases there is no fencing around the quarters where they live, and they can do their own shopping or even run a small business in the settlement where they are affected. Subject to prior authorisation, they may meet with their families and receive money from them. The total number of banished individuals that State Enterprise M222 is presently dealing with is about 600.

Banished workers are employed in logging and timber ventures run by M222. A few of them help in various municipal tasks in China’voryk, and some are employed in craftsmanship activities (painting icons and others). They are paid about 100 Rubles a month (USD 3.5). M222 runs three “colonies”, one in Chin’avoryk (capacity: 240 banished, the colony is fenced but banished people are in principle free to move around in the village during daytime), the other two further North on the way to the bauxite mine⁹:

- Shomvukovo (unfenced colony, capacity: 240 banished, currently about 210 banished persons plus about 40 M222 personnel and about 30 other inhabitants),
- Kasyan Kedva (unfenced colony, capacity: 240: banished, currently about 210 banished person plus about 40 M222 personnel and 25 other inhabitants).

M222 enterprise is by far the main employer in Chin’avoryk, and tends to cater for various municipal tasks in cooperation with the municipal organization of the village. The mayor (appointed) is himself a former M222 official. Interviews with M222 personnel carried out by the study team tend to indicate that these personnel also have a high level of expectation with respect to the Komi Aluminium Programme, which they expect may, contribute to improve municipal services and housing in the village.

Under Russian law, banished persons can only be employed by State Enterprise M222. Their regime does not allow employment in any other enterprise (except running a small business in the settlement, which is tolerated). Therefore, they cannot be employed in Project-related activities, including working at the mine or in a sub-contracted activity for the mine. There is a strong possibility of misperceptions of this aspect, particularly outside of the Russian Federation. As a result, it is strongly recommended that:

- The fact that no forced labour can and will be used be reaffirmed by Boksit Timana, SUAL, and the lenders,
- The follow-up of this prohibition be included in the environmental and social monitoring of the Project.

⁹ Please note that in the Environmental and Social Due Diligence Audit, one of these settlements was mistakenly referred to as a ‘prison’. There is no prison in the vicinity of the MTBM site.

6. IMPACTS

6.1 Introduction

On the basis of the environmental aspects identified in the description of the proposed expansion together with the existing state of the environment, impacts that could potentially occur have been identified together with the significance of those impacts. An important source of information in identifying and assessing possible impacts has been the Environmental and Social Due Diligence Audit that was conducted in September 2003, on current operations of the Middle Timan Bauxite Mine. The findings of the due diligence audit together with the gap analysis provides an important foundation in identifying possible impacts as a result of the proposed mine expansion.

For each potential impact, the circumstances leading to the manifestation of the impact are described. Thereafter, the significance of the impact is presented as a function of the extent, duration, intensity and probability. Mitigation is presented for all impact categories regardless of the significance of the impact, where an environmental aspect or impact associated with the proposed mine expansion can be reduced or improved. Impacts that are rated as high significance are considered have the potential to disqualify the project unless adequately countered by mitigation.

6.2 Air quality impacts

6.2.1 Atmospheric emissions

Ongoing mine and proposed expansion activities will result in a variety of atmospheric emissions. These include gaseous and particulate emissions from various fuel burning devices on the expanded mine including plant such as excavators, crushers, stackers, bulldozers and road scrapers, vehicles such as utility motor vehicles and haul trucks, and boilers and electricity generators. In addition smoke is generated during burning of timber from areas that have been felled. These various activities result in emissions of sulphur and nitrogen oxides, carbon monoxide, carbon dioxide, soot and aerosols (fine particles). Blasting to loosen the overburden and the ore will also result in air pollution emissions – emissions from blasting are typically regulated as 'emissions per draught'. The total suite of emissions from the expanded operation is given in Table 24.

Table 24: Projected emissions from mobile combustion sources on the mine following expansion to 6.0 mtpa.

Pollutant	Source	Quantities (tpa)	Increase (tpa)
Sulphur dioxide	Diesel generators, vehicles, boilers and plant.	600	204
Nitrogen oxides	Diesel generators, vehicles, boilers plant and blasting.	1,196	406
Carbon monoxide	Diesel generators, vehicles, boilers and plant.	3,000	1,020
Soot	Diesel generators, vehicles, boilers plant and blasting.	463	157
Hydrocarbons	Diesel generators, vehicles, boilers and plant.	900	306

6.2.2 Dust

Dust will also be generated during blasting, stripping of overburden, drilling, excavations and general materials handling including transport, crushing and blending. Windblown dust will also be generated in areas that have been cleared of vegetation or where there is no vegetation to inhibit Aeolian erosion, especially the mine haul roads, the overburden and bauxite stockpiles and mine pits. Although dust only gets generated under certain weather conditions (which are limited to short periods during the summer months) it poses the risk of potential impacts on the work force, surrounding vegetation and surface water quality. Current sources of dust are shown in Table 25, together with an indication of how these sources and resultant emissions might increase for the expanded operation.

It is also important to note that there are perceptions amongst communities that the area surrounding the mine is heavily impacted by dust emissions from mine operations. This perception probably stems from the dust emissions on the access road that were generated during the time when the bauxite was trucked by road into China'voryk, and also from red dust that is reportedly still generated on the mine access road from old spills of bauxite that have never been cleared.

Table 25: Summary of current dust sources and how these might increase following the mine expansion to 6.0 mtpa

Source	Current (tpa)	Projected (tpa)
Existing ore stockpiles	0.92	1.84
Waste rock stockpiles	6.69	13.38
Basalt stockpile	1.66	3.32
Basalt loading	0.2	1.01
Ore and overburden loading	0.84	4.22

The principal dust emissions abatement is water spraying which is used during the summer months on the roads in the mine. For the proposed expansion, the current bauxite crushing operation will be replaced with two crushing plants. These crushing plants will be fitted with dust extraction facilities and this will result in a reduction in dust emissions per unit of bauxite mined.

Unless controlled, bauxite dust has the potential to impact on the surrounding natural environment especially vegetation and surrounding surface water. Dust emissions will obviously vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. Dust generation is caused by the pulverization and abrasion of surface materials and/or entrainment of dust particles by the action of turbulent air currents (typically when wind speeds exceed about 19 km/hr).

The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. Theoretical drift distance, as a function of particle diameter and mean wind speed, has been computed for fugitive dust emissions. Results indicate that, for a typical mean wind speed of 16 km/hr, particles larger than about 100 µm are likely to settle out within 6 to 9 meters from the edge of the road or other point of emission. Particles that are 30 to 100 µm in diameter are likely to undergo impeded settling and depending on the degree of atmospheric turbulence are likely to settle within approximately one hundred metres of the source. Smaller particles obviously have much slower gravitational settling velocities and are much more likely to have their settling

rate retarded by atmospheric turbulence implying that these particles could settle beyond 100 metres from the source.

6.2.3 Bauxite dust constituents

In order to understand the potential impacts of dust from the mine, it is necessary to present the composition of the materials that could be contained in the dust. These constituents include:

- Aluminium oxide (Al_2O_3)
- Iron oxide (Fe_2O_3)
- Silica oxide (SiO_2)
- Titanium oxide (TiO_2)
- Trace concentrations of various heavy metals.

In the national emissions inventory, Environment Australia indicated that emissions from bauxite mining contributed to heavy metals emissions of Arsenic (As), Cadmium (Cd), Hexavalent Chrome (Cr(VI)), Cobalt (Co) & compounds, Lead (Pb) and Mercury (Hg) (Environment Australia, 2002). Although the emissions quantities of these metals are small it is important to recognise that the compounds may potentially be contained in the dust emitted from MTBM, and as such the dust should be measured and characterised to determine the prevalence of these metals.

6.2.4 Probable ambient concentrations

Ambient concentrations of the various atmospheric pollutants emitted from the mine are unlikely to result in adverse human health effects. This is because the emission sources are dispersed across the mine site and as a result are unlikely to act cumulatively to any significant degree. At the same time there are limited opportunities for exposure to the air pollutants as there are no communities in close enough proximity to the mine operation. The mine's sanitary protective zone (SPZ) is defined as 1000m from the mine boundaries in terms of Sanitary Norms and Regulations (SNR) 2.2.1/2.1.1.1031-01. There are no residential areas within the defined SPZ. Although the work force will be exposed to the pollutants there are no specific sources that are considered significant enough to pose a direct threat of adverse human health effects.

6.2.5 Greenhouse gas contributions

The mine is not a significant source of greenhouse gas emissions either in terms of emissions from the mine or as a result of the generation of power to support mine activities. It is worth noting though that the potential cumulative effects of greenhouse gas emissions as part of the integrated aluminum development will need to be considered in future.

6.2.6 Key air quality findings from the due diligence audit

The following are the key audit findings for air pollution emissions:

- Currently the mine operational facilities do not have a significant negative impact on air quality. Total air pollution emissions for 2003 are expected to be about 1200 tonnes (viz. under the current operating capacity of 1.5 mtpa). That amounts to some 22% of planned emissions for the projected production capacity of 2.5 million tons of bauxite per annum.
- All atmospheric protection permits are in place for the mine and the mine's operations comply with existing air emissions regulations.
- Operational environmental monitoring at the mine is conducted following a schedule agreed with the state environmental protection bodies.
- There are no residential areas within the defined SPZ for the mine.
- There were no exceedances of the specified maximum permissible emissions during the last two

years of mine operations.

- Air pollution emissions abatement is limited to dust suppression spraying during adverse meteorological conditions.

The following gaps have been identified in terms of air quality management:

- The boiler constructed in 2003 is diesel-fired rather than coal-fired as specified in the air pollution permit. As a result there is a large (positive) discrepancy between the calculated emissions in the permit documents and current emissions (presented in the state statistical reporting files for the first six months of 2003).
- In a similar vein, air emissions from diesel generators have been calculated incorrectly in the state statistical reporting files “2-ТП (air)” for 2002 and 2003.

6.2.7 Air quality impact assessment

6.2.7.1 Extent

The extent of potential air quality impacts is limited to the **immediate vicinity** of the mine and associated infrastructure (haul roads, CBY and overburden stockpiles). However it is important to note that these effects may extend along the length of the railway line, where bauxite dust may be generated during transport of the material by rail.

6.2.7.2 Duration

The duration of the impact will be **long term** and continue as a function of the mine operation. In addition the effects of dust fallout would continue to be manifest well beyond the life of the mine.

6.2.7.3 Intensity

The intensity of the potential impacts of dust is considered to be **moderate** in the event of no mitigation and **low** in the event of effective mitigation to control dust emissions. Control of dust emissions by spraying and/or dousing with water must extend to excavations and the haul roads as well as limiting dust from the transport of the bauxite either within the mine boundary or while transporting the material by rail.

The intensity of impacts associated with emissions from the various fuel burning devices that will be used at the mine is considered to be **low**, given that the sources are dispersed across the mine area and are unlikely to result in significant ambient concentrations.

6.2.7.4 Probability

Impacts associated with elevated dust loading including impacts on surrounding vegetation and surface water are considered **probable** in the absence of measures to control dust. Impacts as a result of emissions from fuel burning devices are considered **improbable**.

6.2.8 Impact significance

Impacts associated with dust generated during mine activities are considered to be of **moderate** significance, but of **low** significance with mitigation in the form of effective dust control during mine activities. Impacts associated with emissions from fuel burning devices are considered to be of **low** significance.

The impact significance is based on the assumption that occupational exposures to emissions from fuel burning devices and dust are kept at levels that will not present a risk of adverse health effects to mine personnel.

6.2.9 Mitigation

The following mitigation will be applied to reduce possible air quality effects still further:

- Diesel operations will be optimized including monitoring generator loading and redistributing the load

where required;

- All combustion devices, including mobile equipment will be regularly serviced and correctly maintained.
- Combustion sources will be monitored on a regular basis to ensure that they are operating within design parameters for emissions.
- An aggressive campaign of road watering and control of vehicle speeds will be implemented to reduce dust loading as a result of mine activities.
- Mining and hauling equipment will be equipped with catalytic converters;
- The possible use of low sulfur diesel fuel will be investigated for all diesel uses across the site (but most especially vehicles).

6.3 Surface water impacts

6.3.1 Risks to surface water

There are several activities, however, that will be associated with the mine expansion, which will present a possible threat to the ecological function of the Vorykva River watershed. These include:

- The discharge of water from mine operations into the Vorykva River and other surface water bodies. These discharges include:
 - Water pumped from the aquifers ahead of pit excavations in order to dewater the aquifer and reduce the potential inflow into the pit
 - Water pumped from within the mine pits (from sumps within the pits) i.e. dewatering
 - Effluent from the sewage treatment plant
 - Surface water runoff from the mine area, especially the CBY
- Mine pits dewatering influence on the local (or regional) hydrology and aquifers
- Mining of pits nearby the river for the Verkhne-Vorykvinskoya deposit
- The construction of a bridge over the river to provide access between the main mine area and the Verkhne-Vorykvinskoya deposit.

During the public consultation and disclosure process, widespread concerns have been raised regarding possible impacts of the mine expansion on the Vorykva River. These concerns relate to maintaining the general ecological function of the river, its aesthetics and most importantly perhaps, the fact that the river is a protected ichthyological reserve. The major public concern has been that the mining of the Vezhayu-Vorykvinskoye deposit (which underlies the river) would result in a substantial deterioration in the ecological function of the river, if not the complete loss of the river as the deposit is mined.

At the outset and in response to the concern it is necessary to highlight that although the mine plan includes the mining of the Vezhayu-Vorykvinskoye deposit, the south western extremity of the pit (the point closest to the deposit), will not extend beyond the railway line and mine access road. The closest point of mining will be more than 1 km from the river. Accordingly, there will be no *direct* physical transformation of the river as a result of pit excavation (Figure 16). Indeed the portion of the deposit (so-called deposit 11) that underlies the Vorykva, has been removed from the mine's reserve balance so it is simply not available to be mined.

Despite the fact there will be no direct transformation of the Vorykva, the various activities of the expanded mine operation pose potential indirect impacts as a result of the proposed dewatering and the need to discharge that water to the river. Before describing the surface water impacts that may manifest, it is necessary to revisit the protection status of the Vorykva. This description serves to describe the state of the *receiving* environment as the foundation for the assessment that follows.

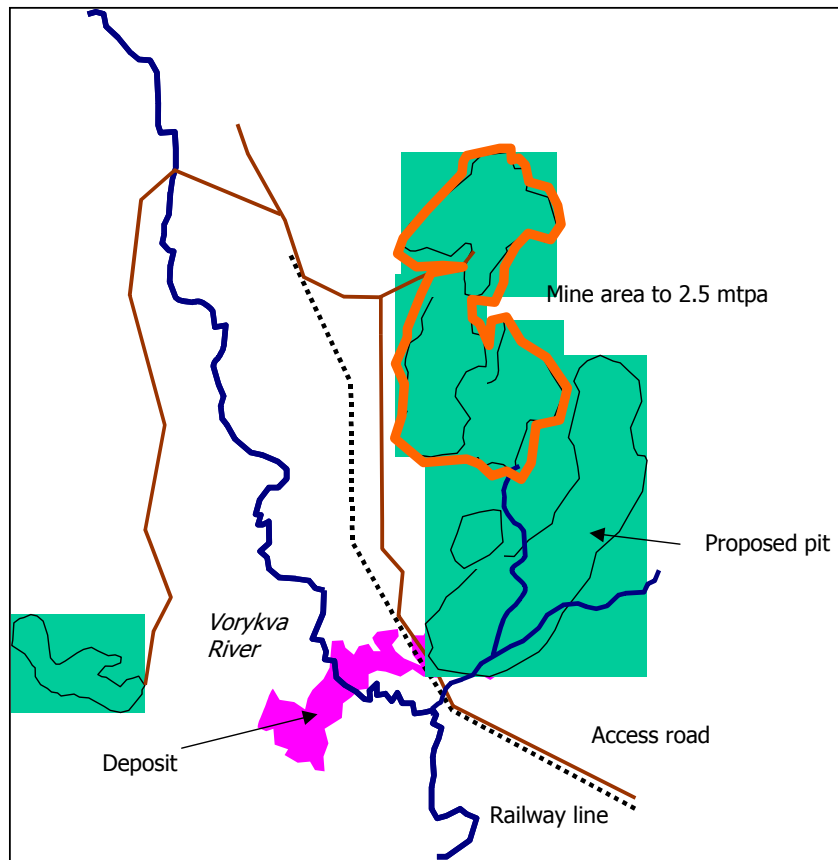


Figure 16: Schematic illustration of the deposit underlying the Vorykva River and the position of the planned pit. Note the pit edge will be separated from the river by the railway line and the access road.

6.3.2 The ichthyological reserve

The area of the ichthyological reserve of the Vorykva River is illustrated in Figure 17. The reserve, which is known as the *Vymsky State Ichthyological Reserve (VSIR)*, serves to protect the spawning area of salmon and a range of other fish species that have been described in the baseline section (Chapter 3). The following activities are prohibited within the area of the reserve¹⁰:

- Commercial fishing;
- Commercial forestry;
- Any land disturbance
- Storing and or using poisonous substances such as chemical fertilisers and/or pesticides without special permission;
- Disposal of industrial and municipal waste;
- Discharge of *untreated* industrial and municipal liquid waste into 'ground waterways'; and,
- Construction of 'capital' tourist facilities.

¹⁰ As defined in the *Annex to the Decree of the Head of the Republic of Komi, 16 January 2001*. Please note that the reserve refers to an area of 1 km on either side of the river – denoted in light blue in Figure 17.

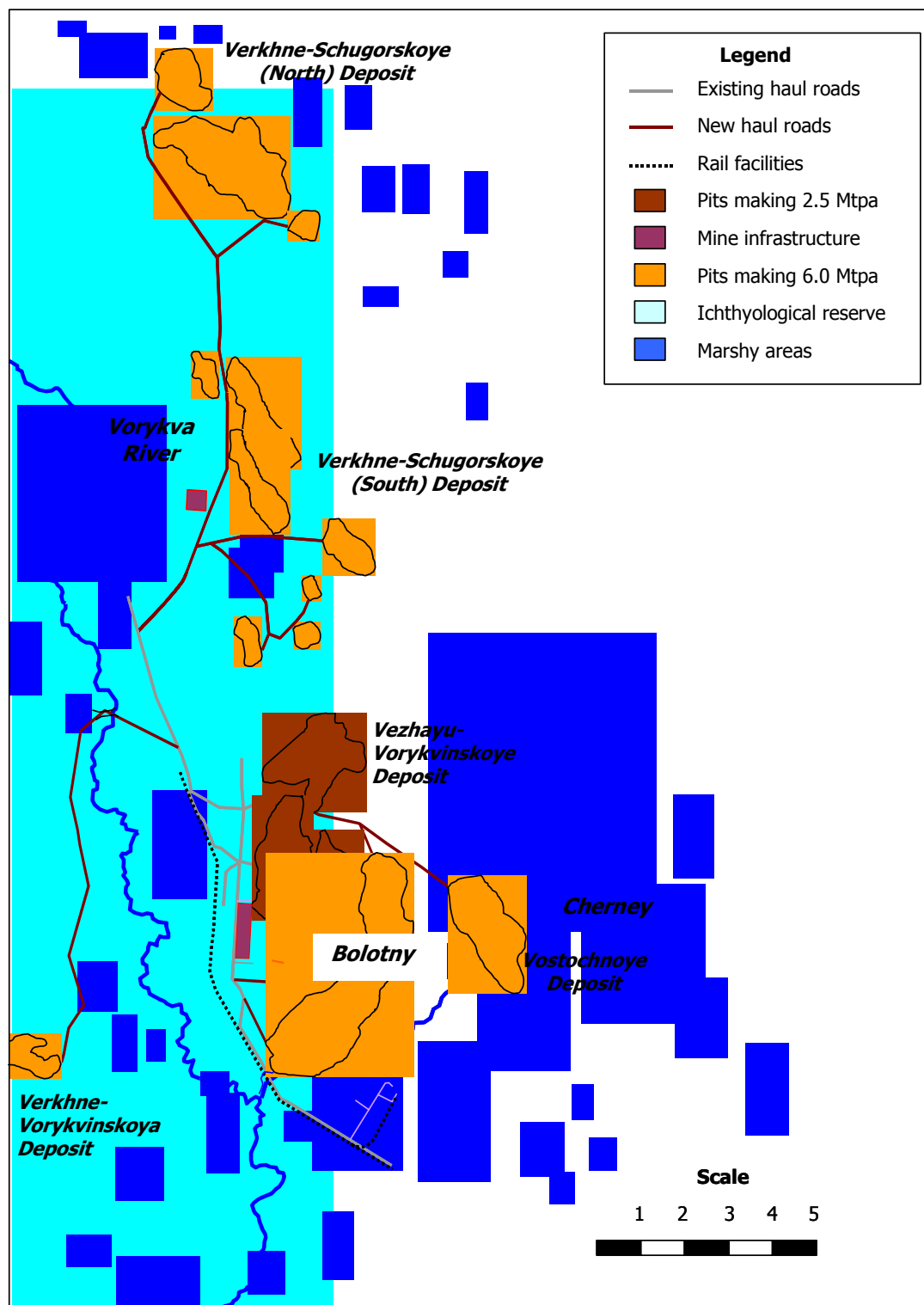


Figure 17: Schematic illustration of the relative positions of the ichthyological reserve, Vorykva River, the Cherney and the Bolotny, and marshy areas to the existing and proposed new mining areas. Note that the scale of the figure is approximate.

The provisions of the reserve allow a range of recreational activities including the gathering of berries and mushrooms, 'haymaking', sport hunting (in accordance with rules governing hunting), sport fishing using a fishing rod in specially demarcated areas, establishing tourist paths and the use of small boats on the river. A

special provision is also made within the decree, for the ongoing operations of the MTBM including transport infrastructure, geological surveys and mining using *'the most environmentally friendly technologies and methods, in accordance with the requirements of the current legislation and having a positive SER conclusion'*.

The proposed mine expansion will have a direct impact on the ichthyological reserve as a result of the proposed road connecting the central mine facilities to the Verkhene-Vorykvinskoye deposit. The road as well as the bridge will result in a land disturbance within the reserve area and will require special permission for its construction. The current road routing will also need to be changed to minimise the road footprint within the reserve, with a more latitudinal traverse of the reserve substantially reducing the footprint.

Although effluent discharge into the rivers is not expressly prohibited, it is clear that the spirit of the provisions is to protect the ecological integrity of the reserve and maintain an aquatic environment that supports the fish populations that are found in the river. To this end any impacts arising from expanded mine operations that threaten fish diversity and/or populations in the reserve should be considered significant and potential fatal flaws. This is especially true of the proposed discharge of pumped groundwater and effluent into the river as well as surface water runoff, which may result in contaminated water (high suspended solids) entering the river. Activities that may result in reduced flow within the river are also considered significant and will be addressed later in the report (see Section 6.7). In the sections that follow impacts that may result from these proposed discharges have a bearing on the sustainability of fish diversity and populations are described, including:

- Changes in river system hydrology (flows)
- Changes in river hydraulics (altered energy loading and changes in sediment transport and channel dynamics)
- Changes in the physical (especially temperature and sediment loading), chemical (mineralization and other possible pollutants) and nutrient properties of the river.

6.3.3 Estimated dewatering volumes

The estimated dewatering volumes are based on previous groundwater studies on the Vezhayu-Voryvinskoye (central), Verkhne-Schugorskoye North and South and Vostochnoye deposits. The two source documents for the groundwater, dewatering and chemistry are:

- Geological Structure and Reserves of the Verzhau-Vorykvinskoye and the Verkhne Voryvinskaya Deposits of the Middle Timan, by the Ministry of Geology of Russia, Ukhta Exploration Expedition. V.G.Smirnov, V.M.Tarssin and G.K Sharoeva, 1977;
- Geological Structure and Reserves of the Verkhne-Shugorski and Vostochnoye Bauxite Deposits by V.A.Shimanski and E.Kh.Khodzaev, UKHTA, 1989.

Very extensive field testing programmes were carried out comprising drilling and test pumping from numerous single and multiple borehole tests in all the geological horizons. The multiple tests comprised pumping from one borehole and monitoring in an array of around 6 other boreholes. Some tests were done specifically in the alluvial materials adjacent to the Vorykva River to try to assess potential river leakage (i.e whether water would 'leak' from the Vorykva as the groundwater was pumped out). A total of around 43 multiple tests and a similar amount of single borehole pumping tests were carried out between both the source reports. Tests were carried out in each of the aquifer horizons.

A wide range of analytical and numerical methods of analysis were done by the original investigators to derive aquifer characteristics and preliminary computer based modelling was done to assess possible dewatering requirements for individual pits. The available reports provided estimates of pit inflows or dewatering requirements and on that basis, SRK have estimated possible abstraction requirements, based on the available figures, experience of similar conditions, possible boundary effects and interference effects. The estimated yields are summarised in Table 26.

Table 26: Summary of total estimated dewatering yields

Area	Pit number	Maximum yield m3/day
Vezhayu-Vorykvinskoe	1	Nil
	2	Nil
	3	Low
	4	100,000
	5	150,000
	6	36,000
Verkhne-Vorykvinskaya	7	Nil
Vostochnoe	8	55,000
Verkhne-Schugorske (south)	9	48,000
Verkhne-Schugorske (north)	10	72,000
Vezhayu-Vorykvinskoe	11	-

Note: the above estimates are given by SRK based on the original test information and assumes that pits 4,5 and 6 are mined together and that there is no contribution from leakage from the River. The issue of possible leakage of the river is discussed later in this document. The flows also exclude rainfall and snow melt to be pumped from sumps within the pits. It is understood that rainfall infiltrates the pit floor in the present pits 1 and 2 and sump pumping is not required.

The given yields are based on final yields for each pit. The total yield from the site will depend on the sequencing of the mining and the time to develop each pit. Each pit will progressively require increasing dewatering as it is developed to the full yield. It must be stressed that the table of yields is based on information provided. There could be large variations from the given yields but it can be concluded that dewatering requirements will be high.

To be able to provide more confidence in the overall number is not realistic without a comprehensive aquifer model. The numbers given in Table 26 are estimates and it is unlikely that flows will be significantly less than the amounts given. It is possible that flows could be higher in the central region, depending on the leakage from the river and flows through the alluvium (note the marshy areas along the river to the north of the proposed bridge crossing). This cannot be confirmed until modelling is done on the dewatering and the river/aquifer interaction.

A schedule of pit development will require integration of dewatering for each of the pits as well as designing the rate of drawdown for each pit to minimise pumping costs while maintaining the pit in a dewatered stage ahead of mining. The current preliminary schedule is likely to see the development of pits 1,2 and 3 followed by Schugorskoye south in years 4 to 10, Schugorskoye north in years 8 to 20, Vezhayu Vorykvinskoye pits 4, 5 and 6 from years 12 onwards and Vostochnoye from year 13.

Each area may comprise a number of smaller pits and therefore may not require the full amount of dewatering given in Table 26, depending on the sequencing of the pits. . In most cases, dewatering at any pit should be planned to start 6 to 12 months in advance of mining below the piezometric surface. The

maximum volume of discharge will be from pits 4 and 5. Based on the initial sequence an order of magnitude, total pumping regime is presented in Table 27.

Table 27: Estimated total discharge for the duration of the proposed expanded mine operation.

Year	Total discharge MI/day
5 to 8	50
9 to 11	100
12 to 15	150
16 to 18	200
19 to 23	250
24 to 27	350
28 to 32	200

The above figures are given for guidance only and should not be taken as definitive for design purposes. The final mining schedule has not yet been developed and most importantly, dewatering quantities cannot be defined until a detailed numerical dewatering model is developed.

6.3.3.1 Changes in river system hydrology

Were the water volumes that are required to be pumped from the aquifer and pits, to be discharged into the Vorykva and other surface water bodies, there would be substantial changes in the flow regime of the rivers. As a result an investigation will be conducted to determine the minimum possible discharge quantity from the mine (see Section 7.5.4) for a description of this investigation).

6.3.3.2 Discharge water quality

Based on the two reference reports, cited earlier the groundwater from all the aquifers appears to be a good quality with low TDS. Water from the wells will be free of suspended solids and in terms of chemistry is classed as a calcium magnesium carbonate type with a total dissolved solids (TDS) content of between 100 and 250mg/l. The water from all the formations is a similar chemistry although some of the groundwater in the carboniferous rocks has a higher TDS of up to 400mg/l. Ph ranges from 6.7 to 8.18 In all cases the water is suitable for drinking without treatment. Water samples were taken from the surface and groundwater systems. The following elements are generally typical: Al, Fe, Mn, Cu, Zn, Sr, Ba, Ti and Cr but at low levels. Other elements are occasionally found such as Pb, Ag, Ni and Co. These comments are based on samples taken in the original studies and the company developing the mine plan (SRK) have not examined any results from recent sampling campaign.

The temperature and oxygen content of the discharge water may differ from that of the surface water so there will be a need to ensure that any water that does get discharged to surface water or the natural environment will require adjustment in a conditioning pond before being discharged. . The ability to discharge as well as the volume that can be discharged (if at all) will depend on the environmental considerations for the aquatic life in the river that must still be investigated in detail. The temperature of the groundwater is fairly constant at between 2 to 5°C. The oxygen saturation is between 2 and 50%. The ambient temperature of surface water will vary through the seasons and for part of the year the rivers are frozen, therefore direct discharge without conditioning may not be environmentally acceptable. The size of the pond will be based on an estimated 12 to 24hrs retention of the water for the dewatering wells and cascades may be required to promote oxygenation. Although the pumped ground water will have similar

chemical and physical properties to the surface water it is important to recognise that the pumped ground water will be virtually devoid of nutrients.

Pumping from sumps in the pit will contain high suspended solids and clay in particular. This will require settlement before discharge. Flocculation may also be required. The experience of the present operation can be extrapolated to assess the settlement facilities required. Depending on the suspended solids nature and content, this water could be used for purposes such as dust suppression in summer with limited settlement.

The chemistry of the surrounding surface river water shows that it is a similar type of chemistry with a TDS of between 100 and 300mg/l although the TDS is higher at certain times of the year. This means that the groundwater from most of the aquifers, should have no significant impact on the river water in terms of chemistry, once it has reached ambient conditions, implying no significant changes in TDS, alkalinity or concentration of constituents that may give a chemical imbalance and change the chemistry of the river.

6.3.3.3 *The hydrology of the Vorykva*

Unfortunately flow data for the Vorykva River is limited to several measurements a year for 2002 and 2003 respectively. The flow measurements were specifically measured with a view to representing high and low flows respectively. These value have been plotted on a graph in Figure 18 together with crude linear extrapolations of possible variations in flow during the course of a given year. Peak flows occur in May following the Spring thaw (some 2,900,000 to 3,300,000 m³ a day), low late summer flow in August/September (some 138,000 to 968,000 m³ a day) with low Winter flows in January of (some 40,000 to 458,000 m³ a day). As would be expected, there is significant season variation in the flows, as well as potentially from year.

Given the projected pumping rate it can be seen that the discharge volumes may be as much as nine times the low flow condition and between 10 and 12% of the high flow condition (in years 24 to 27). These are obviously extreme conditions that will prevail for a relatively short period, but discharge quantities will be 5 times the low flow condition for about half the life of the mine (16 years). It is obviously not possible to do much than the crude analysis presented here on the basis of available flow data, but these preliminary figures suggest significant increased flow in the Vorykva as a result of pumped groundwater.

The effects of these increased flow volumes in the Vorykva are several and varied. The first of these effects is possible changes in the morphology of the river and changes in the scouring (erosion), transport and sedimentation (deposition) processes. The pattern of sedimentation may also change as a result of the increased (and sustained) energy in the river. A second possible effect is changes in the pattern of flooding of the river. Drainage in the area is relatively poor and there are areas of forest dieback, which appear to be associated with poor drainage. Up-flooding due to the higher water levels may exacerbate this condition.

Finally, but importantly, the changes in hydrology will probably change the freezing and thawing cycle of the river. The larger flow volume will have greater thermal inertia thus potentially delaying the onset of freezing of the river and the ongoing addition of relatively warmer water may enhance thawing. This is an effect that may be further exacerbated by the significantly larger volumes that would be present in the river than typically prevail at the onset of the thaw.

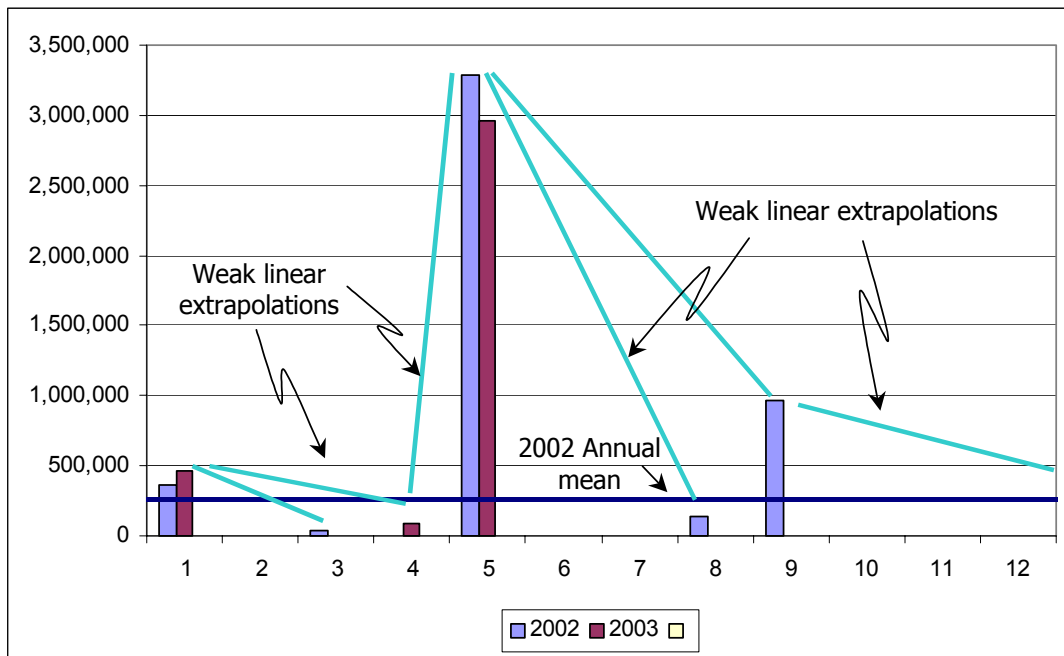


Figure 18: Flow conditions in the Vorykva River. The bars represent actual measurements and the lines crude extrapolations between those measurements.

6.3.4 Resultant changes in habitat

The changes in river morphology described above will result in important changes to the habitat presented currently in the Vorykva and surrounding water bodies. These changes include changes in the light conditions in the river as a result of changes in the depth of the river and changes in the sediment loading. These changes in the light conditions in the river will effect river plant communities in turn (diversity and abundance) as will changes in sedimentation processes. The increased sediment loading will also have the effect of acting as a reflector to incoming solar radiation with possible reductions in temperature.

These changes in temperature regimes within the river will also effect the habitat condition of the river. This is especially true for the breeding of invertebrates such as mayfly, caddisfly and stonefly where a small change in temperature may change the onset time for breeding and reduce the period during which breeding takes place. The obvious consequence of changing the breeding conditions of invertebrates is reducing the food source for fish in the river. Changes in temperature may also have an impact on processes such as nitrification and de-nitrification further changing the nutrient balance of the river. Finally changes in temperature may also change the oxygen content of the water with reductions in temperature reducing the quantity of oxygen within the water.

For salmon to maintain healthy, sustainable populations they require diversity in habitat within the river environment, as well as diversity in habitat over time. The breeding cycle of the salmon requires markedly different habitat conditions some of which can be found in different parts of the river and some of which occur during different times of the year as the flow conditions in the river change from the low winter flow condition, to the high spring flow condition with the onset of the thaw. Salmon are especially sensitive to changes in the streambed condition, requiring gavel bottoms for spawning with very specific gravel size distributions. An accumulation of sandy material within the gravel bed typically used for spawning would render the beds unsuitable for further spawning.

In addition salmon are very sensitive to even small changes in water chemistry and dissolved oxygen content. EU water quality standards for salmonid rivers confirm this sensitivity with a minimum dissolved oxygen content of 7 mg/l being required. Given the relatively small discharges of effluent from the proposed

sewage treatment plant it is entirely feasible that effluent quality can be managed to ensure that the required receiving water quality is maintained. What may present more of a problem is discharges of water containing a high suspended solids loading as a result of uncontrolled surface runoff. Suspended solids concentrations from surface water runoff from disturbed areas may run into 1000's of mg/l with 25 mg/l being the required suspended solids loading in the receiving water. Reductions in oxygen available to the eggs as a result of siltation of redds, is one of several possible impacts on salmon populations in the Vorykva. Additional Impacts on the Cherny and Bolotny Streams.

The Cherny is a small right tributary of the Vorykva, and the Bolotny a small left tributary of the Cherny, that overlie one of the proposed pits that will be established as part of the mine expansion (Vezhayu-Vorykvinskoye deposit). As a result it will be necessary to at least line, and possibly divert the two streams to reduce the quantity of water entering the pit as it is excavated. In regional terms the two streams are relatively small and insignificant, but in local terms they form a direct and important hydrological function for the Vorykva River.

The area drained by the two streams is marshy and punctuated with peat bogs. As such the streams serve to provide nutrients (biogens) to the Vorykva. The marshy area is also a roosting area for migratory birds. This implies that the diversion (or any other impact for that matter on either the Cherny or the Bolotny will have to be investigated to determine not just how to divert the water flows but to maintain the ecological function that they play in the general ecology of the Vorykva, and the larger Vymski catchment.

6.3.5 Changes in the chemical properties of the river

Apart from the additional volume of water that will be introduced into the Vorykva, the risk exists of discharges of water containing various pollutants, most notably fuel, oil and grease as well as high suspended solids loadings. The handling and stockpiling of bauxite in the Central Blending Yard (CBY) presents a risk of contaminated stormwater runoff. The highest concentration of bauxite fines are generated at the mine's CBY and rail loading facility. Under the relatively high rainfall conditions, this material is easily mobilised, transported from the yard in storm water run-off and potentially introduced into nearby surface water bodies. The threat of sediment loading also applies to the overburden stockpiles and to the access road and railway line.

Similarly, clearing of forest in advance of pit excavations and the preparation of other mining facilities exposes the soil to the effects of storm water erosion – resulting in the potential introduction of turbid (e.g. clay loads) water into nearby surface water bodies. The rivers and streams in the area carry very low suspended sediment loads and increased water turbidity could result in several environmental impacts (e.g. unfavourable habitat conditions for fish).

The soils in the area are of the Gleyic Podzoluvisol type (FAO), mainly acidic (surface pH 4.2-5.8) and are 0.6-1.0 meters deep. The clay content ranges between 10% and 25%, which gives rise to low permeability¹¹. Disturbed soils can give rise to suspended sediment loads and dissolved salts in surface runoff water. The clay particles of less than 1 µm in diameter are easily suspended and generally take much longer to settle out than coarse material. The impacts of increased suspended sediment relate to physical characteristics of the water body, as well as the downstream deposition of such material. The primary impacts of such changes to the water in rivers could include the following:

- Reduced hunting success of predators due to reduced sight
- Increase in water temperature due to absorption of light energy
- Reduced primary production (photosynthesis) due to lower light penetration

¹¹ Stolbovoi V., and I. McCallum, 2002. *Land Resources of Russia* (CD-ROM), International Institute for Applied Systems Analysis and the Russian Academy of Science, Laxenburg, Austria.

- Less efficient respiration of aquatic species
- Modified breeding behaviour due to reduced sight
- Increased sediment will reduce the aesthetic appeal of the rivers, and as a secondary impact of ecological response, fishing potential could be reduced.
- A higher sediment load will increase the scouring potential of the water body, which could affect geomorphological processes.

Mobilized sediment will be deposited downstream, with the following potential environmental impacts:

- Deposited sediment will reduce the available habitat to bottom-dwelling aquatic species (invertebrates and fish)
- Deposited sediments will reduce the aesthetic appeal of rivers
- Pools can become filled with sediment
- Submerged vegetation can be coated with fine sediment
- Changes to the channel morphology will change hydraulic processes
- Sediments deposited before surface runoff reaches rivers would change the surface characteristics of soils, with potential impacts on germination and growth of smaller plants

6.3.6 Acid rock drainage

The sulphide minerals required for ARD are not present in either the bauxite or the rock types (principally basalt) that will be removed and stockpiled as part of the overburden. Ongoing monitoring results do not indicate excess acidity in the surrounding surface water and thus ARD effects are not considered relevant to the mine's activities.

6.3.7 Potential impacts on river biota

Potential habitat changes brought about by the discharge of water into the Vorykva will result in turn in changes to the river biota. The various stages in the lifecycles of the fish species in the Vorykva occur in different parts of the river, with spawning for example taking place in shallow parts of the river where the water flow is slowed and the temperature of the water relatively higher. As the characteristics of these parts of the river are changed under the new flow regime there will be impacts on the various lifecycle stages of the various fish species in the river.

At the same time areas of foraging/feeding will change for both predatory and non-predatory species. It is not possible at this early stage to define the direct impact on fish populations but can be stated with some certainty that there will be a severe disruption to the ecology of the Vorykva and until there is better information available on the extent of that disruption the precautionary principle dictates that reductions in fish populations could result from the proposed discharges into the Vorykva.

Table 28 Selected aspects of Atlantic salmon habitat requirements together with the thresholds of possible change that can be tolerated by the species (Hendry and Cragg-Hine, 2000).

Biodiversity Pattern/process	Requirements	Acceptable conditions
Spawning	- Clean, coarse gravel. - Preferred current velocity - Suitable water depth	25 – 90 cm.s ⁻¹ 17 – 76 cm
Egg incubation	- Acceptable range of winter water temperatures.	3°C – 12°C (generally < 25°C)

Biodiversity Pattern/process	Requirements	Acceptable conditions
	temperatures. - Stable gravel beds. - High gravel to fine material ratio.	25 ⁰ C)
Feeding	Invertebrates (spring)	Conditions that support abundant mayfly, caddisfly and stonefly.
Habitat	Juveniles: - Mix of riffles and deeper pools - Suitable water depth - Suitable water velocity (NB) - Streambed substratum - Overhanging vegetation - Woody debris in-stream - Aquatic vegetation Adults: - Overhanging vegetation - Submerged vegetation - Deep water and surface turbulence - Woody debris in-stream	20 – 40 cm 60 –75 cm.s ⁻¹ Cobble up to boulder (64 – 256mm)

Table 28 shows only some requirements of salmon and how these relate to river function. However, even with this very broad and superficial consideration of what is required to support salmon production, it is clear that:

- Salmon have very specific requirements in terms of their breeding, feeding and growth ecology (i.e. small ranges of tolerance and specific requirements at specific times of the year).
- These requirements are directly dependent on certain features of, and the maintenance of system variability in the river system, including the riparian zone.

The near-pristine condition of the Vorykva, Cherney and Balotny Rivers clearly support the conditions required to support the production of both salmon and other fish species. Additional water discharge into the

Vorykva River will likely reduce system variability and through this, reduce the variability of the patterns and processes that match the requirements of salmon at various stages in the fish life cycle. Increased volumes (ten times low flow for example) and higher water temperatures (reducing freezing) resulting from the expanded mining operation are likely to affect river hydrology significantly (Beltaos, 2000, Ma and Fukushima, 2002 and Van der Linden *et al.*, 2003).

Increased volume will also affect sediment dynamics. The impacts of these changes cannot be quantified here, but in terms of salmon requirements at least, the impacts on for example suitable spawning substrate availability, suitable depth of water and water velocity are likely to be significant, given the specific requirements of this species.

Maintaining the conservation and fisheries status of the river clearly depends on managing and maintaining the spectrum of variability of pattern and process that is currently characteristic of these systems. A process such as salmon production certainly appears to be very vulnerable to even small changes in river characteristics. For example, salmon can ideally tolerate a 2-fold change in water depth (juveniles) and 4.5-fold change in depth for spawning adults. Large changes (for example the proposed 6-fold increase in low flow volume) are therefore likely to affect fish populations dramatically and probably to the extent that conditions will be completely unsuitable for some fish species (leading to local species extinction).

Given the above discussion, it should be clear that the ability of the Vorykva River to assimilate the projected pumped ground water quantities is limited as a result of the sensitive ecosystems that support diverse fish populations. At the same time, high suspended sediment loads from surface water runoff, or from increased flow conditions in the river, may also result in impacts on fish diversity and populations in the river. On the basis of available information it is simply not possible at this stage to define an acceptable discharge volume that will not affect the hydraulics of the river, and associated aquatic habitat in the manner described above.

6.3.8 Key water resource protection findings from the due diligence audit

The following are the key audit findings for water resource protection:

- There are no large-scale water management problems as a result of either rainwater or ground water entering the mining pit under the current mining scenario. However, it should be noted that mining of lower-lying bauxite deposits under an expanded operation may (will) result in groundwater entering the pit and the need for de-watering.
- There are no indications of exceedances of relevant water quality standards for the current mining operation.

The following were identified as gaps in terms of water resource management.

- The design and function of the sewage and domestic effluent disposal system is inadequate, resulting in the discharge of chlorinated effluent into the environment
- There is no formalized drainage and suspended sediment control system at the Central Blending Yard resulting in the risk of introduction of high loads of sediment (clay, etc.) into surface water bodies.
- Erosion of soil from sites cleared in advance of mining and overburden storage presents a risk of the introduction of high loads of sediment (clay, etc.) into surface water bodies.
- Erosion of soil from road and rail embankments presents the risk of the introduction of high loads of sediment (clay, etc.) into surface water bodies.



Figure 19: The Vorykva River in the vicinity of the MTBM.

6.3.9 Water quality impact assessment

6.3.9.1 Extent

The direct extent of potential impacts on the Vorykva is deemed to be **local** but could become **regional** if typical high flow volumes discussed earlier are discharged, but because of the role played by the river as a spawning area for fish species and salmon in particular, the indirect impact is considered to be **regional** in extent.

6.3.9.2 Duration

The duration of the impact will be **long term** given that the dewatering is likely to be maintained for some 30 years and even once the dewatering is discontinued it is likely that there will have been significant changes to the river morphology and habitat, that may remain for some time after the mining has been stopped.

6.3.9.3 Intensity

The intensity of the potential impacts on water quality is considered **high** due to the ecological significance of the Vorykva (as a protected ichthyological reserve) and the threats inherent to fish diversity and populations. These threats arise from the changes that will be caused by changes in the flow conditions and physical, chemical and nutrient property changes in the river as a result of the projected water volumes that will be released into the river.

6.3.9.4 Probability

The impact of reduced fish diversity and populations is considered to be **highly probable** in the event that there is no mitigation geared towards reducing the quantity of water being discharged

6.3.9.5 Impact significance

Given the above the significance of the potential impacts on the Vorykva is **high** which means that the proposed activity could result in substantial detrimental effect to the environment. For this reason mitigation will be required to ensure that the impact significance is lessened to the point of not impairing the ecological function of the Vorykva.

6.3.10 Mitigation

6.3.10.1 Overview

Mitigation to reduce the significance of the potential impact lies in several possible domains. Before describing these domains it is necessary to emphasize that there is simply not enough final information at present to evaluate the dewatering requirements and therefore to assess the options for mitigation or quantitatively presenting the adequacy of the implementation in reducing impact significance. As a result the mitigation presented here is grounded in further, more detailed investigations that will be required on the river systems that can be used to quantitatively assess the effectiveness of the proposed mitigation. Before presenting that, it is necessary to emphasise that ***discharges from dewatering will not be directed into the Vorykva until a complete hydrologic and hydro-geological investigation has been completed to provide a full understanding of the situation. This includes potential impacts and the required mitigation measures to ensure that the dewatering and disposal of extracted water does not cause unacceptable environmental impacts.***

When the mine plan is finalized and based on further scientific evidence that will be gathered in the interim, Komi Aluminium and MTBM will ensure that potential impacts on river biota are comprehensively defined and quantified where possible. Once these impacts have been so defined the mitigation plan in the following section will be a finalised to ensure that there is no significant impact on the Vorykva River and the VSIR. The approach to defining mitigation is presented schematically in Figure 20.

It can be seen from Figure 20, that mitigation is directly dependent on reducing the quantity of the discharge water that goes into the Vorykva. Given the projected quantities of discharge it seems highly improbable that a zero discharge scenario is feasible. That implies reducing the discharge quantity by as much as possible and then determining a threshold of acceptable discharge into the Vorykva. That threshold can be defined at two possible levels, firstly a threshold that will ensure that there are no significant effects on the river hydrology and hydraulics and in the event that proves impossible, ensuring that there are no impacts that will lead to reductions in fish diversity or populations. If it cannot be guaranteed that there will be no reduction in fish diversity and/or populations then the impact must be deemed to be unacceptable. A thorough review of alternatives will be undertaken, based on a detailed numerical model of the dewatering system and river-aquifer interaction (Fig. 21). This will be used to make a final decision on an overall mitigation strategy and implementation of feasible mitigation measures. This will take place by the end of calendar year 2004.

6.3.10.2 Further investigative work on dewatering requirements

The amount of test work carried out in the past is extensive. There is an adequate amount of information, and this will be used to develop a good numerical aquifer model. Once the model has been developed it will be used to define dewatering requirements for each of the pits as they are developed. Hydraulic interference effects between pits will be assessed as well as river and aquifer interaction to provide accurate predictions of the dewatering requirements and quantities.

It is understood that a numerical aquifer model has been developed so the first step will be to review update and/or further develop this model once the final mine plan has been decided. In the interim, the model will be extended to a dewatering model to assist in the detailed planning and management of the dewatering system and to assist in assessing options for mitigation of the effects of dewatering. As part of this process a detailed review will be conducted of all the available information on the hydrology and geohydrology of the area, to obtain additional insight into the surface and groundwater conditions that prevail, as well as the interface between the two.

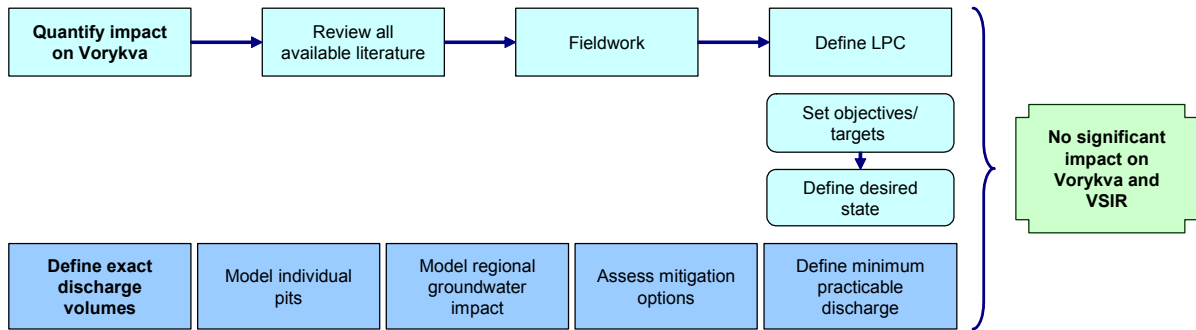


Figure 20: Schematic presentation of the process of defining mitigation to ensure zero impact on surface water systems.

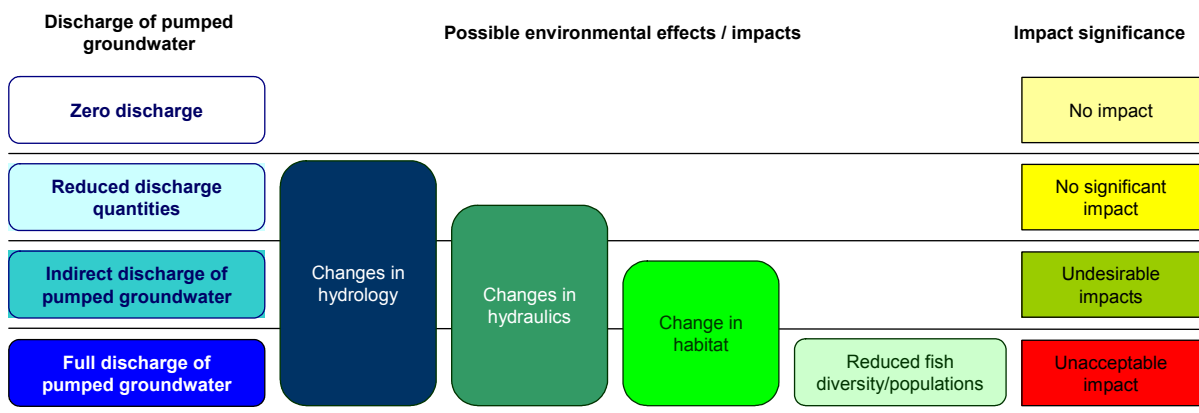


Figure 21: Schematic presentation of the possible environmental effects/impacts of discharging pumped groundwater and associated impact significance.

6.3.10.3 Modelling and management requirements

The hydrogeology is complex and the number of pits and sequencing of mining means that it is difficult to make a confident assessment of the dewatering requirements without a detailed numerical model. Such a detailed numerical model will be developed as part of the feasibility study, final design and for ongoing management of the aquifer system. It is understood that the existing model only covers the hydrogeology of the central area and is not a dewatering design model.

The numerical aquifer model presently being developed will be extended to cater for preliminary design and as an ongoing management model for the dewatering system. Due to the scale of the regional model, separate models for each of the main pit areas may be required to enable it to be used to optimize the individual dewatering systems. An extensive series of piezometers will also be established to monitor the performance of the wells and the interference effects between adjacent pits. This will be especially important in the initial stages to confirm that aquifer dewatering is progressing sufficiently in the confined aquifers ahead of mining.

6.3.10.4 Surface water hydrology

A lot of information is available on the surface water hydrology. Additional work will take place to review this information in detail. This information will no doubt prove to be valuable in developing a model of the river

flows through the seasons to be able to assist in designing possible discharge methods. At the same time local expertise will be used especially the Komi Institute of Biology who have good knowledge of the local conditions, and the characteristics of the aquatic biota. These inputs will be supplemented by inputs from 'Geolog' based in Ukhta, who have good working knowledge of the geology and hydrogeology in the vicinity of the mine. The purpose of this work will be to characterize surface water hydrology in the Vorykva as the basis for properly defining possible changes in river hydrology and hydraulics as a result of the proposed discharges into the Vorykva.

6.3.11 Options for reducing the discharge volumes

There are a number of possibilities to limit the impact of discharge from a dewatering system. Large dewatering systems for mines in Russia are not unusual and the nature of the aquifers in the area mean that a zero discharge option will be extremely difficult and expensive. No assessments have been done to establish the worst-case total discharge requirement during the life of mine. The preliminary schedule shows that dewatering will not be required until year 5, with high volume discharges (100,000 m³ a day) arising in year 9, increasing progressively through to year 24 (350,000 m³ a day) and reducing in year 28 (200,000 m³ a day). This provides enough time for the true dewatering requirements and water management options to be assessed and designed so as to ensure that the objective of zero impact discharge is upheld.

Options for reducing the discharge volume are listed below. It must be emphasised that these have not been assessed in any detail, but there is a commitment from Komi Aluminium and MTBM to investigate each with a view to ensuring that the mine expansion can be implemented without significant negative impact on the VSIR. The mitigation options include:

- Discharge into another catchment to the north or the east;
- Splitting the discharges to 2 or 3 river catchments
- Discharging into the swamp/wetlands areas to ensure stabilisation with ambient conditions including chemistry and nutrient load, before the water reaches the river;
- Investigating the principle of 'no net loss' – the full impact on the Cherney and the Bolotny of the proposed diversion of these streams has not been quantified, but the potential loss of the marshy areas that they drain as a result of excavations of Vezhayu-Vorykvinskoye, must be examined with a view to creating a 'replacement' marshy environment. This in the spirit of the principle of 'no net loss'. ;
- Developing groundwater cutoffs and grouting to reduce inflows but this would be extremely expensive and would also impact significantly on side slope stability and slope angles;
- Using earlier pits as recharge cells but this could only work if permeability of the discharge pit is at least as high as the pumped pit;
- Artificial recharge into recharge wells specially drilled between the abstraction wells and the rivers. This would remove the water while also maintaining the groundwater levels outside the dewatering wells in the surrounding aquifer (this will be especially important in reducing potential impacts on the regional groundwater condition – see next Section) .
- Concurrent use of some of the above options to maximize the possible reduction in discharge volumes, whilst maintaining cost effectiveness in the mining operation.

Komi Aluminum is committed to a solution that will ensure that no discharge will be allowed from the mine, if it will result in negative impacts on the VSIR. Discharge into the Vorykva river would have to take place throughout the year due to the volumes of water abstracted but location and acceptable volumes will be properly assessed technically and with the involvement of the relevant authorities, stakeholders, and local and international experts to ensure that only volumes and quality of water that will not result in significant impact on the environment will be discharged. For example, discharge could occur into rivers that are less vulnerable. Also, there may be some scope for attenuating the discharge in low flow times if a temporary storage can be used in an abandoned pit. It will not be feasible to stop pumping the dewatering wells for any length of time.

Komi Aluminium will now embark on strategy to find discharge solutions that will have “zero impacts on the natural environment”. At an appropriate time, and if needed, an independent review of this strategy will be initiated by IFC and EBRD prior to further involvement in the mine expansion. Finally, but importantly, the zero impact discharge strategy will need to be presented in the OVOS documentation that will be submitted to the Russian SER. A positive conclusion will be required from the SER before the mine expansion can be implemented.

6.3.12 Defining an acceptable threshold for zero impact discharge

In parallel to the assessment of different scenarios for reducing the amount of water discharged to the Vorykva it will be necessary to assess and define an acceptable discharge quantity to the river. As a minimum this discharge quantity will need to ensure that there is no impact on fish diversity or populations in the river and preferably no significant impacts to river hydrology or hydraulics. It is proposed here that the approach of defining Thresholds of Potential Concern (TPCs) be utilized. These are defined briefly below together with a method that can be used to define the same.

6.3.12.1 Thresholds of Potential Concern (TPCs)

TPCs represent statements or hypotheses of the limits of acceptable change in ecosystem structure, function and composition (Rogers and Biggs, 1999). TPCs and the approach used to derive them will be used to provide ecological thresholds for the Vorykva, as they relate to conservation objectives. TPCs are based on a desired state of the system. The desired state is in turn underpinned by the structure and dynamics of the patch mosaic of different types of river reaches, as well as particular conservation concerns. The TPCs can be used in this case to reflect the hydrological and hydraulic threats posed by the need to dewater. The TPC for discharge to the Vorykva is likely to be zero (or very low) as it is an ichthyological reserve (VSIR). This work will be driven to coordinate closely with the Russian authorities and the government agencies responsible for the reserve, in ensuring that if it is possible to define a zero impact discharge, it will be done with the full participation and endorsement of Russian regulators and local specialists including the local Komi Institute of Biology.

6.3.12.2 A method for defining TPCs

Define Desired State

The overall conservation goal, or ‘desired state’, is defined by the structure and dynamics of the river patch mosaic. The patch mosaic consists of ‘patches’ of various scales of ecological importance. Scale importance is in turn, determined by the underlying biophysical template as well as the biological and ecological response to impact. These parameters assist in defining the boundaries (or thresholds) and targets for conservation.

Setting goals and targets (TPCs)

An objectives hierarchy process is used to disaggregate the ‘desired state’ and its key elements into a series of objectives of increasing focus, rigour and achievability. These objectives can be set in this case to ensure the conservation of the Vorykva River. The goal setting process is driven by the identification of strengths (of the river system in this case), determinants of these strengths, threats and constraints and these are then reconciled to produce a next level of objectives. This process cascades down into increasingly technical and measurable parameters and end in the definition of the actual, quantified TPC. All TPCs are defined in spatial terms as well depending on the characteristics of the river system and maintaining the habitat required to protect the conditions in which the lifecycles of the various fish species unfold.

6.4 Ground water impacts

6.4.1 Potential impacts

The need to dewater aquifers ahead of the mining operation will result in a significant loss of water from the

aquifers. As such it is necessary to assess the effect of the water loss at a regional level to determine whether the dewatering will have an effect on groundwater quality or quantity and or whether other impacts may manifest as a result. Such impacts include (but are not limited to):

- Changes in topography as a result of settling or deformation –formation of depressions
- Lowering of the water table and changes to the ecological character of marshy areas and/or peat bogs
- Reduced availability of ground water for other possible land uses (unlikely to be significant given that there are no communities living in close proximity to the mine)
- Long term effects on regional groundwater, including water supply of surrounding communities
- Reduced water supply to rivers in the area, most notably the Vorykva – through the possible loss of tributaries and direct decant of water from underlying aquifers.

6.4.2 Extent of cone drawdown

The cone of drawdown in the various aquifer units will be constrained by the fault boundaries to a large extent, except to the north and the west. Faulting in the east brings the low permeability schists into contact with the basement rocks. The proposed aquifer model will enable the extent of the cone of drawdown and associated potential impacts, to be assessed.

It can be expected that the cone of drawdown will extend to the subcrop of the carboniferous and Devonian rocks in the west but the Vorykva River is likely to be a hydraulic boundary to the west although if it responds actively to constrain the extent of the cone of dewatering, the streamflow will be impacted. It is likely that the dewatering effects will spread further to the west but only to be constrained by a faulted contact. The anticipated quantities of water to be abstracted are large therefore the cone of drawdown can be expected to extend for several kilometers from the point of abstraction. This will be predicted for the different mining scenarios, using the numerical model described earlier.

To the east, the lateral extent of the cone of drawdown will be constrained by the faulted schist contact as well as the progressive decrease in permeability in the basement rocks. There will be an effect to the south in the direction of normal groundwater flow. Again, this will be predicted using a numerical model.

The Verkhne River can potentially be impacted by dewatering especially in the southern part to the west of pits 5 and 6. The pumping test results showed mixed results but it was concluded that there is likely hydraulic connection between the river and the alluvium and basement aquifer. A 2D model will be used to carry out a sensitivity analysis and evaluate the risk and magnitude of flow. This will enable the potential pit inflows to be refined as well as provide important information on the potential impact on the river.

6.4.3 Changes in topography

The scale of the dewatering in a regional context, of 200,000 m³ a day (or more) is significant. The extraction of such quantities of water may result in localized surface settlement around the pit areas and possible local subsidence where karst features exist on surface.

Reduced water supply to rivers. The relationship between the rivers and the aquifers is also unclear at this stage, although there is evidence suggesting both hydraulic contact and hydraulic barriers in different parts of the Vorykva. As such the possibility exists of reducing the flow in at least the Vorykva as a result of the dewatering programme – by reducing the quantity of groundwater that may flow into the river from the underlying aquifer. Although the full extent of this contribution is not well understood at present there are several artesian wells in the area, where such spring water flows into the river. This is an issue of critical importance in understanding the full impacts of the dewatering programme and how best to mitigate these impacts. As a result it will be investigated as an urgent priority in better defining the impacts that could be associated with the dewatering.

It will be important to understand groundwater flow mechanisms in the various hydro-geological units present and associated recharge areas. In particular, to determine if the flow in the carbonate unit is fracture flow or through dissolution cavities. Further, it is crucial to understand what impact the dewatering will have on local groundwater and surface water, and any associated environmental impacts, such as dewatering of the river.

6.4.4 Lowering of the water table

As the water table is lowered the peat bogs in the area may start to drain and this will impact on the habitat created by the peat bogs. The peat bogs that exist on the downstream side of the Cherny and Bolotny may thus be impacted upon, by disruptions to the Cherny and the Bolotny, physical transformation as the pit is excavated and finally a drying out as a result of the lowering of the water table. As described previously the peat bogs have ecological significance as a roosting area for migratory birds and changes in the character of these bogs will reduce the attraction of the area to migratory birds.

Another issue that must be considered is the potential impact on water supply to other potential users of the aquifer water. Given that the mine is in a remote location, other use is considered highly unlikely. The cone of drawdown might impact on the mine's own water supply, however, and this will have to be assessed in more detail during further investigations into this issue.

6.4.5 Groundwater impact assessment

6.4.5.1 Extent

The possible impacts on groundwater as a result of the expansion of MTBM are **regional** in extent given the large area that may be affected by the dewatering of the various pits. There will also likely be a range of **local** affects such as deterioration in the ecology associated with the peat bogs.

6.4.5.2 Duration

The duration of the impact will be **long term** and if sinkholes or depressions form, these will be **permanent**.

6.4.5.3 Intensity

The intensity of the impact is likely to be **moderate to high** depending on the full extent of the effects of the dewatering. If the effects extend to a reduction in the flow of the Vorykva and Vym rivers the intensity of the impacts is considered **high**.

6.4.5.4 Probability

The impacts described above are considered to be **probable**.

6.4.5.5 Impact significance

Given the above impact significance, in the absence of mitigation, is considered to be **high**.

6.4.6 Mitigation

The mitigation required to reduce the significance is closely related to the mitigation options for the surface water impacts described earlier. Some of the options to reduce the quantities of discharge water are based on the principal of recharging the aquifer and wherever this gets done the extent of the dewatering cone and associated impacts will be reduced.

The key requirement is to develop an understanding through modeling, of the relationship between surface water and groundwater. This will serve to better define the dewatering requirements as well as providing a more quantitative assessment of the potential impacts on the Vorykva, of the water that will need to be discharged. The process of doing so is described in more detail in the section describing mitigation for surface water impacts.

As discussed earlier it is simply not possible at present to assess the full extent of the likely impacts that may

be brought about by the dewatering requirement of the expanded mine. Neither is it possible to present mitigation that is assuredly implementable, cost effective and effective in preventing ecological degradation of the Vorykva river. As a result it is neither possible nor prudent to change the current significance rating for potential surface and groundwater impacts as a result of the proposed dewatering requirement, until the river system is better understood and has been better defined, and the practicality, cost and effectiveness of the mitigation proposed has been properly assessed.

This is not to say that impacts on either the regional groundwater condition or the Vorykva cannot be prevented or reduced to an acceptable level. Although it seems unlikely that a single mitigatory response will serve to address the impacts, it is equally likely that a combination of the approaches will enable the principle of zero impact discharge to be maintained during the expanded mine operation. Only once these options have been investigated within the context of the current ecological function of the river, the cost and practicality of implementation will it be possible to make a final decision on the environmental feasibility of the proposed expansion.

6.5 Impacts as a result of waste generation

The most significant waste type that is generated by mine operations is overburden and waste rock. These waste types will be temporarily stockpiled before being returned to the pits as part of the reclamation process. Overburden and topsoils will be kept separately for further use during reclamation activities. In terms of current mine operations the absence of a formalised domestic waste landfill presents a potential threat to the environment but given that such a landfill will be developed as part of the proposed expansion, the risk of impacts associated with the disposal of domestic waste is likely to be low.

In terms of hazardous waste the dominant waste type in terms of quantity is used oil and oil-contaminated materials. These wastes will either be recycled (in the case of the used oil) or used as a fuel in the boiler. The disposal of used oil by using it as fuel is directly prescribed by the Russian regulatory authorities, but will be investigated for possible conflict with EBRD (essentially EC) requirements. In the event that there is a conflict the mine will discuss an alternative disposal strategy with the regulators, and implement that disposal option. Fused mercury lamps constitute the most hazardous waste type but these are generated only in relatively small quantities and there is provision for the recycling of the lamps so that they do not need to be disposed. Several options exist for the disposal of tyres and although these are not yet implemented at the mine, a safe disposal option for tyres will be implemented as part of the expansion of the mine.

6.5.1 Key waste findings from the due diligence audit

The following are the key audit findings for waste management:

- For the most parts the mine's operations comply with existing waste management regulations and permit requirements.
- A waste management plan (Waste Storage and Neutralization) has been developed and has been approved by the state environmental bodies for the period of 1 year.
- All the wastes are removed and disposed of timeously except tyres, which are temporarily stockpiled.
- Because the mine is still relatively new, there are few used batteries. Batteries that have become unserviceable are temporarily stored at the mine and will be recycled in future.
- There are no asbestos products at the mine that require disposal.
- Again, given that the mine is relatively new, there are no transformers with PCB containing transformer oil.

The following gaps have been identified in terms of waste management:

- There is no formal disposal facility for municipal solid waste (MSW) and the current practice of disposing the same to the overburden stockpile is not an acceptable waste management practice.

The planned introduction of a formalized landfill for MSW at the mine should be expedited.

- Although the quantity of used tyres is relatively small (approximately 200 a year), the ongoing accumulation of used tyres may start to pose a problem in future.
- There are a number of scrap metal stockpiles in an around the mine which also contravene good waste management practice. Containers are not clearly separated and marked as required by regulations.
- It is recommended that as part of the landfill development, a waste transition facility be developed that provides segregated areas for waste disposal that are properly marked and numbered.
- The 1-year validity of the waste management plan is unduly restrictive and should be developed for a 5-year period.
- The installation of a diesel-fired rather than a coal-fired boiler has resulted in the incorrect classification of waste from the mine (clinker coal is currently specified as a waste type).

6.5.2 Waste impact assessment

6.5.2.1 Extent

Possible impacts associated with the proposed waste handling associated with the mine expansion will be **local** in extent and limited to the progressive use of airspace in the domestic waste landfill. No significant impacts are associated with the temporary storage of overburden and waste rock, and the planned implementation of a robust reclamation programme, will reduce the threat of impact further still.

6.5.2.2 Duration

The duration of the impact will be **long term** and follow the life of the mine. The domestic waste landfill will be **permanent** but impacts associated with the landfill will be limited, if at all.

6.5.2.3 Intensity

The intensity of the impacts associated with waste management is likely to be **low**.

6.5.2.4 Probability

The manifestation of significant impacts as a result of waste generated during expanded operations are considered **improbable**.

6.5.2.5 Impact significance

Given the above impact significance is considered to be **low**.

6.5.3 Mitigation

A waste management plan will be developed for the expanded mine operation and mitigation will take the form of the implementation of that waste management plan. The waste management plan will satisfy Russian regulatory, IFC and EBRD requirements (specifically the EC Framework directive on waste). The waste management plan will specify procedures for:

- Minimising waste at source
- Segregation and temporary storage
- Re-use and recycling
- Final disposal
- Monitoring of waste management performance

In order to fulfil these requirements two facilities will be established at the mine. These are:

- A formal municipal waste landfill at the mine that meets Russian regulatory, IFC and EBRD requirements (specifically the EC Landfill Directive).
- A dedicated waste transition area that can be used as a central collection area for waste generated at the mine, and from where the waste once segregated, can be sent for recycling, recovery or disposal.

6.6 Hazardous materials

Materials spillages, especially oils and petroleum products, pose a risk to surface and ground water quality. In general terms, this is an area of concern that was highlighted during the environmental and social due diligence audit, given the lack of spill control/prevention facilities at the various fuel storage facilities and evidence of oil leaks from vehicles and ad hoc maintenance, refuelling, lubrication and topping up of oil that happens across the mining area. The planned establishment of proper refuelling facilities at the mine with the necessary hard surfaces, bund walling and spill drains and capture sumps will significantly reduce the threat of such spillages, despite the fact that significantly larger volumes of fuels and lubricants will need to be stored at the mine to provide for the increased vehicle fleet and equipment.

As part of the Environmental and Social Action Plan (ESAP) that followed the completion of the Social and Due Diligence Audit, it was recommended that a full spill management plan be implemented at the mine. This spillage plan is to include the identification of all activities that have the potential to result in spillages of hazardous materials, and the development and implementation of operational procedures and facilities to:

- prevent spills
- ensure that when spills do occur that they are rapidly and effectively ameliorated
- reduce the potential for spilled material to enter the environment

These facilities include bunding for storage tanks, filler connections and loading/unloading areas, consolidation of outdoor maintenance areas, sealing the floors of maintenance areas and the establishment of oily water separators at points of discharge of surface water runoff into the external environment. The implementation of these requirements will reduce the potential for spills to result in an impact on ground and/or surface water quality.

6.6.1 Key hazardous materials findings from the due diligence audit

The following gaps have been identified in respect of hazardous materials management:

- There is no formalized hazardous materials management on the mine for the purpose of protects the environment from the effects of uncontrolled release of hazardous metals.
- Vehicle and plant maintenance and servicing is *ad hoc* and scattered and has no hard surfaces, banded floor area, drip trays, etc. This implies a number of areas where the risk of spillage of fuel, oil, hydraulic oil, and resultant soil contamination is high.
- There is no spill containment structure beneath and around the used oil storage cage, resulting in the risk of uncontrolled discharge of pollutants into the environment.
- No oily-water separator is in place.
- There is no spill containment structure beneath and around the vehicle refuelling station and generator supply fuel tank resulting in the risk of uncontrolled discharge of hydrocarbon pollutants into the environment.
- Field maintenance of plant (bulldozers) and ore trucks occurs currently on the overburden dump resulting in the risk of uncontrolled release of pollutants into the environment (oil, hydraulic fluid, etc.). Many of the vehicles were seen to be leaking oil.
- The fuel storage facility at the central blending yard is inadequate (no hard surface, no bunding, no drip trays etc.) resulting in the risk of uncontrolled discharge of pollutants into the environment.
- The above-ground fuel pipeline feeding the generator is vulnerable to being broken by passing plant

or vehicles resulting in the risk of uncontrolled discharge of hydrocarbon pollutants.

- The diesel tank used to supply heat-generating equipment for the workshops is not fitted with vapour venting equipment, there is no filler cap and no spill containment facilities around the filler point resulting in the risk uncontrolled release of hydrocarbon pollutants into the environment.
- There are scattered accumulations of scrapped equipment, some of which may contain pollutants such as oil and hydraulic fluid with resultant risk of uncontrolled discharge into the environment.

6.6.2 Hazardous materials impact assessment

6.6.2.1 Extent

The extent of impacts associated with possible spillages of hazardous materials is considered to be **highly localized** given that there will be effective controls at points of possible spillage as well as mechanisms for the rapid and effective rehabilitation of spillage should these occur.

6.6.2.2 Duration

The duration of such impacts would be short term in nature. Again, this is a function of measures to remediate rapidly in the event of a spill before the hazardous materials can impact on ground or surface water.

6.6.2.3 Intensity

Given the environmental sensitivity of surrounding watercourses the intensity of the impact were hazardous materials to be released into the environment would be severe. By ensuring that even in the event of a spill, that hazardous materials are not released into the environment the impact intensity would be **low**.

6.6.2.4 Probability

The manifestation of a significant impact on the environment in the event of a hazardous material spill is considered to be **improbable**.

6.6.2.5 Impact significance

Given the above, the significance of potential impacts on the environment is considered to be **low**. However, it must be emphasized that this rating is contingent on the full implementation of the various spill control measures defined in the mine plan and supported by the implementation of the Oil Spill Prevention, Control and Countermeasures Plan that is included in the ESAP presented as part of this document.

6.6.3 Mitigation

To ensure that impact significance remains low a fuel spill prevention, control, and countermeasures plan (SPCC) will be developed and implemented. The SPCC will include information and management interventions in respect of:

- Materials, properties, quantities, and containers;
- Safe practice in transporting materials;
- Spill responsibility;
- Readiness;
- Accidental release notifications, and protocols;
- Spill prevention;
- Spill control and countermeasures; and,
- Employee training.

6.7 Impacts on ecology

6.7.1 Physical transformation of the landscape

The most obvious and direct impact on ecology will be the physical transformation of the landscape as vegetation is cleared ahead of the mine expansion (Table 29). This will have the effect of destroying habitat that may be home currently to the various faunal species described in the baseline. It is important to recognize though that the existing mine activities have probably resulted in the clearing of these areas of fauna anyway due to noise and other disturbance from the mine. At the same time the surrounding vegetation is largely homogenous implying that faunal species could relocate with relative ease to other areas where there will be no clearing of vegetation and resultant habitat destruction. In relative terms the size of habitat that will be lost as a result of the vegetation clearing ahead of the mine is small.

Table 29: Additional land disturbance that will be brought about by the proposed mine expansion. Note that these areas may be less following the finalisation of the mine plan.

Current source	Current area	Expanded area	Increase	Percentage increase
Haul roads	88	122	34	39%
Overburden stockpiles	310	1032	722	230%
Mining areas	409	2,933	2,524	617%

6.7.2 Access to previously inaccessible areas

A less direct impact on ecology, but potentially more significant impact would be the access provided by the land clearing to new parts of the forest and poaching. This is also an impact that can be effectively prevented through developing and strictly enforcing anti-poaching policies amongst the directly-employed workforce and contractors alike. This is also an area that will require ongoing monitoring to ensure that there is not an adverse impact on faunal populations in the area. Note that the mine has strict access control on the last section of the access road to the mine. The road has a gate manned by a security guard who only allows mine personnel to pass.

6.7.3 Changes in water quality and flow regimes

Finally, potential changes in water quality and the flow regimes of the Vorykva as described above could have a detrimental effect on the aquatic life in the river. This would impact in turn on fish populations and undermine the purpose of the ichthyological reserve. This implies ensuring that there are no uncontrolled discharges of effluent of any sort into the Vorykva River, either from dewatering, other effluent (especially sewage) and control of hazardous materials and hazardous materials spillages across the mine site. The potential impact of the dewatering is considered to be significant, to the extent of reducing fish populations in the Vorykva (see Section 5.12).

6.7.4 Rare and/or endangered species

From the baseline description it is evident that there is a range of rare and endangered species of both flora and fauna, which could occur in the area targeted for the mine expansion. In terms of fauna it is considered that there are no characteristics of the landscape that would be affected by the proposed mine expansion that present a specific and unique habitat for the endangered faunal species listed. The marshy area of the Cherry and Bolotny streams, however, is known to present a roosting area for migratory bird species, and while the loss of that marshy area, would probably not represent a significant change in the availability of

such habitats, it is worth considering the principle of no net loss and investigating the possibility of replacing the marshy area that will be lost when the pit is excavated.

In terms of floral species, the possibility exists that some of the endangered species of flora listed in the baseline could be present in the area to be cleared. For this reason it will be necessary to survey the area ahead of the clearing of the vegetation and to identify and relocate rare and or endangered plant species. However, the area that will be cleared ahead of the mine expansion is considered not to present unique features that support the propagation of rare and or endangered floral species.

Finally it must be emphasized that the arguments presented above, pertinently exclude the Vorykva River and its tributaries. Given that the river is a declared ichthyological reserve, it must be assumed that all fish species within the river are protected and any threats to the ecological integrity of the Vorykva will pose a significant risk to the aquatic biota it supports.

6.7.5 Key ecological findings of the due diligence audit

The following are the key audit findings for ecology:

- The physical transformation of the natural environment as a result of the mine and associated infrastructure is not considered to have resulted in a significant ecological impact.
- There are several protected ecological areas in the vicinity of the mine, these include:
 - The ichthyological reserve
 - Important landscape reserves
- Much of the environmental management effort on the mine is geared toward protecting the ecological reserve (the construction of the railway bridge is a good example). The mine has no direct impact on the important landscape reserves.

The following gaps have been identified in terms of ecological impact of the mine and associated infrastructure:

- The constructed road and rail infrastructure (for access and product conveyance), appears to have disrupted the surface hydrology (flow impedance and back-flooding) which may be affecting forest ecosystems
- Forest clearing and resultant ecosystem loss in advance of mining, preparation of overburden stockpile areas and the construction of mining infrastructure such as roads, appears excessive.
- The current reclamation/rehabilitation practice is deemed to be problematic for the following reasons:
 - It is likely that the stripped top soil will become sterilized in the period before reclamation/rehabilitation commences
 - There will be a significant cost at the end of the mine life for reclamation/rehabilitation, which could hamper the extent to which reclamation rehabilitation is effected.
 - There is no mention of mine closure, simply references to reclamation and rehabilitation and it is not clear whether or not there is adequate provision for mine closure in the mine plan.

6.7.6 Ecological impact assessment

6.7.6.1 Extent

The ecological impacts of vegetation clearing ahead of the mine and associated habitat loss are considered to be **localized**. These effects extend, however, through the entire mine infrastructure including the railway line and mine access road and from that point of view can be considered **regional**.

6.7.6.2 Duration

The loss of habitat will be **long term** but can be prevented from being permanent through the implementation of the reclamation plan that will be developed as part of the mine plan.

6.7.6.3 Intensity

The intensity of the potential impacts on ecology is considered to be **moderate** even pertinently excluding the potential impacts on the ecology of the Vorykva River and Cherney and Bolotny streams (addressed separately in the section on surface water impacts (see Section 6.3). The reason for the moderate intensity is due to the size of the footprint, the not inconsiderable challenge of effective reclamation, and the increased access to areas that were previously difficult to access.

6.7.6.4 Probability

A significant impact on the ecology of the area (excluding the Vorykva river and related surface water systems) is considered **improbable but possible**.

6.7.6.5 Impact significance

The significance of potential ecological impacts is considered to be **moderate**.

6.7.7 Mitigation

An erosion control plan will be developed and implemented to prevent surface water contamination by suspended solids as a result of land disturbance. This will include:

- Minimising the overall mine footprint
- Maintaining water protection zones as 'no-go' areas
- Establishing bridges or culverts for all stream crossings.
- Designing the bridge that will be constructed over the Vorykva River to forgo support structures that would otherwise impact on the riverbed or banks.
- Establishing catchment and diversion of stormwater
- Using the settlement ponds that will be established for the mine dewatering, for stormwater that may be contaminated with suspended sediment
- Pursuing interim reclamation to stabilize all disturbed land areas that may pose a risk of stormwater contamination
- Only removing vegetation from those areas where it is absolutely necessary (i.e directly affected by project activities);
- Slopes will be minimized and where unavoidable will be revegetated ; and,
- Disturbed areas will have appropriate drainage controls that prevent runoff from both entering the disturbed area or being discharged into an uncontrolled manner on the downstream side of the disturbance.
- Limit the quantity of soil that needs to be stockpiled.
- Pursuing an aggressive reclamation plan

Develop and implement a reclamation and rehabilitation plan (RRP). The RRP will include information and management interventions in respect of:

- Establishing land use objectives
- Reducing the mine footprint
- Managing soil and overburden
- Recovering soil-making material such as weathered basalt
- Ensuring the stability and safety of the areas being reclaimed

- Sloping & contour ripping
- Reintroduction of overburden and topsoil
- Re-vegetation
- Establishing and propagating a nursery
- Monitoring
- Minimising waste dump areas and developing suitable drainage
- Progressive restoration

6.7.8 Birds and mammals

- Minimise mine footprint
- Educate workers to uphold conservation principles
- Maintain and enforce anti-hunting and poaching policy
- Maintain and encourage free access to regulators to police the access road
- Maintain ecological monitoring.

Where stockpiles are unavoidable these will be designed in such a way as to reduce the potential of leaching from surface water and contamination from other sources (e.g., petroleum spills). To ensure that impact significance remains low, the following mitigation will be required:

An erosion management plan will be incorporated in the MTBM Water Management Plan that includes the development and implementation of a stormwater management strategy that includes:

- Diverting stormwater runoff from entering areas where it could become contaminated
- Provide settling areas to allow sediment contained in the stormwater to settle out
- Shape and contour undeveloped areas to ensure that they are not prone to erosion
- Stabilise road and rail embankments.

The mine layout must be subjected to a detailed review to ensure that the footprint of the mine is minimized. This includes selecting suitable corridors for the haul road routings and minimizing the clearing of vegetation prior to mine excavations activities. During the expansion of civil works, MTBM staff and outside contractors will need to receive clear and transparent guidelines on deforestation and land clearing in order to minimize rights-of-way and land use for all need facilities.

Finally and most importantly, reclamation is the single most important mitigation strategy for reducing ecological and other impacts. The reclamation programme must be implemented, as soon it is logistically viable to begin the process of reclaiming disturbed areas. These disturbed areas include areas that have been unnecessarily stripped of vegetation to clear areas for overburden and waste rock stockpiles.

A detailed Mine Reclamation and Rehabilitation Plan (MRRP) will be prepared when sufficient information is available as part of the ESAP. The current practice is not satisfactory but MTBM has agreed to enhance its rehabilitation activities in the context of the development of the MRRP at the beginning of the proposed expansion. MTBM recognizes the importance in bauxite mining to have the reclamation/revegetation stages closely integrated with the mining stage.

6.8 Human health effects

Given the remoteness of the mine from inhabited settlements, as well as the limited environmental aspects that have the potential to cause adverse health effects, the risk of adverse health effects in communities neighbouring the mine is negligible. That excludes adverse health risks to personnel working at the mine but a comprehensive health and safety management strategy will be implemented as part of the mine

expansion. The health and safety management strategy will serve to ensure that all potential risks to worker health and safety from the various mine activities have been identified, that the risks have been quantified and prioritized and that adequate preventative measures have been implemented. These preventative measures include the correct use of Personal Protective Equipment (PPE) such as hearing protectors and respirators to reduce the risk of longer-term adverse health effects amongst the workforce.

6.8.1 Human health assessment

6.8.1.1 Extent

The extent of any potential impact on human health from activities at the mine is considered to be **highly localized**.

6.8.1.2 Duration

Duration is not a relevant criterion given the perceived status of the impact.

6.8.1.3 Intensity

The intensity of the impact is considered **negligible**.

6.8.1.4 Probability

Human health effects are considered **improbable**.

6.8.1.5 Impact significance

Given the above the impact significance is considered **negligible**.

6.8.2 Mitigation

Develop and implement a mine environmental, health and safety plan (HSP)¹². The HSP will include information and management interventions in respect of:

- Worker responsibilities;
- Emergency procedures;
- Accident investigation procedures;
- General health and safety guidelines;
- Personal protection;
- Employee information and training; and,
- Transportation safety.

6.9 Impacts on heritage resources

Information on cultural and heritage resources within the area of the proposed expansion is limited but the area is considered one in which there may have been ancient activities. For this reason the possibility that there will be cultural or archaeological artefacts uncovered within the mine footprint cannot be excluded. As such it will be necessary to ensure that the area is examined prior to the start of the clearing for cultural heritage artefacts and an operational procedure implemented (including a detailed assessment by an anthropologist or archaeologist) that can be used if any heritage or archaeological artefacts are uncovered during pit excavations.

¹² HSP will be based on the World Bank's Occupational Health and Safety Guidelines (World Bank, 1988), Russian health and safety requirements, and the U.S. Mine Safety and Health Administration (MSHA, 1980-1998) guidelines as well as applicable EC requirements

It is especially important to recognize that, should cultural heritage resources be discovered in the area to be mined, it will be necessary to ensure that these do not invoke the IFC safeguard policy on heritage resources. There is simply inadequate information currently available to draw any definitive conclusion on the cultural heritage status of the site and whether or not the safeguard policy would be invoked.

6.9.1 Cultural heritage assessment

6.9.1.1 Extent

Should cultural heritage sites be discovered in the area proposed for the mine expansion they would have the potential to have **regional** or even **national** importance.

6.9.1.2 Duration

Impact duration is not a relevant criterion in this case

6.9.1.3 Intensity

The intensity of the impact is impossible to predict given the limited information available at present. Based on the precautionary principle and impact intensity of **moderate** is presented.

6.9.1.4 Probability

The presence of cultural artefacts is considered **possible** but impact probability is impossible to predict in the absence of any definitive information.

6.9.1.5 Impact significance

Given the lack of information on which to draw a more definite conclusion an impact significance of **moderate** is presented.

6.9.2 Mitigation

For the expanded operation, a policy will be implemented to ensure that any archaeological monuments that are uncovered during vegetation clearing or excavations, will be properly managed to preserve the heritage and historical value of the find. The policy sets out procedures to be implemented in the event of a archaeological find during mine operations. These procedures define the following actions in the event of a find namely:

- Upon discovering any potential artefacts during construction or operations, work will be temporarily halted in this area;
- If any bones have been discovered, they will be covered with cloth, and earth and sod placed over them to protect them from the elements; and,
- A specialist will be summoned to catalogue the find, advise on the cultural/historical significance of the find and define further mitigation as appropriate to the value of the find.

6.10 Social and economic impacts

6.10.1 Local employment

There are a variety of potentially positive impacts that will be brought about the mine expansion. The first and most obvious of these is job creation where the labour force at the mine will increase significantly as the new pits are opened and excavated. Ensuring that labour is sourced locally, from especially China's voryk can easily enhance these positive effects. Given the time before the mine is brought to full capacity a skills development programme could also be developed and implemented that would serve to increase the 'employability' of locals. The development, publication and widespread dissemination of a recruitment policy for the mine would serve to encourage local employment, as well as reducing the potential influx of work seekers into the area. The recruitment strategy must also make an unequivocal statement on forced or

prison labour to ensure that there is no perception that this may happen at the mine.

Employment is a positive social and economic impact that will be brought about by the mine expansion. It is estimated that about 700 jobs will be created, with fluctuations during the Project life cycle. The labour force at the mine will increase significantly as the new pits are opened and excavated. Employment will result in increased purchasing power for locals, with indirect benefits to local small businesses and local administrations through increased tax collection. The mine will develop¹³:

- a hiring policy to enhance employment positive impacts, limit in-migration and mitigate the potential effects of residual in-migration;
- a training policy and skill enhancement programme to increase the employability of locals.

The proximity between the mine and Enterprise M222 which uses prisoners may be wrongly perceived, especially outside of the Russian Federation. It is therefore necessary that the Project make an unequivocal statement on forced or prison labour to ensure that there is no perception that this may happen at the mine.

6.10.2 Increased local spending

Increased local employment would lead to increased local spending and the further economic growth potential of that spending. A focused programme aimed at building SME links to the mine could also supplement this. It is recognized that these links are currently limited due to the specific equipment requirements of the mine, but this should not prevent the continual pursuit of creating and maximizing local business opportunities.

6.10.3 In-migration

Employment opportunities created by the mine expansion will generate expectations, which if unmanaged may cause an in-flux of job-seekers to the Project area. Potential effects of in-migration could include price inflation, housing problems and additional pressure on municipal and community infrastructure and services.

However, in the context of the project area, in-migration is not likely to be of a great extent. It is not expressed either as a major concern by the local population. It needs however to be anticipated and managed. The Project will put in place a hiring policy (detailed in Section 7.7) to limit in-migration through the prioritization of locals for employment, and disclose and disseminate it widely.

6.10.4 Local procurement

Although the mine has specific equipment requirements that cannot be met easily by the local supply, there are still many goods and services that can be purchased locally. To enhance these positive impacts, the mine will develop a procurement policy that is described in Section 7.7.

6.10.5 Traditional livelihoods of the original Komi population

The impact of the Project on natural resources will not affect any group of Komi nomadic reindeer herders, as no such community is using the mine area for grazing, even temporarily. Various representatives of the Komi community, including Komi NGOs, have confirmed this. However, Komi (and other) people consulted with in China'voryk village have expressed that they are attached to natural resources, including rivers, which are used for fishing, and areas in the forest where they collect mushrooms and berries. These areas will be identified in detail and mapped for further protection.

¹³ These policies are described in Section 5.15.

In the Project area, the Komis, the original population, do not meet the criteria established by the World Bank Group OD 4.20 for Indigenous People (while the same Komi ethnic group could meet these criteria in other areas of the Russian Federation). In the Project area, Komis are fully part of the mainstream economy and suffer no economic or cultural discrimination. Komis however express their attachment to their cultural traditions through cultural societies, folkloric groups and the preservation of their language, amongst others. They will therefore be addressed by the Project as a distinct cultural group, particularly in terms of consultation and information.

6.10.6 Social development programme

It has also been made clear in the public consultation and disclosure process that there is an expectation of municipal services being upgraded and enhanced by the mine. This is the quid pro expectation if return for the 'giving up' of the district's resources. Again, the response required here is to develop a social development programme that unambiguously details where the mine will invest and where it will not. A critical element of the social investment programme is ensuring that the investments are sustainable.

6.10.7 Key social findings from the due diligence audit

The following are the key audit findings in terms of social impacts of the mine:

- The Middle Timan Bauxite Mine is situated in Knyazhpogostsky District of the Komi Republic with the nearest settlements being the village of Chin'avoryk (142 kilometers to the south of the mine) and the city of Ukhta (150 kilometers to the southeast).
- There are no directly affected communities in the mining area but the Chin'avoryk community is directly affected by road and rail activities.
- Beyond the directly affected community of Chin'avoryk, community issues focus to a much greater extent on the potential social benefits of the mine and mine expansion such as job creation and social investment in those communities.
- Environmental NGOs that have an interest in the mine and its potential impacts on the environment are mostly located in Syktyvkar. Non-governmental organizations (NGO's)
- Timan Bauxite provides support to local schools in Emva and China'voryk and the hospital (maintenance, purchase of computers etc.). In addition the local church in Emva has been supported as well. As will be described later, during the public meeting in China'voryk, questions were asked about a school and a hospital that were 'promised' by the mine.
- Based on these findings the only native people to be affected by the mine are the Komi of China'voryk and as a result it is not necessary to prepare an IPDP.
- The mine has had ongoing public consultation in the context of environmental assessment processes most notably as part of the OVOS for the expansion of the mine to 2.5 mtpa (2002), and the working project for the establishment of the car and railway bridge that crosses the Vym River (1999)¹⁴.
- Although there are prison facilities are in relatively close proximity to the mine, the mine makes no use of forced or prison labour. Indeed no forced labour is currently acknowledged in Russia
- No indigenous people are affected by the mines activities but attention needs to be paid to ongoing communication with NGOs representing indigenous peoples

The following gaps have been identified in terms of social impacts:

- Communication appears to be less than adequate with community concerns pertaining to:
 - Rail crossings

¹⁴ It is worth noting that the representative of Greenpeace Russia was complimentary about the process that had been used to authorize the railway bridge

- Radioactivity in the bauxite
- Maintenance of the road
- Communities requested that the mine consider education and training programmes that would maximize the number of people eligible for any work opportunities that may become available at the mine.
- There are expectations of social investment that may or may not be met by the mine
- Environmental NGO concerns relate to the possible impact of mining ore body 11 and the impact that may have on the Vorykva river
- In general NGO concerns relate more to the proposed integrated aluminium development than they do to the mine itself. Concerns regarding the development of the refinery and the smelter relate to the degree to which local communities will benefit from those developments versus the degree to which 'big business' will benefit.
- While the Knyazhpogost District has adequate administrative capacity, concerns exist as to their ability to deal with conflict issues during public consultation. At the same time there are concerns about whether public consultation will be broadly based enough, to meet good practice requirements (and the IFC/EBRD requirements specifically) for public consultation. The capacity of the China'voryk Administration in conducting public meetings could and should be improved.
- There are no established forums for ongoing consultation outside of the OVOs requirements.
- SME development focuses on the cities to a greater extent than in the rural areas implying that a more rural district like Knyazhpogost may not fully benefit from SME opportunities.
- There are some major barriers to the growth of SMEs including lack of credit access, the generally higher prices charged by local small businesses, low OPEX by the mine on local suppliers and several others.
- Maintaining dialogue with the NGO Komi-Kotyr as a representative of IP will be necessary and desirable.
- In general Timan Bauxite responds to social investment requests that are put to the company in a largely *ad hoc* manner. The risk of operating in this manner is that unfounded expectations are created of what will be included in the social investment programme.
- The socio-economic baseline in the Komi Republic needs to be more clearly defined in preparation for the later environmental assessments.

6.10.8 Social impact assessment

6.10.8.1 Extent

The extent of the potential positive impacts (benefits) from the mine expansion would be largely limited to the Knyazhpogost district and thus **local** in nature. The benefits can be considered to extend to both **regional** and **national** extents given that both Komi Republic and the Federal Government derive benefit from tax revenues received from the mine.

6.10.8.2 Duration

The impact will be maintained for the duration of the mine project

6.10.8.3 Intensity

Given the limited population in Knyazhpogost, the additional jobs that will be created by the mine are considerable and thus the intensity of this impact is considered **moderate**.

6.10.8.4 Probability

The impact is considered to be **definite**.

6.10.8.5 Impact significance

The potential positive impacts associated with the mine expansion are considered on the basis of the above to be of **moderate to high** significance.

6.10.9 Mitigation

The mitigation to reduce or prevent negative, and enhance positive socio-economic impacts is detailed in the ESAP presented in Chapter 7. The mitigation has the following key elements:

Develop and implement a **communication strategy** that details procedures and actions required for:

- Stakeholder identification;
- Stakeholder engagement mechanisms;
- Establish partnerships;
- Maximise Information disclosure and Consultation; and,
- Dealing Specifically with the Komi Community.

Develop and implement an **employment strategy** that details procedures and actions required for:

- Maximising local employment;
- Defining unambiguously, the “area of influence” of the project;
- Ensuring gender equality in appointments;
- Using a single recruiting agency; and,
- Broadly publicizing the employment strategy beyond the area of influence of the project.

Develop and implement a **training policy** that details procedures and actions required for:

- Coordination with local vocational and higher education institutes on training needs and building capacity to meet project recruitment needs;
- In-service training and qualifications upgrade for unskilled and semi-skilled workers; and,
- Providing external training where needed.

Consolidate and implement a **social development programme** that is based on the following principles:

- Keeping the programme affordable, sustainable and aligned with broader mine business and policy objectives;
- Prevent usurping of municipal or district functions; and,
- Managing expectations so that there are not undue expectation or misunderstandings of what the mine will and will not support.

Implementing the **private investment partnership** (PEP) with a specific focus on:

- Increasing access to markets for SMEs;
- Raising the level of local management skills;
- Reducing administrative and legislative barriers;
- Educating and informing the public of the importance of the private sector;
- Creating transparent demand profile that can be disseminated to local suppliers;
- Designing and implementation of a solid, sustainable strategy; and,
- Complement SME development efforts with a targeted, sustainable financial model.

Develop and implement a project local procurement policy that includes:

- An initial market survey to establish local capacities to meet the mine expansion requirements and delineate areas of local, national and international procurement for the various goods and services required;
- Defined monitoring targets for local procurement;
- Maximising local procurement of goods and services;
- Strengthening local business capacity to meet the mine expansion's procurement needs;
- Advertising procurement requirements locally first;
- Establishing a dedicated small business support function within the project; and
- Expressly prohibiting any procurement from State Enterprise M222.

6.11 Noise and vibration

A range of mine related activities generate noise and vibration across the mine. These noise sources are summarized in Table 30. Although the movement of heavy machinery, bauxite crushing, excavation and so forth all result in vibration to greater and lesser degrees, it is only blasting that is considered a significant source. There are no significant sources of electro-magnetic radiation at the mine. Noise limits that apply to the mines activities are summarized in Table 31.

Table 30: Principal noise sources on the mine and typical noise levels for those sources

Source	Noise level
Drilling machines	115 dB(A)
Bulldozers	106 dB(A)
Crushing excavators	105 dB(A)
Excavators	80 dB(A)
Generators	72 dB(A)

Table 31: Noise limits that could be applied to activities at the mine

Where	Limit	Limit source
Residential areas (07:00 – 23:00)	60 dB(A) average 75 dB(A) maximum 55 dB(A) maximum Those exposed to levels of between 65 and 55 dB(A) and those currently exposed to less than 55 dB(A) should not suffer any increase	SNR 11-12-77 World Bank EC*
Residential areas (23:00 – 07:00)	50 dB(A) average 65 dB(A) maximum 45 dB(A) maximum	SNR 11-12-77 World Bank
Site boundary	70 dB(A)	World Bank
Occupational exposure	93 dB(A) maximum	GOST 12.1.003-83

exposure	85 dB(A) average Exposure to more than 65 dB(A) should be phased out and at no time must exceed 85 dB(A)	12.1.003-83 EC*
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(* Guideline published in Commission's Fifth Action Plan on the Environment: *Towards Sustainability*)

According to calculations of current mine activities, the noise level at the SPZ boundary is less than 50 dB(A) and this has also been confirmed by annual measurements. As has been indicated there are no residential areas in close proximity to the mine that could be impacted upon by noise generated by the mine. In similar vein, there are no direct limits on vibration from blasting operations¹⁵. Although there will be a significant increase in mining activities, these activities will not all be concentrated within the current mine area. Given the lack of receptors that could result in noise or vibration disturbance or nuisance, around the mine potential impacts are considered unlikely.

6.11.1 Key noise and vibration findings from the due diligence audit

The following are the key audit findings for noise and vibration (as they apply to current mine operations):

- Given the lack of proximity of residential areas and the noise levels generated by the mining activities, which do not exceed 50 dB at the mine boundary, noise does not pose a significant ambient environmental risk.
- Noise level from certain mining activities requires the use of personal protective equipment (PPE) specifically ear protectors. Ear protectors are provided to mine personnel and the cabins of excavators are hermetically sealed.
- Again due to the lack of residential areas in the immediate vicinity of the mine, there are no direct restrictions regarding vibration as a result of blasting operations.

6.11.2 Noise and vibration impact assessment

6.11.2.1 Extent

The extent impact associated with noise and vibration are considered **highly localized** and limited to occupational health risks for workers on the mine.

6.11.2.2 Duration

The impact will be maintained for the duration of the mine project

6.11.2.3 Intensity

Given the lack of receptors in the vicinity of the mine that may perceive noise and/or vibration as a nuisance, the impact intensity is considered **negligible**. Without adequate use of hearing protectors there are several noise sources that could result in hearing loss if workers are exposed to the noise source for a full shift.

6.11.2.4 Probability

Impacts associated with noise and/or vibration are considered **improbable** in terms of the external environment but **probable** in the absence of mitigation, in terms of occupational exposure.

6.11.2.5 Impact significance

The potential impacts of noise and/or vibration associated with the mine expansion are considered, on the basis of the above, to be of **low** significance in terms of the external environment but of **moderate**

¹⁵ Federal regulations exist that would limit the charge and time of day of blasting, if residential areas were affected by noise and/or vibration from the blasting activities.

significance for potential occupational exposures. The correct use of Personal Protective Equipment (PPE) will ensure that the occupational health impacts are of **low** significance.

6.11.3 Mitigation measures

There are no direct measures to reduce ambient noise but these are not required given the noise levels that are measured at the site boundary and the noise levels likely to be generated by the expanded operation. Abatement measures are all geared towards occupational health protection and include the use of ear protectors and hermetically sealed cabins on the excavators.

6.12 Cumulative impacts

Cumulative impacts are those that occur, when different environmental aspects or impacts act in combination to generate, impacts of greater intensity and significance. In terms of the proposed mine expansion the most important possible cumulative impacts are those associated with the proposed dewatering programme. This has the potential to translate into multiple possible effects, including sub-surface impacts and surface and surface water impacts where a number of different mine expansion activities (clearing and grubbing, excavations, material transport and so forth) can potentially act together to exacerbate the impact. That notwithstanding, the programme of defining the interaction between all the activities, aspects and impacts that may have a bearing on surface and groundwater effects will provide an adequate definition of these impacts. By the same token the mitigation identified in that process will also serve to address the impacts and ensure that they do not result in a significant impact on the environment. From that point of view cumulative impacts associated with the proposed mine expansion in its own right will be managed to the point that they are not significant. At a broader level, however, it is necessary to consider cumulative effects/impacts for the Komi Aluminium Programme as a whole. Such effects relate to:

6.12.1 Power supply and energy use and emissions of greenhouse gases

These are impacts that will definitely need to be considered cumulatively within the context of the refinery and the smelter, as potentially significant. Given the relatively low energy use at the mine and independence of a central or grid power supply, the mine is not considered to contribute significantly to this potential impacts.

6.12.2 Economic development and job creation within the region

In general terms these will be positive impacts and will be further enhanced by programmes to maximise local employment, procurement and SME promotion. The full cumulative effect of these benefits will only be able to be characterised once there is adequate detail on all the projects.

6.12.3 Transport infrastructure joining the three proposed projects

The transport infrastructure connecting the three projects to one another needs to be recognised in terms of its cumulative effect, rather than simply relative to each of the individual projects. However, the bulk of this infrastructure is already in place and there will be little difference made to the impacts associated with establishing that infrastructure by the proposed Komi Aluminium Programme. An important public concern is dust from the trains transporting the bauxite, and for this reason a mitigation action that will be pursued by the mine is to investigate cost effective measures of covering the wagons to prevent bauxite dust blowing from the trains.

6.12.4 Regional significance of vegetation and habitat loss

In general terms the combined projects will result in the loss of some 3,000 hectares of currently forested land. The loss of that vegetation is significant and needs to be addressed at the level of the programme. The only effective way in which to address the problem is through the implementation of an off-set programme that will serve to recreate at least some, and possible all of the lost vegetation and habitat. At

this early stage of the programme it is not possible to do much more than confirm the commitment of Komi Aluminium to such an off-set project, but the full details will be developed once the full details of the refinery and smelter sites are known.

7. ENVIRONMENTAL AND SOCIAL ACTION PLAN

7.1 Introduction

The need for implementation of an Environmental and Social Action Plan (ESAP) during development of the MTBM Project is stipulated by the International Finance Corporation¹⁶ (IFC) the European Bank for Reconstruction and Development (EBRD) and Russian regulations¹⁷. This document is prepared to address these requirements. This document is a 'living' document and will be updated and modified as needed as it is implemented. This ESAP is Revision 1 but includes the content of the initial ESAP that was developed as part of the Environmental and Social Due Diligence Audit. A second revision (Rev 2) will take place at the end of 2004 when a final decision is made on the expansion based on the feasibility study and strategic decisions by Komi Aluminium on bauxite supply. A third revision (Rev. 3) will be prepared before any construction activities take place to reflect final understanding of the whole spectrum of impacts and their mitigation measures.

This document serves as the basis for the environmental and social monitoring and management programs to be implemented over the course of the MTBM mine expansion project. Komi Aluminium will review the frequency and types of monitoring regularly to ensure:

- Compliance with all Russian, World Bank Group, EU and EBRD policies and guidelines and standards;
- Compliance with all permit conditions including those issued by the Komi Republic and the Russian Federation ; and,
- Effective monitoring and mitigation of project impacts.

As part of the on-going implementation, this ESIA/ESAP will be public disclosed as part of the Public Consultation and Disclosure Plan (PCDP). This includes disclosure in the Public Visitor Centres at various locations in the Komi Republic, during public meetings, and at the mine site. In addition the ESAP will be disclosed publicly in Moscow (Saul, EBRD and IFC), and at the World Bank Info Shop in Washington and EBRD Public Centre in London .

The recommendations set forth in this ESAP are dependent on regulatory approval that will be received in Fall, 2004, pending the outcome of the State Environmental Review (SER). It is acknowledged that the ESAP will be updated and disclosed by the end of 2004 to reflect the operational conditions set forth by the regulatory authorities, as well as the final mine plan and the feasibility study. It is also important to recognise that the ESAP is drawn from both the ESIA (presented earlier in this document) as well as an Environmental and Social Due Diligence Audit that was conducted in September 2003 on the existing mine operation. A number of gaps were identified during the due diligence audit between current environmental management practice at the mine and what would be deemed to be international best practice. These gaps were then used to structure

¹⁶ *Procedure for Environmental and Social Review of Projects – Guidance Note C: Outline of an Environmental Action Plan*, IFC, September 1998, pp. 45-46.

¹⁷ SNIP 11-01-95 *"Instructions on the process for development, approvals, confirmation, and composition of project documentation in construction of facilities, buildings and equipment"*. 1995

recommended remedial actions and it is these that have been carried forward to the ESAP presented here.

7.2 Purpose

The purpose of the ESAP is to identify the set of responses to potential adverse impacts, determine requirements for ensuring responses are made effectively and in a timely manner, and describe the means for meeting the environmental requirements. The ESAP will assess mitigation, monitoring, and other measures that will be taken during construction and operations to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. It will also outline commitments by Komi Aluminium and MTBM to carry out any additional activities, and to prepare a full management plan to fulfill the lender's requirements.

7.3 Scope

The ESAP includes mitigation measures, monitoring, management, and an implementation schedule. This information is provided for construction and operation of the mine, man camp, and ancillary facilities. It includes mitigation and monitoring for potential impacts on:

- Air quality;
- Terrain;
- Soils;
- Hydrogeology;
- Groundwater quality
- Surface water hydrology;
- Surface water quality;
- Vegetation;
- Fauna;
- Socio-economics;
- Archaeology;
- Health and safety;
- Spill prevention;
- Waste management; and,
- Reclamation and closure.

7.4 Project background

SUAL Group is currently contemplating a large-scale aluminium development in Komi Republic, Russian Federation. The development, which is known as the 'Komi Aluminium Programme', is made up of three separate projects namely:

- Phase 1 –Expansion of the Middle Timan Bauxite Mine (MTBM)
 - 1a – continued previously permitted expansion to 2.5 million tonnes per year. It is anticipated that this will be achieved in mid-2004.

- 1b – Potential further expansion to 6.0 million tonnes per year, commencing in 2005 and completed by 2007. It is anticipated that the ESIA will be disclosed in March 2004. The Russian Expansion OVOS will be prepared in Summer 2004 and disclosed in October 2004.
- Phase 2 – Potentially establishing an Alumina Refinery in the Ukhta/Sosnogorsk area (proposed capacity of 1,400,000 tonnes per year). An environmental impact assessment will commence in 2004, to include baseline investigations.
- Phase 3 – Potentially establishing an Aluminium Smelter at Pechora with a proposed capacity of 300-500, 000 tonnes per year. An environmental impact assessment will commence in 2004, to include baseline investigations.

SUAL is currently assessing the technical, economic, environmental and social feasibility of the three projects. This will culminate in a Russian State Environmental Review (SER) for each of the three projects including Environmental Impact Assessment (or OVOS) documents. At the same time the International Finance Corporation (IFC) and the European Bank for Reconstruction and Development (EBRD) have been approached for loan financing for the programme. IFC's policy on environmental assessment (OP 4.01 – Environmental Assessment), and similar EBRD policy, states that all projects proposed for IFC/EBRD financing require an Environmental Assessment (EA) to ensure that they are environmentally and socially acceptable.

7.5 Brief project description

SUAL is currently proposing an expansion of an existing, fully-permitted facility from 2.5 million to 6.0 million tonnes per year. The major changes include:

- Expansion of the open pit area (from 2 pits currently to 17 pits);
- Additional land disturbance as the footprint will significantly increase (from the current 807 hectares to 4,087 hectares following the expansion)
- Upgrading wastewater treatment facilities;
- Finishing expansion programs approved under the 2.5 million tonnes per year project;
- Expanding ancillary facilities to accommodate the expansion; and,
- Upgrading equipment used to mine the deposit.

The mine currently is permitted to mine 2.5 million tonnes per year and is currently mining around 1.0 million tonnes per year. Phase 1a of the project (up through 2007) is designed to increase the production at the existing operations. Phase 1b of the project (2007 and beyond) is designed to expand the mining operations to ensure that there approximately 6.0 million tonnes per annum is available for mining. This includes extending operations to the north and south of the existing deposits.

Phase 1a does not change the pits to be mined but does change the footprint as the pits are extended spatially and additional infrastructure established. Phase 1b requires additional pits to be opened up in order to support mining of up to 6 million tonnes per year, with a bigger and wider footprint that will impact land use, habitat, biota, fauna and flora (terrestrial as well as aquatic). The major impact that will occur under phase 1b is the requirement for pit dewatering and subsequent impacts on geohydrology and hydrology regimes. Additionally and in order to accommodate the expansion, all

existing infrastructure will be expanded and upgraded. This includes expanding the footprint and services at the camp, expanding the power capacity with new diesel generators, upgrading the wastewater treatment facility, and upgrading the mining equipment.

7.6 Impact summary

The impacts of the proposed 6.0 million tonne per year expansion have been evaluated in relationship to the existing operations. The impact matrix (Table 32) identifies the greatest impacts associated with the expansion of the pits and the need to dewater.

Table 32: Impact matrix summarising the major impacts identified for the expanded mine operation and the significance of the impacts

Impacts associated with	Extent	Duration	Intensity	Probability	Significance
Dust	Local	Long term	Moderate	Probable	Low
Emissions from fuel burning appliances	Local	Long term	Low	Probable	Low
Impacts on fish diversity and population in the Vorykva River	Regional	Long term	High	Probable	High
Regional impacts of groundwater abstraction	Regional	Long term /permanent	High	Probable	High
Waste	Local	Long term	Low	Improbable	Low
Hazardous materials	Local	Short term	Low	Possible	Low
Terrestrial ecology*	Regional	Long term	Moderate	Possible	Moderate
Human health	Local	NA	Low	Improbable	Negligible
Heritage resources	Regional	NA	Moderate	Possible	Moderate
Job creation	Regional	Long term	Moderate	Probable	Moderate to high
Local spending	Regional	Long term	Moderate	Probable	Moderate
SME development	Regional	Long term	Moderate	Probable	Low

Impacts associated with	Extent	Duration	Intensity	Probability	Significance
Noise and vibration (ambient environment)	Local	Long term	Low	Improbable	Low
Noise and vibration (occupational exposure)**	Local	Long term	Moderate to low	Improbable	Low

*i.e. excludes the potential impact of dewatering on the ecology of the Vorykva.

** significance rating is based on the correct use of PPE

7.7 Mitigation of environmental and social impacts

In this section mitigation that will be included as part of the implementation of the expanded operation is presented. The mitigation serves to ensure that the proposed expansion will proceed in an environmentally and socially sound manner. The mitigation will be implemented throughout the life of the project, from construction through closure, to ensure that the site will be returned to the Russian government in a satisfactory condition following closure and decommissioning. Mitigation measures can be changed during the life of the project based on management requirements, regulatory guidance, or identification of inefficient practices.

7.7.1 Air quality control measures

The three main sources of air emissions are stationary point sources, stationary fugitive dust sources, and mobile sources. The major pollutants that will be emitted during construction and mining operations include: particulate matter, sulfur dioxide, oxides of nitrogen, and oxides of carbon.

7.7.1.1 Point source emissions

The major stationary point sources for air emissions are:

- diesel power station; and,
- crushing plant and ore transfer points.

Air emissions from the combustion sources will be reduced via the following mitigation measures:

- Optimization of diesel operations. This will include monitoring the loading of each generator to ensure that the facilities operate under optimal conditions, and where the loading is inappropriate redistributing the load;
- All combustion devices will be regularly serviced and correctly maintained.
- Combustion sources will be monitored on a regular basis to ensure that they are operating within design parameters for emissions.

The crushing plant and ore transfer points will be fitted with a wet scrubber capable of dust control for

flows up to 8,000 cfm. Proper maintenance and operation of this equipment will be ensured by ongoing monitoring of flow rates. In the event of a pressure drop the crushing plant will be shut down and the wet scrubber returned to full functionality before operations are restarted. The scrubber will also be regularly maintained in strict accordance with the manufacture's instructions. This will ensure that dust emissions from the ore processing circuit will be insignificant. In stack sampling will be done on a campaign basis as defined by the Russian authorities to ensure that the plant is functioning adequately in meeting specified emission limits. Where emissions limits are not being met, the required remedial action will be implemented within 48 hours.

7.7.1.2 Fugitive sources

Emissions during construction and operations consist primarily of fugitive dust sources. Fugitive dust includes wind erosion from cleared areas as well as dust mobilized from vehicle traffic. The major source of impacts during construction and operations will be fugitive dust from vehicle traffic on roads. These emissions occur only when there is no snow on the road and are distributed over the entire length of the access road. Emissions from the haul roads typically do not disperse far from the roads due to the horizontal velocity of the dust. Mitigation from fugitive dust will be via an aggressive campaign of road watering and control of vehicle speeds.

7.7.1.3 Mobile sources

Emissions from mobile sources are combustion gases. These emissions are difficult to predict due to the fact that there will be no set routes for most of the mobile equipment. Mitigation measures that can be taken to reduce emissions include:

- Mining and hauling equipment will be equipped with catalytic converters;
- The possible use of low sulfur diesel fuel will be investigated for all diesel uses across the site (but most especially vehicles), and,
- Mobile equipment will be regularly serviced to ensure proper operations.

7.7.2 Land disturbance

Impacts associated with land disturbance include direct and indirect impacts. Direct impacts that may occur during construction and operation of the facility include:

- changes in topography including changes to visual aesthetics of the area;
- removal of vegetation and soil cover;
- reduction in quality of surface water, air quality, snow cover, and vegetative cover; and,
- changes to fish community structure due to surface water runoff and erosion.

These changes are expected to last the duration of the project (approximately 20 to 30 years including construction) – or until the areas are reclaimed. Indirect impacts can occur assuming that direct impacts are not mitigated through actively pursuing conservation and re-cultivation measures. Indirect impacts that may occur include:

- wind and water erosion;
- leaching of chemical constituents from process workings; and,

- leaching of dissolved minerals and accumulation in the environment.

The zone of indirect impacts will be confined to watershed basins where impacts may occur and can last in excess of the life span of the mine without proper mitigation measures.

MTBM will implement an aggressive *in-situ* reclamation program that minimizes stockpiling of overburden and maximizes reduction in surface land disturbance. Additionally, the mine will implement a soil erosion control plan designed to reduce sediment loadings to streams and rivers. As new mining equipment becomes available this will include mobile equipment that can be used to address any sort of work related to soil and erosion mitigation requirements. Comprehensive planning complemented by appropriate levels of capacity building is required at Komi Aluminium and MTBM to address the issue of soil and erosion management. MTBM has agreed to augment their rehabilitation activities in the context of the development of a Mine Reclamation and Rehabilitation Plan (MRRP) that will be prepared before the end of 2005.

7.7.3 Erosion control plan

An erosion control plan will be developed and implemented to prevent surface water contamination by suspended solids as a result of erosion. The single-greatest mitigation measure that will be employed to prevent or reduce these impacts is by keeping the overall mine footprint as small as possible and thus reducing the spatial extent of land disturbance and minimizing the risk of erosion. Additional general erosion control concepts that will be employed by the mine include:

7.7.3.1 Water protection zones

Water protection zones¹⁸ on either side of the rivers will be designated 'no-go' areas, and access to such areas allowed only in the event of an emergency. The no-go status of these water protection zones will be maintained throughout the mine operation and closure period.

7.7.3.2 Bridges and culverts

Bridges or culverts will be established for all stream crossings. The crossings will be clearly delineated and provided with adequate sizing to ensure the water throughput capacity provides for a 10% exceedance discharge. The culvert end features will be designed to prevent silt deposition or clogging and erosion rate reduction. The culverts will be made of steel. The bridge that will be constructed over the Vorykva River will be designed to forgo support structures that would otherwise impact on the riverbed or banks.

7.7.3.3 Catchment and diversion

Catchment and diversion will be utilised to ensure that surface run-off beyond process and ancillary site areas is managed to and controlled prior to discharge to the surface water environment. If adequate settlement of suspended solids cannot be achieved using catchment and diversion, then such surface water runoff will be directed to the settlement dams that will be established as part of the overall mine development. No discharge will be allowed if the quality of the water is not within

¹⁸ Note that the Vorykva River is a protected waterway with formalised water protection zones on either side of the river.

specified discharge standards.

Finished grades on the site will provide positive drainage away from structures to reduce moisture in the subsoils and reduce the potential for frost heave from frost susceptible foundation soils. Yard and other disturbed areas will be graded to drain surface runoff into drainage ditches that will be directed into settlement ponds for treatment prior to release to the environment.

Diversion ditches will be provided up-slope of the disturbed areas to minimize the quantity of surface water runoff that may become contaminated and require treatment. Diversion ditches will be located a minimum 5 m from the edge of disturbed areas and will be designed to be non-erodible for the 10-year flood flow. Ditch armouring will be provided where maximum velocities exceed are likely to exceed 1.5 m/s.

The settlement ponds will be used to trap suspended sediment and channel bed load before release of clarified surface runoff into the natural streams. The ponds will be sized to remove the 0.02 mm diameter sediment size and provide detention times of 16 to 24 hours during a 1:10 year flood event. Each settling pond will be designed, implemented and operated as follows:

- Baffles will be located at the inlet of the ponds to spread the inflow and reduce the velocity;
- Accumulated sediments will be cleaned out when 50% of the pond volume is lost to sediment storage or the surface area is reduced to 20% on account of delta deposits. Clean out and disposal will be carried out during dry periods;
- Flocculants will be added at the inlet if unaided settlement is insufficient to meet allowable discharge suspended solid concentrations of 50 ppm during the 1:10 year flood or background suspended solids concentrations;
- Spillway channels outlets will be cleared of snow and ice before snow melt each spring;
- Pond inlets and overflow spillways will be designed to pass the 1:200-year flood with 0.5 m freeboard.

7.7.3.4 Interim Reclamation

In areas where new constructions and the building of facilities is taking place, interim reclamation will be used to minimize potential impacts. When construction is complete (2005), the mine will commence reclamation of areas that will not be used during operations. Reclamation of these areas will include proper re-contouring, sloping and re-vegetation. As part of the reclamation, proper surface water run-off control will be implemented. Additionally, reclamation will be scheduled to take place as soon as practical after operational activities are completed in a given area to minimize erosion and other impacts to the ambient environment. In general, reclamation activities will be timed to take advantage of climatic conditions, particularly the peak season rainfall. Areas to be re-vegetated will be prepared and seeding will be completed in late summer or early fall to capitalize on available moisture. Interim reclamation measures include¹⁹:

- Only removing vegetation from those areas where it is absolutely necessary (i.e directly

¹⁹ See Section 7.5 for the overall approach to reclamation.

affected by project activities);

- Minimizing slopes and, where such slopes are unavoidable, re-vegetating the same; and,
- Disturbed areas will have appropriate drainage controls that prevent runoff from both entering the disturbed area or being discharged into an uncontrolled manner on the downstream side of the disturbance

7.7.4 Soils

Impacts to physical characteristics of soil during construction, salvaging and stockpiling will include compaction, soil structure loss, and increased core fragment content due to mixing. Soil loss may be induced through transportation and erosion. Increased soil runoff may occur due to decreased infiltration and reductions in permeability.

Mitigation measures include limiting the quantity of soil that needs to be stockpiled and pursuing an aggressive reclamation plan. Additionally, where stockpiles are unavoidable these will be designed in such a way as to reduce the potential of leaching from surface water and contamination from other sources (e.g., petroleum spills).

7.7.5 Surface water impact mitigation

The largest sources of potential impacts to surface water quality surrounding MTBM are described in Chapter 6 of the EIA. In summary, these impacts have been identified as:

- Discharges of pumped groundwater
- Surface water run-off; and;
- Discharges from the wastewater treatment plant.

7.7.5.1 Mitigation

Mitigation to reduce the significance of the potential impact lies in several possible domains. Before describing these domains it is necessary to emphasize that there is simply not enough final information at present to evaluate the dewatering requirements and therefore to assess the options for mitigation or quantitatively presenting the adequacy of the implementation in reducing impact significance. As a result the mitigation presented here is grounded in further, more detailed investigations that will be required on the river systems that can be used to quantitatively assess the effectiveness of the proposed mitigation.

When the mine plan is finalized and based on further scientific evidence that will be gathered in the interim, Komi Aluminium and MTBM will ensure that potential impacts on river biota are comprehensively defined and quantified where possible. Once these impacts have been so defined the mitigation plan in the following section will be finalized to ensure that there is no significant impact on the Vorykva River and the VSIR. The approach to defining mitigation is presented schematically in Figure 22.

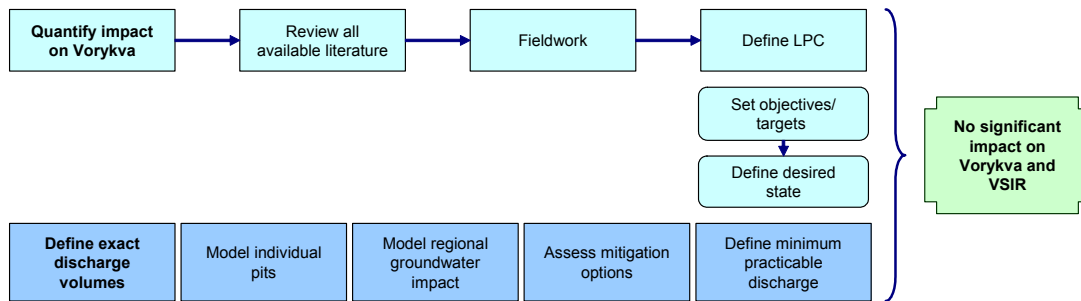


Figure 22: Schematic illustration of the development of a strategy to ensure that potential discharges from the expanded mine do not result in significant impacts to the VSIR.

It can be seen from Figure 22, that mitigation is directly dependent on reducing the quantity of the discharge water that goes into the Vorykva. Given the projected quantities of discharge it seems highly improbable that a zero discharge scenario is feasible. That implies reducing the discharge quantity by as much as possible and then determining a threshold of acceptable discharge into the Vorykva (Fig. 23). That threshold can be defined at two possible levels, firstly a threshold that will ensure that there are no significant effects on the river hydrology and hydraulics and in the event that proves impossible, ensuring that there are no impacts that will lead to reductions in fish diversity or populations.

If it cannot be guaranteed that there will be no reduction in fish diversity and/or populations then the impact must be deemed to be unacceptable. A thorough review of alternatives will be undertaken, based on a detailed numerical model of the dewatering system and river-aquifer interaction. This will be used to make a final decision on an overall mitigation strategy and implementation of feasible mitigation measures. This will take place by the end of calendar year 2004.

7.7.5.2 Further investigative work on dewatering requirements

The amount of test work carried out in the past is extensive. There is an adequate amount of information, and this will be used to develop a good numerical aquifer model. Once the model has been developed it will be used to define dewatering requirements for each of the pits as they are developed. Hydraulic interference effects between pits will be assessed as well as river and aquifer interaction to provide accurate predictions of the dewatering requirements and quantities.

It is understood that a numerical aquifer model has been developed so the first step will be to review update and/or further develop this model once the final mine plan has been decided. In the interim, the model will be extended to a dewatering model to assist in the detailed planning and management of the dewatering system and to assist in assessing options for mitigation of the effects of dewatering. As part of this process a detailed review will be conducted of all the available information on the hydrology and geohydrology of the area, to obtain additional insight into the surface and groundwater conditions that prevail, as well as the interface between the two.

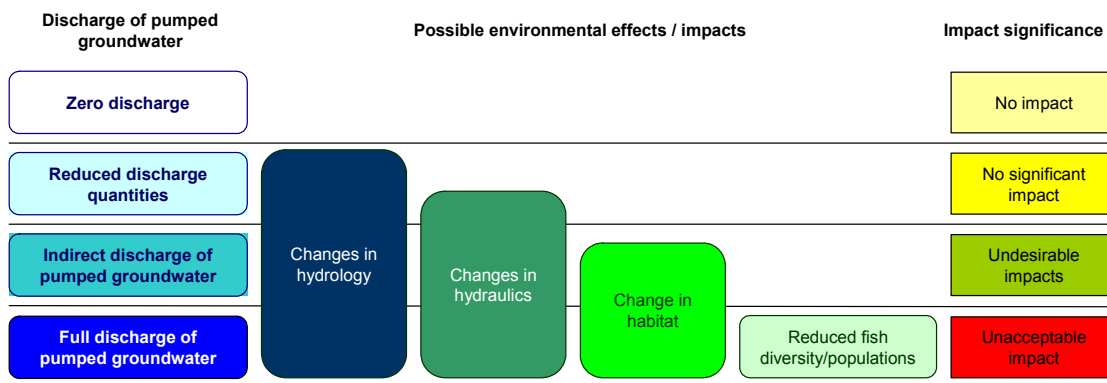


Figure 23: Schematic presentation of the possible environmental effects/impacts of discharging pumped groundwater and associated impact significance.

7.7.5.3 Modelling and management requirements

The hydrogeology is complex and the number of pits and sequencing of mining means that it is difficult to make a confident assessment of the dewatering requirements without a detailed numerical model. Such a detailed numerical model will be developed as part of the feasibility study, final design and for ongoing management of the aquifer system. It is understood that the existing model only covers the hydrogeology of the central area and is not a dewatering design model.

The numerical aquifer model presently being developed will be extended to cater for preliminary design and as an ongoing management model for the dewatering system. Due to the scale of the regional model, separate models for each of the main pit areas may be required to enable it to be used to optimize the individual dewatering systems. An extensive series of piezometers will also be established to monitor the performance of the wells and the interference effects between adjacent pits. This will be especially important in the initial stages to confirm that aquifer dewatering is progressing sufficiently in the confined aquifers ahead of mining.

7.7.5.4 Surface water hydrology

A lot of information is available on the surface water hydrology. Additional work will take place to review this information in detail. This information will no doubt prove to be valuable in developing a model of the river flows through the seasons to be able to assist in designing possible discharge methods. At the same time local expertise will be used especially the Komi Institute of Biology who have good knowledge of the local conditions, and the characteristics of the aquatic biota. These inputs will be supplemented by inputs from 'Geolog' based in Ukhta, who have good working knowledge of the geology and hydrogeology in the vicinity of the mine. The purpose of this work will be to characterize surface water hydrology in the Vorykva as the basis for properly defining possible changes in river hydrology and hydraulics as a result of the proposed discharges into the Vorykva.

7.7.5.5 Options for reducing the discharge volumes

There are a number of possibilities to limit the impact of discharge from a dewatering system. Large dewatering systems for mines in Russia are not unusual and the nature of the aquifers in the area

mean that a zero discharge option will be extremely difficult and expensive. No assessments have been done to establish the worst case total discharge requirement during the life of mine. The preliminary schedule shows that dewatering will not be required until year 5, with high volume discharges (100,000 m³ a day) arising in year 9, increasing progressively through to year 24 (350,000 m³ a day) and reducing in year 28 (200,000 m³ a day). This provides enough time for the true dewatering requirements and water management options to be assessed and designed so as to ensure that the objective of zero impact discharge is upheld.

Options for reducing the discharge volume are listed below. It must be emphasised that these have not been assessed in any detail, but there is a commitment from Komi Aluminium and MTBM to investigate each and with a view to ensuring that the mine expansion can be implemented without significant negative impact on the VSIR. The mitigation options include:

- Discharge into another catchment to the north or the east;
- Splitting the discharges to 2 or 3 river catchments
- Discharging into the swamp/wetlands areas to ensure stabilization with ambient conditions including chemistry and nutrient load, before the water reaches the river;
- Investigating the principle of 'no net loss' – the full impact on the Cherney and the Bolotny has not been quantified but these streams may be lost as a result of excavations of Vezhayu-Vorykvinskoye. In this comes to pass a similar 'replacement' marshy environment could be created and water discharged in amounts equivalent to the typical flow volumes of the two streams;
- Developing groundwater cutoffs and grouting to reduce inflows but this would be extremely expensive and would also impact significantly on side slope stability and slope angles;
- Using earlier pits as recharge cells but this could only work if permeability of the discharge pit is at least as high as the pumped pit;
- Artificial recharge into recharge wells specially drilled between the abstraction wells and the rivers. This would remove the water while also maintaining the groundwater levels outside the dewatering wells in the surrounding aquifer (this will be especially important in reducing potential impacts on the regional groundwater condition – see next Section).
- Concurrent use of some of the above options to maximize the possible reduction in discharge volumes, whilst maintaining cost effectiveness in the mining operation.

Komi Aluminum is committed to a solution that will ensure that no discharge will be allowed from the mine, if it will result in negative impacts on the VSIR. Discharge into the Vorykva river would have to take place throughout the year due to the volumes of water abstracted but location and acceptable volumes will be properly assessed technically and with the involvement of the relevant authorities, stakeholders, and local and international experts. For example, discharge could occur into rivers that are less vulnerable. Also, there may be some scope for attenuating the discharge in low flow times if a temporary storage can be used in an abandoned pit. It will not be feasible to stop pumping the dewatering wells for any length of time.

Komi Aluminium will now embark on strategy to find discharge solutions that will have "zero impacts on the natural environment". At an appropriate time, and if needed, an independent review of this strategy will be initiated by IFC and EBRD prior to further involvement in the mine expansion. Finally, but importantly, the zero impact discharge strategy will need to be presented in the OVOS

documentation that will be submitted to the Russian SER. A positive conclusion will be required from the SER before the mine expansion can be implemented.

7.7.5.6 Defining an acceptable threshold for discharge

In parallel to the assessment of different scenarios for reducing the amount of water discharged to the Vorykva it will be necessary to assess and define an acceptable discharge quantity to the river. As a minimum this discharge quantity will need to ensure that there is no impact on fish diversity or populations in the river and preferably no significant impacts to river hydrology or hydraulics. It is proposed here that the approach of defining Thresholds of Potential Concern (TPCs) be utilized. These are defined briefly below together with a method that can be used to define the same.

7.7.5.7 Thresholds of Potential Concern (TPCs)

TPCs represent statements or hypotheses of the limits of acceptable change in ecosystem structure, function and composition (Rogers and Biggs, 1999). TPCs and the approach used to derive them will be used to provide ecological thresholds for the Vorykva, as they relate to conservation objectives. TPCs are based on a desired state of the system. The desired state is in turn underpinned by the structure and dynamics of the patch mosaic of different types of river reaches, as well as particular conservation concerns. The TPCs can be used in this case to reflect the hydrological and hydraulic threats posed by the need to dewater. The TPC for discharge to the Vorykva is likely to be zero (or very low) as it is an ichthyological reserve (VSIR). This work will be driven to coordinate closely with the Russian authorities and the government agencies responsible for the reserve, in ensuring that if it is possible to define a zero impact discharge, it will be done with the full participation and endorsement of Russian regulators and local specialists including the local Komi Institute of Biology.

7.7.5.8 A method for defining TPCs

Define Desired State

The overall conservation goal, or 'desired state', is defined by the structure and dynamics of the river patch mosaic. The patch mosaic consists of 'patches' of various scales of ecological importance. Scale importance is in turn, determined by the underlying biophysical template as well as the biological and ecological response to impact. These parameters assist in defining the boundaries (or thresholds) and targets for conservation.

Setting goals and targets (TPCs)

An objectives hierarchy process is used to disaggregate the 'desired state' and its key elements into a series of objectives of increasing focus, rigour and achievability. These objectives can be set in this case to ensure the conservation of the Vorykva River. The goal setting process is driven by the identification of strengths (of the river system in this case), determinants of these strengths, threats and constraints and these are then reconciled to produce a next level of objectives. This process cascades down into increasingly technical and measurable parameters and end in the definition of the actual, quantified TPC. All TPCs are defined in spatial terms as well depending on the characteristics of the river system and maintaining the habitat required to protect the conditions in which the lifecycles of the various fish species unfold.

7.7.6 Wastewater treatment

For treatment of domestic wastewater from the man camp and ancillary facilities, the design calls for the construction of a wastewater treatment facility at the man camp with a capacity of ~125 m³/day. This water will be discharged into Vorykva River after treatment below the man-camp. As a result of this discharge, there will be minor changes in the biological productivity of Vorykva River during the life of the mine due to the addition of organic substances. A prediction of the composition of the wastewater discharges after biological treatment is shown in Table 33.

Table 33: Wastewater treatment discharge predicted composition

Parameter	Biological Treatment	IFC Guidelines*	EC Standards**
BOD ₅	20 mg/l	50	3 mg/l
TSS	30 mg/l	50	25 mg/l
NH ₃	13 mg/l	10 mg/l	0.04 mg/l
Surfactants	2.8	NS	NS
Residual chlorine	9	0.2 mg/l	0.005 mg/l
Phosphate	2.1 mg/l	NS	NS
pH	6-9	6-9	6-9
DO avg.	>6.0	NA	
Nitrates			0.1 mg/l
Coliform bacteria	0	<400 MPN/100 ml	

* Limits for process wastewater, domestic sewage and contaminated stormwater discharged to surface waters for general application

** receiving water quality for Salmonid waters

Discharge of the wastewater after biological treatment is not expected to have long-term impacts and therefore, no additional mitigation measures are proposed.

7.7.7 Vegetation

Mitigation for the reduction of impacts to vegetation lies in a combination of reducing the mine footprint in combination with an aggressive reclamation programme. During operations, the only impacts to vegetation will be localized and may result from dust generated along the haul and access roads for the facility. These impacts will be limited to a maximum of 4 months during the year and will be primarily during heavy traffic periods. These effects are considered minor and short-term but the following mitigation measures will be implemented to reduce the impacts further still:

For any new land disturbance every effort will be made to reduce the footprint of that disturbance.

This will reduce the direct effect on vegetation as well as the indirect effects through reduced dust loading from the mine;

- Air pollution and fugitive dust emissions will be minimized through the mitigation described in Section 7.7.1; and
- Surface water runoff will be managed as described in Section 7.5.2.

7.7.8 Birds and mammals

Impacts to birds and mammals can occur due the expanded footprint and presence of additional people and equipment. This can lead to loss in habitat and upset of natural patterns. To mitigate impacts MTBM will implement a dual approach of minimizing footprint and education of workers.

7.7.9 Hunting and poaching

A firm policy against hunting and poaching has been implemented by the mine and governs the behaviour of all mine personnel. The policy serves to mitigate impacts to any large game species from poaching or hunting in the area. Additionally, MTBM allows free access to regulators to police the access road and there is ongoing ecological monitoring.

7.7.10 Archaeology

Investigations conducted by an archeological expedition have identified the site as a potential site for ancient activities. To date, no known archeological remnants have been identified but due its location, the mine has developed an Archeological Preservation and Protection Plan. For the expanded operation, a policy will be implemented to ensure that any archeological monuments that are uncovered during vegetation clearing or excavations, will be properly managed to preserve the heritage and historical value of the find. The policy sets out procedures to be implemented in the event of a archeological find during mine operations. These procedures defines the following actions in the event of a find namely:

- Upon discovering any potential artifacts during construction or operations, work will be temporarily halted in this area;
- If any bones have been discovered, they will be covered with cloth, and earth and sod placed over them to protect them from the elements; and,
- A specialist will be summoned to catalog the find, advise on the cultural/historical significance of the find and define further mitigation as appropriate to the value of the find.

7.7.11 Waste management

A waste management plan will be developed for the expanded mine operation and mitigation will take the form of the implementation of that waste management plan. The waste management plan will satisfy Russian regulatory, IFC and EBRD requirements (specifically the EC Framework directive on waste). The waste management plan will specify procedures for:

- Minimising waste at source
- Segregation and temporary storage

- Re-use and recycling
- Final disposal
- Monitoring of waste management performance

In order to fulfil these requirements two facilities will be established at the mine. These are:

- A formal municipal waste landfill at the mine that meets Russian regulatory, IFC and EBRD requirements (specifically the EC Landfill Directive).
- A dedicated waste transition area that can be used as a central collection area for waste generated at the mine, and from where the waste once segregated, can be sent for recycling, recovery or disposal.

The mine's current waste management plan has been created within the framework of mining in Russia and as a result certain standard 'western waste management' practices have not been readily available or implementable at the mine. The waste management plan makes provision for all waste types generated during mining operations, which are classified as:

- Domestic liquid effluent;
- Domestic solid wastes; and,
- Industrial solid wastes²⁰.

The solid waste disposal plan is developed in accordance with federal law "On industrial consumption and generation of wastes" (No. 89-FZ, 6/24/89) and governmental decree "Guidelines for development and approval for waste generation and disposal" (No. 461, 6/16/00). These guidelines require that a user identify wastes, classify them in accordance with their toxicity and volumes, and develop a disposal strategy. The waste classification was completed in accordance with the requirements set forth in Order No. 511 (promulgated on 6/15/01). This decree requires the categorization of all wastes in accordance with the requirements set forth in Table 34.

Table 34: Waste classifications and associated environmental impact potential.

Waste Classification	Potential Environmental Impact	Comments
Class I	Very High	Environmental system can be irreversibly impacted. No mitigation measures available.
Class II	High	Environmental system can be severely impacted. Impacts can last longer than 30 years.
Class III	Average	Environmental system can be impacted. Impacts can last longer than 10 years.

²⁰ Please refer to Section 3.16 for a detailed description of the waste types associated with typical mine operations and the quantities projected for the expanded mine.

Class IV	Low	Environmental system can be impacted. Impacts can last longer than 3 years.
Class V	Very Low	Very low possibility of environmental impacts. Requires special testing to be classified as a Class V waste.

The basis of the plan prepared by MTBM is to minimize Class I wastes. Currently, the only proposed Class I material at site is the mercury from lamps. The lamps are collected in a clearly marked location, protected from the elements, and secure from unauthorized persons. This area is hydrologically isolated and well ventilated. Once a sufficient number of lamps have been accumulated, they are returned as a batch to Syktyvkar for recycling.

7.7.12 Health and safety program

The mine currently employs a full-time Health and Safety Person. As part of this ESAP, a full Environmental, Health and Safety Plan (HSP) will be created for this project. The framework of the HSP will be based on the World Bank's Occupational Health and Safety Guidelines (World Bank, 1988), Russian health and safety requirements, and the U.S. Mine Safety and Health Administration (MSHA, 1980-1998) guidelines as well as applicable EC requirements. The HSP will include information on:

- Worker responsibilities;
- Emergency procedures;
- Accident investigation procedures;
- General health and safety guidelines;
- Personal protection;
- Employee information and training; and,
- Transportation safety.

The HSP will continue to be updated as part of the ESAP to incorporate the contractors HSP as more information becomes available. Additionally, as the project moves forward, the requirements set forth in the HSP will be married to the existing policies currently implemented at the mine to protect worker health and safety.

7.7.13 Fuel spill prevention plan

A Fuel Spill Prevention, Control, and Countermeasures Plan (SPCC) has been developed for the expanded mine operation. The plan details procedures for ensuring that the potential for, and risk resulting from, accidental releases of potentially hazardous materials is minimized or prevented.

The materials used at the mine and mill are common to other mining facilities of this type located elsewhere and include diesel fuel, lubricants, petroleum solvents and miscellaneous laboratory chemicals.

The SPCC includes information on:

- Materials, properties, quantities, and containers;
- Safe practice in transporting materials;
- Spill responsibility;
- Readiness;
- Accidental release notifications, and protocols;
- Spill prevention;
- Spill control and countermeasures; and,
- Employee training.

The full SPCC Plan is found in Attachment 1. The plan will be updated as part of the ESAP as more information becomes available during project implementation. These updates will include a comprehensive Emergency Response Plan (ERP) for transportation, storage, use, and management of hazardous substances.

7.7.14 Reclamation plan

Komi Aluminium is committed to both interim and long-term reclamation of disturbed areas. The money required for reclamation (which will be determined as a component of the final mine plan), will be set aside for reclamation during operations. This money will be accrued in a Mine Reclamation Fund that will be established solely for the purpose of Reclamation and Closure. The money will be accrued on a quarterly basis (commencing in 1st quarter, 2005) and will be monitored by IFC in accordance with the requirements set forth in a Mine Reclamation Deed. This will include IFC approval of the distribution of the funds, a blocking mechanism designed to ensure that funds are accessed only for reclamation, and monitoring/reporting requirements.

In the event that Komi Aluminium does not complete reclamation to the standards required by IFC and Russian authorities, IFC will retain the right to hire independent contractors to complete the work with the money set aside in the Mine Reclamation Fund. Money spent, money accrued, and progress of interim reclamation will all be required as part of the Annual Monitoring Plan submitted to IFC no later than 90 days of each calendar year.

The approach to reclamation at the MTBM will be based on the sustainable development principle that the mining process be managed as a transient land use activity. In other words the overarching objective of the reclamation process is that the condition of the land will be restored to a value similar to or greater than it was before the mining process was initiated. The following process will be implemented at the mine to achieve these objectives:

7.7.14.1 *Establishing land use objectives*

The first task in developing the proposed reclamation process for the expanded (and current) mine operation will be defining clear, post-mining land use objectives. These land use objectives will be developed to:

- Be compatible with surrounding land use;

- Support species diversity;
- Promote the re-establishment of stable biological systems;
- Be consistent with the expectations of the local community;
- Have the support of regulatory agencies

7.7.14.2 Reduce mine footprint

A key component of the reclamation programme will be ensuring that the mine footprint is kept as small as possible and that vegetation clearing only happens where and when absolutely necessary. For the pits that will be excavated, vegetation will be cleared immediately prior to the start of the stripping of the overburden. Haul roads will only be established as a function of the implementation of the mine plan and corridor routings chosen to minimize the land area needed. For overburden stockpiles a balance will be found between the area required for the stockpile and the rate at which it gets stripped.

7.7.14.3 Soil and overburden management

Soil and overburden management will be implemented in advance of pit excavations. The maximum amount of soil will be separated from the overburden and transported to local pre-defined soils dumps situated within close proximity to the excavation area. The topsoil will be stockpiled in piles of no more than 10 m in height (slope will not exceed 1:3), suitably armored against wind and water erosion and left undisturbed prior to its reuse. Peripheral drains will also be used to protect the pile. The soil will be reused for reclamation as quickly as possible and within no more than two years after the topsoil has been excavated.

7.7.14.4 Soil making material

Some of the likely deficit in soil will be addressed by recovering so-called soil-making material such as weathered basalt and allowing this to decrepitate into a soil forming material. This material will be stored in separate dumps, constructed to a maximum height of 15 meters in progressive 5 meter layers. The dumps will be protected by a peripheral drainage catchment system.

7.7.14.5 Stability and safety

The first requirement in initiating the reclamation programme for a particular mine pit will be to ensure the mined areas are returned to a safe and stable physical state that is integrated to the greatest degree possible, with the surrounding landscape. Safety will be considered in terms of risks to humans and wildlife, whilst maintaining the character of the surrounding landscape. The following benefits will accrue through ensuring adequate solid stability. Stable soils:

Are more likely to re-vegetate effectively and sustain productivity;

- Maintain a protective cover over any hostile materials buried beneath them, such as acid-generating rocks (although these do not occur in the area of the MTBM) or subsoils with toxic salt or metal concentrations.
- Prevent off-site impacts such as turbidity (muddiness) and siltation of watercourses.

7.7.14.6 Sloping & contour ripping

In the next step of the reclamation process, vertical faces of mined pits will be battered down to a slope of less than one in two. This will have the dual benefit of improving both the stability of the mining face and the general aesthetics of the mine pit (Hickman et al. 1992, Ward et al. 1996). Contour ripping will then be done to a depth of approximately 2 m to promote maximum lateral cracking of the clay. Mounds of soil will be established at heights of 1-2 meters along contour lines with 10 meters intervals to reduce sheetflow, increase infiltration and generally prevent erosion. Pipe overflows will also be established to deal with extreme rain events

7.7.14.7 Reintroduction of overburden and topsoil

The overburden, which will have been stripped separately from the topsoil, will then be reintroduced into the mine pits and covered with topsoil. The topsoil will be sourced from newly cleared areas (a practice known as 'direct return') or from topsoil stockpiles. Direct return of fresh topsoil enhances the return of viable seeds, nutrients, organic matter and beneficial soil micro-organisms. To maintain these important soil properties at the surface, the topsoil will be stripped and returned in as thin a layer as possible, generally 10 to 15 cm (reference c). Another technique that will be used is the process known as double-stripping.

This process will see topsoil that has been stockpiled being deposited in a relatively thicker layer (possibly as much as 40 cm), and then spreading a thin (approximately 5 cm layer) of fresh top-soil, on top of the 'old' top soil. The technique of double-stripping results in greater vegetation cover, more species diversity and increased groundcover. This is because stockpiled topsoil tends to lose its biotic activity, structure, and nutrient status (particularly nitrate) over time. Double-stripping reduced the need for fertilizer and results in a faster rate of re-colonization of plants.

7.7.14.8 Re-vegetation

After reintroducing the overburden and topsoil, the reclaimed areas will be re-vegetated using a combination of seed collection and direct topsoil transfer (and double stripping) techniques. Planting will take place during the growing season. Vegetation will be selected on the basis of productivity and sustainability in establishing and maintaining a self-sustaining ecosystem and only indigenous species will be included in the seed mix (seed will be sourced from the area surrounding the mine to retain local genetic material in the rehabilitated areas). A key focus in this regard will be ensuring that species diversity is restored to facilitate the reestablishment of native ecosystems. Establishing appropriate habitat and ecosystem recovery processes that will subsequently encourage the full suite of flora and fauna to re-colonize is a key reclamation success factor. Tree stumps, logs and rocks will also be returned to the reclaimed areas to provide habitat for fauna.

7.7.14.9 Nursery

Due to the difficulty of establishing plant species in the area from seed, a nursery will be established as an immediate priority. Plant species not easily re-established from seeds, will be propagated in containers using tissue culture, cuttings or seed. The possibility of outsourcing the establishment and maintenance of the nursery to a local SME will be investigated and implemented if technically and commercially viable.

7.7.14.10 Monitoring

The final component of reclamation will be ongoing monitoring of the reclaimed areas. The monitoring will include checking that trees and understorey are establishing properly and that there is no erosion within the reclaimed areas. At a later stage (from about 15 months onwards) plant species richness will also be measured. At this stage it is envisaged that the current ecosystem monitoring programme that is run by the mine will be extended to include direct monitoring of the reclaimed areas of the mine.

7.7.14.11 Waste dump areas

Detailed designs of the waste dump areas will be developed. Soils will be stripped from the waste dump footprint areas prior to their establishment. A herringbone drainage system will be excavated and filled with blocking material to prevent water pressure build up within the dump. The dump will be constructed over a wide deposition front to minimize water pore pressure build up and increase the stability of the dumping area. Peripheral toe drains will be constructed around the dump footprint to collect water runoff and to prevent additional excess water runoff from higher elevations, running into the main body of the dump.

7.7.14.12 Restoration

The principle here is to implement progressive restoration as soon as it is practicable. The method and approach for restoration will be a function of the nature of the individual pit profiles and the ability to backfill abandoned pit areas within the design. Opportunities to directly place overburden into bauxite abandoned areas will be pursued to reduce re-handling.

7.7.15 Off-set programme

Due to the extent of the vegetation and habitat lost in implementing the mine, Komi Aluminium and MTBM will investigate and develop an off-set programme. The purpose of the off-set programme will be to replace the habitat lost through the mine operation by creating similar habitat elsewhere.

7.7.16 Socioeconomics

7.7.16.1 Develop and implement communication strategy

An effective communication strategy will be developed and implemented prior to the start of the proposed expansion. The purpose of the communication strategy will be to build a relationship between MTBM and its stakeholders. The communication strategy will be designed to ensure that the company's activities are transparent and open and takes cognizance of stakeholder concerns.

7.7.16.2 Stakeholder identification

The location of MTBM within a social environment means that there are a number of groups who have an interest in the project. Company stakeholders range through employees, shareholders, communities, NGOs, consumers, partners, suppliers, governments and society at large (WBSCD 2002). The company recognises the responsibility it has to share information with its stakeholders on regular basis. The key stakeholders for the MTBM are reflected in Table 35:

Table 35: Key stakeholders for the MTBM

Internal	Government	Community-based	NGOs
Shareholders Employees Funders - IFC/EBRD	Local, regional (district) and federal authorities	Local community at Chin'avoryk Community representatives from Ukhta Association of small business development	Komi Kotyr The Save the Pechora Committee The Memorial Greenpeace Russia

7.7.16.3 Stakeholder engagement mechanisms

The mine recognises two main opportunities for stakeholder engagement during the proposed expansion project. This includes the need for project consultation and disclosure on the proposed expansion. A detailed Public Consultation and Disclosure Plan (PCDP) has been developed for the project. The objectives of the mine PCDP are to:

- Provide stakeholders affected by the project with regular information on the progress of the feasibility work and its implications for the stakeholders;
- Inform MTBM of any stakeholder-related issues;
- Monitor the implementation of mitigation measures through direct feedback from stakeholders; and
- Manage any complaints against the MTBM team or contractors.

The second opportunity that the mine will use to engage stakeholders will be on-going, long-term interactions between the company and its stakeholders. The mine recognises that there is a range of misperceptions about the mine and the safety of its operations. As such the mine will maintain on-going engagement throughout the mine's operations to break down the barrier of miscommunication and mistrust between the mine and local communities. Bauxite Timana will manage this engagement through as part of its social development programme and in close alignment with its communication strategy. The company seeks to involve its stakeholders in both consultation and participation in the social development activities of the company. Specific objectives of on-going engagement throughout the project life-cycle are to:

- Provide stakeholders with regular information on the mine and its activities;
- Provide a platform for stakeholders to raise their issues and concerns;
- Clear mechanisms to respond to people's concerns, suggestions and grievances.
- Engage with stakeholders on priorities for social development; and
- Establish partnerships for implementation of social development programmes.

Box 1: IFC Principles for consultation – can be used as the basis to draw up MTBM principles for their communication strategy.

- Written and oral communications in local languages and readily understandable formats;
- Easy accessibility to both written information and to the consultation process by relevant stakeholders;
- Use of oral or visual methods to explain information to non-literate people
- Respect of local traditions of discussion, reflection and decision-making; and,
- Care in assuring that groups being consulted are representative (with adequate representation of women, vulnerable groups, and ethnic minorities, and separate meetings for various groups, where necessary).

7.7.16.4 Partnerships

In addition to consultation, which tends to be more of a one-way flow of information, the mine recognises opportunities for partnerships with government, and civil society (represented by local communities and NGOs) that can be developed to address social needs in Knyazhpogost. Partnerships ensure that MTBM in no way assumes responsibility for municipal/district functions, but rather uses the resources it can bring to bear to facilitate improved services. The potential benefits to be realised through such partnerships are summarised in Table 36.

Table 36: Partnership Opportunities

Government Authority	Corporate Operations	Civil Society
Public/political mandate	Leadership and advocacy	Local knowledge
Coordinated development	Quality performance	Community mobilization and self management
Resource rents	Equipment and technical skills	Labour
Conduit for donor funds	Infrastructure development	
Public meeting facilitation	Capacity building	

7.7.16.5 Vehicles for information and consultation

The following channels will be used for information and consultation:

- Local newspapers need to be used extensively for Project-related communication, as they are widely available and indeed read in confidence by most adults in the area, and local television,
- Reading rooms in the municipal administrations of the relevant towns and villages, with

Project documentation (Project description, sponsor description, lenders documentation, including their environmental policies in Russian, ESIA, mine audit, PCDP, OVOS, etc...),

- Information centre in China'york, opened for instance once a month, with one person available to deliver information or direct to the relevant documentation, and automatic computer presentations, maps, models of the plants, posters, etc.
- General meetings of the population when required (completion of ESIA, completion of the OVOS),
- Focus group discussions when clarifications are required from the population's side, or when the sponsor will need to appreciate the population's opinions on a particular issue,
- Technical support to the school teachers (interventions of technical/environmental specialists from the sponsor company, provision of documentation and computer presentations.
- A Community Stakeholder Group will be formed by Komi Aluminium; it will be made up of opinion leaders as well as ordinary members of the public in the community. This group would will regularly (for example on a two-monthly basis or when needed) and will discuss issues of concern with the Project and help disseminating information informally throughout community, and possibly through a newsletter.

The Project will also use local newspapers to provide a two-monthly "information letter" to the local population, assuring consistency from one letter to the next one. Suggested topics for the first issues of this information letter should include the following:

- General presentation of SUAL, of the Project, and of the different companies that will manage the Project preparation, construction and operation,
- Presentation of the ESIA and OVOS processes, requirements of both the Russian legislation and of international banks potentially involved in the Project, timeframe for the ESIA and OVOS, public consultation, documentation available, inputs expected from the public,
- Presentation of the industrial processes involved in the different components of the Project, and why there is no radio-active materials involved in any of the steps of these processes,
- Presentation of the ESIA/OVOS results: impacts, mitigations,
- Presentation of the Environmental Management Plan for the different components of the Project.

7.7.16.6 Dealing Specifically with the Komi Community

In the Project area, Komi inhabitants have been schooled in Russian and have full command of this language. Some mention using Komi language at home, but it is obvious that in the long term the language is threatened. It is currently estimated that about 74% of the Komi population in the KR (i.e. about 220,000 out of a total Komi population of about 275,000) speak their own language.

There is no need to disclose all Project information in Komi language. This does not mean that the Komi original population should not be addressed as a specific group by the Project, in terms of consultation/information. Komis express their attachment to their cultural traditions through cultural societies, folkloric groups and the preservation of their language, amongst others. The following actions will therefore be taken to address the cultural specificities of the Komi population:

- Translation into Komi of some of the Project documents (for instance the Project description and sponsor description),
- Sponsoring by MTBM of some of the local Komi cultural groups.

7.7.16.7 Develop and implement employment strategy

With the planned expansion of the mine, more personnel will be recruited and to this end MTBM will develop a recruitment policy that explicitly details how recruitment will happen for the expanded mine. The policy will take cognisance of national and IFC/EBRD labour policies and commit the company to maximise local labour, support human rights and non-discrimination, and to emphasise again that no use is made of forced labour. The policy will be based on the laws and regulations of the Russian Federation and the following principles:

- all unskilled workforce will be hired in the area of influence of MTBM,
- a clear definition will be given to the “area of influence” of the Project,
- offers for skilled jobs will be advertised first in the local employment offices,
- wherever possible, job offers will be equally open to males and females,
- “unskilled” and “skilled” positions will be clearly defined, and these definitions will be publicized to avoid any misunderstanding in the public,
- a single agency (preferably the local department/ministry of labour) will be used to recruit labour. The agency will keep a centralised register of work seekers that includes a skills profile of those work seekers. All labour required for the project will then be sourced from this central pool. The register will be updated regularly so that the skills profile of workers reflects the experience gained while working on the project
- In order to avoid an influx of job-seekers that might have adverse social and economic impacts, this policy of local hiring will be broadly publicized.
- Within the framework of the policy, employment will be done through an employee registration programme. Potential employees will undergo a skills assessment with successful recruits then being registered in the skills database, and undergoing health and safety training. Contractors will also be registered on the database and undergo the mine’s health and safety training.

MTBM also recognises the need for participative management and staff development and as such will establish mechanisms to provide formal worker representation in decision-making. Fora will be established at different levels of employees and management, including responsibility and accountability for matters of healthy and safety.

7.7.16.8 Project training policy

MTBM will develop and publicize a training policy based on the following principles

- Coordination with local vocational and higher education institutes (ie. the different professional schools in Ukhta and Sosnogorsk and the State Technical University of Ukhta) on training needs and enhancement of the capacity of these local institutions to meet Project recruitment needs,

- On the job training and qualification upgrade for the unskilled and semi-skilled workforce,
- External training where needed.

In order to enable and empower individuals to perform optimally, performance management and career development programmes will be put in place including:

- Graduate training schemes;
- Systems training scheme;
- Operative training schemes;
- Technician training schemes;
- Technical executive education;
- Skill and job orientation training; and
- Modular training and equipment/systems oriented training.

When personnel have participated in training programmes, their improved skills are registered on the central skills database described earlier.

7.7.16.9 Consolidate social development programme

The objectives of the social development programme are to contribute to social upliftment in a manner that:

- Is affordable for the mine and in keeping with broader business and policy objectives
- Does not usurp municipal or district functions
- Ensures that expectation is managed and that there are not undue expectation or misunderstandings of what the mine will and will not support.

At present, MTBM is investing in community initiatives such as the local schools and hospitals in Emva and Chin'avoryk, as well as a local church in Emva. This demonstrates the willingness of the company to invest in the local communities. However the investments have tended to be *ad hoc* and lack a clear long-term strategy for social development . The inconsistency and lack of a clear and well-communicated strategy has led to community expectations and disappointment about the mine's investments.

In line with an integrated framework for environmental, health, safety and community, MTBM will develop a long-term social development strategy. The strategy will re-emphasise MTBM's commitment to communities who may affected by the mine's activities, while at the same time presenting unambiguously what the mine will and will not support. The strategy will explicitly define the areas in which MTBM will invest and its role in relation to government, NGOs and CBOs. The strategy will be developed using a participatory approach to consult with local communities and government about priority needs.

7.7.16.10 Implement private investment partnership

One of the positive impacts of the mining operation is the opportunity for job creation both within the company as well as through secondary contracting operations. MTBM will enhance this benefit and improve local economic development by committing to utilizing local businesses as far as possible to provide a variety of services and products.

MTBM will also devise an SME strategy in order to support small and medium sized local enterprises in conjunction with the IFC's Private Enterprise Partnership (PEP) Programme. The strategy will identify opportunities for local business to undertake contract work for the mine and assist them in tendering and delivering on the contracts. In order to achieve this, the mine will make services and staff available to assist SMEs in their activities. This will include technical assistance in tender advice, training, bookkeeping, health and safety, quality support systems and business linkage opportunities. This transfer of expertise to local citizens and organizations will extend the influence of the company on local economic development and meet the following objectives:

- Increase access to markets for SMEs;
- Raise the level of local management skills;
- Reduce administrative and legislative barriers; and
- Educate and inform the public of the importance of the private sector.

Special areas of influence that the mine will focus on in the strategy include:

- Creating transparent demand profile that can be disseminated to local suppliers
- The design and implementation of a solid, sustainable strategy
- Complement SME development efforts with a targeted, sustainable financial model

7.7.16.11 Project local procurement policy

MTBM will develop and publicize a procurement policy based on the following principles:

- For each phase of the Project (construction, operation), an initial market survey will establish local capacities to meet MTBM demand, and delineate areas of local, national and international procurement for the various goods and services required,
- Based on these market surveys, MTBM will define for further monitoring targets of local procurement (expressed in percentages of the value of total goods and services procured and monitored quarterly),
- All services and goods that can be procured locally at a competitive price shall be procured locally,
- The Project, with the assistance and support of external partners, will seek to strengthen the capacity of local businesses to meet its procurement needs,
- All procurement notices shall be advertised locally first,
- A dedicated small business support function will be established within the Project. This function would serve to ensure that small businesses are equipped to both tender for and, if successful, complete the work to the required quality, price and schedule. Targets for local expenditure should be set and performance monitored. For instance, Project construction wood needs and food needs should be met by local supply, which would help keeping two badly damaged sectors of the area (forestry and agriculture) afloat.
- No procurement shall be made from State Enterprise M222, to avoid any unpaid labour to be involved in Project procurement.

7.7.17 Implementation and monitoring

This section presents a discussion of the proposed Environmental (and Social) Monitoring Program (EMP) for the MTBM Project. The entire section should be considered “guidelines” for monitoring until the Russian expansion OVOS is approved whereafter specific requirements as stipulated by the Russian authorities will be incorporated and implemented. The primary purpose of the EMP is to ensure that the project is in compliance with Russian operating permits and environmental regulations as well as World Bank Group and EBRD policies and guidelines, and to evaluate the effectiveness of the environmental mitigation measures as described herein.

The results of the monitoring program will be reviewed by project management on an ongoing basis to take stock of the environmental management performance of the mine. If adverse environmental changes occur as a result of the project, appropriate remedial measures will be implemented to reduce or eliminate such effects. Specific details of any mitigation measures associated with unforeseen project-related effects will be developed based on the results of the monitoring. Environmental monitoring is proposed for the following environmental components and mine facilities (the sections that follow provide more detail on the monitoring programme):

- Site air quality;
- Groundwater quality;
- Surface water quality;
- Surface water hydrology;
- Aquatic resources;
- Flora;
- Fauna; and,
- Socio-economics

7.7.17.1 Site air quality

There are two types of air quality monitoring conducted at the MTBM:

- Ambient air monitoring; and,
- Source monitoring.

Ambient air monitoring

Russian air quality standards refer to maximum allowable concentrations (MAC), which are expressed as a maximum single value and as a daily average value for air pollutants, including solids (dust and soot) and gaseous pollutants. The maximum single MAC values refer to a single 20-minute sample. Daily average MAC values refer to long-term effects and are compared to monthly average and annual average concentrations. Pursuant to Russian air sampling methodologies, 20-minute samples are taken 3 or 4 times per day, at 0100 at selected locations only, and at 0700, 1300, and 1900. Daily average concentrations are determined from these samples.

Table 37: Air quality standards that apply to the Middle Timan Bauxite Mine

Pollutant	MAC (Edge of Sanitary Protection Zone) ¹	
	Averaging Period	Standard (mg/m3)
CO	Single	5.0
	24□hour	3.0
SO ₂	Single	0.5
	24□hour	0.05
NO ₂	Single	0.085
	24□hour	0.04
NO	Single	0.4
	24□hour	0.06
Hydrocarbons	Single	0.03
	24□hour	0.005
Dust ²	Single	0.5
	24□hour	0.15
Soot	Single	0.15
	24□hour	0.05

Note: 1. The Sanitary Protection Zone will be determined during the OVOS process.

Note: 2. Dust is separated by the percentage of silicate into three categories: <70% silicate, between 70 and 20% silicate, and > 20% silicate. The standard quoted above is for dust with a silicate content of <20% and is the most lax of the three standards.

Ambient air monitoring will occur for particulate dust, SO₂, and NO_x. In order to comply with Russian guidelines, a pump will be used that pulls 200 liters across a filter during a 20 minute sampling period. NO_x and SO₂ will be sampled using a tedlar bag.

In addition to the Russian methodologies, a sampling program will be established for particulate matter with a diameter less than 10 microns (PM₁₀). This program will be used to verify the Russian sampling and comply with the WBG guidelines for dust monitoring. Sampling locations will be determined during project development to ensure that the ambient air is monitored. This site should

sufficiently distinguish between ambient air concentrations from the various air pollution sources and a representative background concentration. The sampling of the mini-vols or high/low volume samplers should incorporate the following requirements:

- The siting will be as close to the fence line as possible to accurately determine, off-site concentrations.
- The siting will take into account local topography and be positioned such that the surrounding terrain does not obstruct the PM sampler and anemometer in any way.
- Additional considerations will be given to future development and the site located in such a manner as to avoid obstructions to the sampler as the mine life progresses.
- The siting will be a sufficient distance from sources that may bias the measurements. Sources such as haul roads, stockpiles, waste dumps, etc., will be included in the siting analysis.
- The site will be easily accessible to staff.
- A power source will be provided at the site.
- The site will be secured.

Samples will be taken twice per year using Mini-vol samplers. These records will be recorded in a log that will be reported to IFC/EBRD and Russian regulatory agencies in accordance with Russian guidelines. The minimum detection limit is 0 µg/m³. The mini-vols are less accurate at lower concentrations due to the low volume of air used to collect particulate matter on the filter paper.

Stack gas sampling

Monitoring of the Maximum Allowable Emissions (MAE) will be conducted internally as well as by the appropriate regulatory agencies. Stack gas sampling of speed and volumetric flow rate for the diesel generators will be conducted in accordance with the requirements set forth in GOST 17.2.4.06-90. Temperature and pressure will be sampled in accordance with GOST 17.2.4.07-90. Determination of moisture content and gas constituents will be conducted in accordance with the methodology set forth in GOST 17.2.4.08-90. All sampling equipment will be certified for use in the Russian Federation.

Initially, emissions testing will occur quarterly until the generators have come to steady-state. It is assumed that this will occur during the 1st year of operations. After this, sampling will occur twice per year in January and June.

7.7.17.2 Groundwater monitoring

Monitoring wells around the project site are required by Russian regulation (GOST 17.1.5.05-85) for monitoring water table fluctuations and groundwater composition, chemical and bacteriological. These monitoring wells will be established downgradient of the tailings facilities for evaluating subsurface hydrology. The exact depths and locations of monitoring wells are dependent on a variety of factors that will be determined during detailed engineering of the project.

Parameters to be measured

Field sampling will be conducted by on-site personnel for pH, conductivity, temperature, and biological oxygen demand. The results will be recorded in a field sampling log, which will be summarized and

provided to SUAL on a quarterly basis.

Laboratory analyses

Sampling will be conducted to detect any seepage of contaminants from the above-listed potential sources. Certain constituents will be tested in the field while laboratory analysis will also be conducted. Table 38 presents the constituents to be tested for during laboratory analysis.

Table 38: Laboratory Analyses to be Performed on Groundwater Samples

No.	Parameter	No.	Parameter
1	PH	2	Total Dissolved Solids
3	Alkalinity	4	Bicarbonate
4	Calcium	6	Magnesium
5	Potassium	8	Sodium
7	Chloride	10	Fluoride
9	Nitrate and N	11	Ammonia + Ammonium
11	Sulfate	12	Arsenic
13	Bromine	14	Cadmium
15	Chromium	16	Copper
17	Iron	18	Lead
19	Manganese	20	Mercury
21	Selenium	22	Silver
23	Zinc	24	Total Petroleum Hydrocarbons

Samples will be taken from monitoring wells utilizing a portable pump. The water in the well must be purged three times the volume of the casing to assure that the water sampled is indeed groundwater, and not ponded rainwater. Field parameters will be measured on the spot and samples for laboratory analysis will be bottled, chemically preserved where necessary, and delivered to a laboratory for analysis. Equipment needed for groundwater monitoring and approximate prices are provided in Table 39.

Table 39: Specifications of equipment required for groundwater monitoring

Instrument	Manufacturer	Price (US)	Detection Limits
pH meter with thermocompensator	Beckman	\$820	0.00 - 15.99 pH
Conductivity meter-handheld digital	Cole Parmer	\$315	0.00 - 199.99 S
Alkalinity test kit	Hach	\$150	no limits
Portable pump	Solinst	\$5000	NA

Frequency of measurements

On a monthly basis, the groundwater monitoring wells will be measured for water table level elevation. In addition, field water quality parameters will be determined, including temperature, pH, alkalinity and electrical conductivity. On a quarterly basis, groundwater monitoring wells will be measured for water level elevation, field parameters, and the parameters listed in Table 38.

Reporting and Record Keeping

Logs will be submitted in annual reports to IFC and EBRD and to Russian regulatory agencies in accordance with Russian guidelines. Data will also be maintained in a database at the mine site to allow for easy retrieval, in addition to statistical evaluation of trends and parameters of interest.

7.7.17.3 Surface water monitoring

Surface water monitoring includes both surface water hydrology and surface water quality. Surface water quality and dynamics monitoring will be conducted in accordance with approvals received by the appropriate environmental regulatory agencies during formalization of the Water Use and Discharge License. Sampling methodologies will be in compliance with GOST 17.1.5.05-85, "General Provisions for Sampling Surface and Sea Waters, Ice and Precipitation". Monitoring of discharge waters will be in accordance with GOST 17.1.3.07-82, "Rules for Monitoring Water Quality in Waterways and Water Reservoirs" and the normative document, "Decree on Industrial and Governmental Analytical Monitoring of Pollution Discharges in Accordance with Established Norms".

The frequency of monitoring will be no less than once per month. The frequency can be reduced in the event that data collected to date can be shown to be representative of the discharge. The preparation, collection, and transportation of samples will be completed in accordance with GOST 17.1.5.05-85 and ISO-5667.

Permanent hydrological monitoring stations will be established on the Vorykva River (upper and lower station). Manual (part-time) hydrological monitoring will occur for the Cherny and Bolotny to determine the hydrological flow regimes.

Sampling parameters

The parameters in Table 40 will be measured once a month in the laboratory:

Table 40: Surface Water Quality Monitoring Parameters for Laboratory Analysis ^A

No.	Parameter	No.	Parameter
1	PH	21	Ammonia + Ammonium
2	Total Suspended Solids	22	Nitrites
3	Total Dissolved Solids	23	Nitrates
4	Total Petroleum Hydrocarbons (TPH)	24	Phosphates
5	Detergents	25	Free Iron
6	Phenols	26	Silicon
7	Zinc	27	Selenium
8	Alkalinity (total/CaCO ₃)	28	Beryllium
9	Bicarbonate as HCO ₃	29	Vanadium
10	Sulfate	30	Cadmium
11	Calcium	31	Cobalt
12	Magnesium	32	Copper
13	Sodium	33	Molybdenum
14	Potassium	34	Arsenic
15	Chloride	35	Nickel
16	BOD ₅	36	Mercury
17	COD	37	Lead
18	Tellurium	38	Antimony
19	Chromium	39	Zinc

^A parameters may be added or deleted from this list based on discussions with Russian regulators during permitting.

Reporting and Record Keeping

Logs will be submitted in annual reports to IFC and EBRD and to Russian regulatory agencies in accordance with Russian guidelines. Data will also be maintained in a database at the mine site to allow for easy retrieval, in addition to statistical evaluation of trends and parameters of interest.

7.7.17.4 Aquatic and benthic monitoring

Monitoring of the environmental conditions of the surface waters will be conducted using hydrobiological indicators (benthos and ichthyofauna) to give an objective appraisal of the engineering measures used to mitigate impacts at the site. The following two sections highlight the proposed monitoring program for aquatic resources.

Benthos

In accordance with GOST 17.1.3.07-82, Benthos will be monitored approximately twice per year in June and September. The monitoring will occur at the same locations where streams are sampled for water quality.

Ichthyofauna

Ichthyofauna will be surveyed two times per year (June and September) for all streams near the site that can support fish. These surveys will be used to analyze the overall health population and diversity of the ichthyofauna compared to previous years.

7.7.17.5 Vegetation monitoring

In 2000, the Komi Institute of Biology began an impact monitoring program for vegetation at MTBM. It includes monitoring:

- Changes in land structures;
- Soil monitoring;
- Composition of vegetation structures;
- Reclamation activities;
- Wildlife; and,
- Radiation.

It includes 8 permanent monitoring stations (established in 2002) located around the minesite. These include:

Stations 1-4: located within the zone of influence of the bauxite pits;

Stations 5-6: location within the zone of influence of the overburden dumps;

Station 7: located within the zone of influence of the railway to the mine; and,

Station 8: located within the zone of influence for the road to explosive storage.

Additionally, a background point was established at an adequate distance from Pit #4.

In 2003, an additional 6 stations were established:

Stations 9-10: located southwest of Pit #1;

Stations 11-13: are situated in a line from the site over a distance of 1350 meters. Two of these stations (12 & 13) are located near the road to better determine impacts from the roads.

Station 14: located 50 meters to the east of the mancamp.

Monitoring was conducted in accordance with internationally recognized criteria (ICP Forest – International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests).

This program will be continued and expanded to include at least one new monitoring site for each new area that will be developed as part of the mine expansion (an additional 3 new sites). The exact locations of these site will be identified during the up coming field season.

7.7.17.6 Socio-economic monitoring

Monitoring will be undertaken of the following key socio-economic components:

- public consultation and disclosure process; and,
- impacts on local employment levels to include:
 - number of local individuals directly employed by the project;
 - number of households directly employed by the project;
 - entrepreneurial activities associated with the project;
 - changes in income profiles; and,
 - changes in overall community development.

These social components and indicators will be audited annually as part of the auditing procedures to be set up by MTBM. Any improvements to the process will be identified and implemented. Additionally, MTBM will continue to conduct public consultation and disclosure as detailed in the PCDP. This will include continued consultation with NGO's and other key stakeholders identified by the project. Indicators that will be monitored on a quarterly basis include:

- Consultation and information:
 - Number of meetings held, attendance, minutes,
 - Number of newsletters and other project documentation disclosed to the public,
- Employment:
 - Number of person-hours worked,
 - Number of new employees by categories (unskilled, semi-skilled, skilled, professionals),
- Following ratios
 - Unskilled: local vs total
 - Semi-skilled: local vs total
 - Skilled: local vs total

- Procurement: percentage of local procurement in the total procured in the quarter.

7.7.17.7 Health and safety monitoring

The Health and Safety Program that will be developed requires that sources of health hazards be closely monitored, including the monitoring of noise and other industrial hazards. Monitoring will be conducted relative to all World Bank Group guidelines to ensure that the project has an overall positive social impact on the area.. A monitoring programme will be developed and refined prior to start-up and submitted to IFC and EBRD for review.

Noise exposure monitoring

The objective of noise exposure monitoring is to identify and characterize the noise exposure for workers in each job category who work at facilities with high noise levels, and to ensure that regulatory limits and lenders requirements are met (the EC limit dictates that exposure to more than 65 dB(A) should be phased out and at no time must be allowed to exceed 85 dB(A).

Feasible administrative and engineering controls will be employed to reduce the average noise levels in normal work areas. Plant equipment will be well maintained to minimize noise levels. Personnel will wear hearing protection when exposed to noise levels above 85 dB(A).

Parameter to be measured

Noise level in dBA (A-weighted decibel sound scale).

Method to be used

Portable sound-level meter at selected sites.

Sample locations

All working areas with high noise levels including major loading sites, the ore crushing facility and diesel generator buildings.

Frequency of measurements

Measurements will be made monthly, or whenever new equipment is added in operations or old equipment is replaced.

Cost estimation

Cole-Parmer E-01618 Sound Meter (\$350.00)

Detection limit

30-130 dBA.

Audiometric Testing

Annual audiometric testing will be performed on employees who work in high noise areas (8 hours per day under noise level of 85 dBA or greater, and 10 hours per day under noise level of 83 dBA or

greater).

Report and record keeping

A table summary report with the noise survey and audiometric testing results will be generated for record keeping. It will be incorporated in the H&S annual report to IFC and EBRD and Russian regulatory agencies.

7.8 Environmental management

SUAL Group has recently begun to implement a program designed to ensure that all operations within the group are adequately staffed with appropriately trained EH&S personnel. This program includes adding staff at both the corporate and local operations level. Current staffing is discussed in the following sections.

7.8.1 Sual Group

Sual Group is currently building capacity at the corporate level and has recently appointed a Corporate Environmental, Health and Safety Senior Manager. This appointment will serve to ensure that HSEC issues are properly prioritized and given the required attention across all of SUAL Group's operating entities, especially the proposed Komi Aluminium Programme where compliance with Russian Regulatory and IFC/EBRD requirements will need to be achieved throughout all project phases. Specific functions include (inter alia):

- the development and implementation of health, safety, environment and community policies and associated procedures and management plans
- establishing a corporate reporting function
- setting and monitoring performance objectives and targets for different operating entities within the SUAL Group
- Identifying and implementing an HSEC training strategy for the group
- Develop and implement a group auditing function

7.8.2 Komi Aluminium

Komi Aluminium has appointed a full time Environmental Manager, responsible for ensuring that all environmental requirements during the development of the Komi Aluminum Programme are adequately addressed and that a sound basis is established for the environmental management performance of the expanded mine and the two proposed plants. As the programme develops further a full time Health and Safety Manager will also be appointed. The environmental manager will ensure that all components of environment are properly addressed during the implementation of the Komi Aluminium Programme. Specific requirements include:

- Planning and directing the implementation of project ESAPs
- Ensuring that the requirements of the ESAP are effectively communicated and properly implemented during the projects
- To ensure that an appropriate contractor management regime is established to address the

environmental management issues for which they will be responsible

7.9 MTBM staff

The existing HSEC function at MTMB is not integrated and is delivered by one individual (the mine ecologist – who focuses principally on environmental issues) based in Ukhta. This function is augmented by outsourced monitoring activities. In order to ensure that an integrated HSEC system is implemented effectively, a more comprehensive HSEC structure will be established by Bauxite Timana and will include:

- HSEC manager (based in Ukhta); and
- on-site environmental officers.

7.9.1 HSEC Manager

The mine HSEC manager reports directly to the Mine Director. The role of the HSEC manager is to ensure that all components of health, safety environment and community are properly addressed through an integrated system. The existing mine ecologist will undergo training to fulfil the role of HSEC manager. In specific, the HSEC manager's responsibilities include:

- Planning and directing the implementation of the integrated HSEC system;
- Ensuring that the requirements of the HSEC system are communicated, understood and enforced by all personnel at MTBM;
- Training staff in the requirements of the HSEC system;
- Hiring and managing on-site environmental officers;
- Ensuring that officers on site develop, implement and monitor the specific HSEC programmes;
- Ensuring the implementation of all applicable corporate HSEC initiatives at the mine;
- Developing and managing HSEC budgets;
- Managing scheduled audits and inspections, with subsequent report back to management; and
- Liaison and maintaining contact with the local community and with the regulatory agencies, including the development and distribution of annual HSEC reports.

7.9.2 On-site HSEC officers

Two on-site environmental officers will be employed to implement the HSEC system on-site. With the 28-day rotation, at least one of the officers should be on-site at all times. The officers will report to the HSEC manager and will have the following specific tasks:

- Investigate and report on major environmental incidents;
- Monitor all environmental parameters;
- Ensure compliance with all regulatory guidelines and permits;
- Provide background information and support in the compilation of annual reports; Ongoing liaison with appropriate on-site personnel; and

- Monthly reporting.
- Develop annual reports as required under Russian and IFC and EBRD guidelines;
- Develop annual budgets for the environmental department at the mine; and,
- Develop long-term programs to ensure protection of the environment.

Additionally, two Health and Safety specialists work at the mine site on rotation. These people report to the mine manager and the General Director in Ukhta.

7.9.3 Environmental training

Environmental training will be conducted using specialists from Russia and the U.S. that are familiar with both Russian and World Bank guidelines to ensure compliance with all permitting requirements. This training will take place as needed throughout the first two field seasons (May-August 2004 and 2005).

7.10 Implementation schedule

The implementation schedule for the ESAP is presented in Table 41.

Table 41: Implementation plan for environmental and social actions for the proposed expansion of the Middle Timan Bauxite Mine.

	Description	Item	Detailed Requirements	Schedule	Estimated budget (US\$'000)	
					Up front	Recurrent (annually)
1	ESAP from the environmental and social due diligence audit (DDA)	1	As detailed in the DDA	As detailed in the DDA	852	200
2	Air quality management requirements	1	Emissions management and monitoring programme	July 2005	100	100
		2	Mine dust control procedures	December 2004	50	300
3	Modify mine dewatering strategy to ensure that the proposed mine expansion does not result in significant impacts on: • The Vorykva River • The VSIR • Regional groundwater	1	Further investigate, define and quantify the groundwater and surface water condition in the vicinity of the mine	July 2004	100	0
		2	Characterize the full extent of the dewatering on regional groundwater and identify and quality impacts	August 2004	100	0
		3	Quantify the exact dewatering volumes and determine whether the dewatering will result in leakage from the Vorykva River	September 2004	50	0

	Description	Item	Detailed Requirements	Schedule	Estimated budget (US\$'000)	
					Up front	Recurrent (annually)
		4	Propose mitigation options that will reduce both the quantity of pumped groundwater as well as the loss of water from the aquifer	October 2004	50	0
		5	Characterize the flow hydrology, hydraulics and related aquatic habitat in the Vorykva	August 2004	150	0
		6	Determine thresholds of potential concern in the Vorykva to define the maximum discharge quantity that could be tolerated by the river without significant negative impact	September 2004	30	0
		7	Finalise strategy with a Mine Dewatering Plan (MDWP)	December 2004	30	0
	Agreement on finally proposed de-watering strategy	1	Technical presentation to IFC and EBRD for review and discussion (independent review if necessary)	November 2004	5	0
		2	Workshop with Russian regulators	November 2004	5	0
			Public consultation and disclosure of final strategy	November 2004	5	0

	Description	Item	Detailed Requirements	Schedule	Estimated budget (US\$'000)	
					Up front	Recurrent (annually)
4	Actions to reduce land disturbance and ecological impacts	1	Erosion prevention and sedimentation control plan (EPSCP)	December 2004	50	300
		2	Vegetation protection procedures	December 2004	50	50
		3	Hunting and poaching policy	December 2004	50	30
		4	Soil management procedures	December 2004	50	100
5	Waste water treatment facility	1	Waste water treatment facility	December 2005	300	50
6	Archaeological preservation and protection plan	1	Archaeological preservation and protection procedures	December 2004	40	20
7	Waste management plan	1	Municipal waste landfill	December 2005	500	50
		2	Waste transition facility	April 2005	150	20
		3	Finalize Waste Management Plan (WMP)	December 2004		
8	Health and safety programme	1	Health and safety programme	December 2004	25	50

	Description	Item	Detailed Requirements	Schedule	Estimated budget (US\$'000)	
					Up front	Recurrent (annually)
9	Fuel spill prevention and control plan	1	Full spill prevention, countermeasures and control plan (SPCCP)	July 2005	25	50
10	Reclamation and rehabilitation plan	1	Develop interim, pit and mine closure reclamation and rehabilitation procedures	December 2004	300	0
		2	Complete mine reclamation deed (with IFC/EBRD review and approval)	April 2005	50	0
		3	Establish mine reclamation fund	July 2005	Unknown	Unknown
		4	Finalize a comprehensive Mine Reclamation and Rehabilitation Plan (MRRP)	December 2005		
10	Off-set programme	1	Investigate, define and implement an off-set programme	December 2007	100	Unknown
11	Socio-economic interventions	1	Develop and implement communication strategy	December 2004	50	150
		2	Develop and implement employment strategy	December 2006	50	50
		3	Develop and implement training policy	December 2006	50	250

	Description	Item	Detailed Requirements	Schedule	Estimated budget (US\$'000)	
					Up front	Recurrent (annually)
		4	Consolidate social development programme	December 2004	50	Unknown
		5	Develop and implement private investment partnership (PEP)	December 2005	50	Unknown
		6	Develop and implement local procurement policy	December 2004	50	150
12	Environmental and social monitoring programme	1	Extend existing environmental monitoring programme to include addition requirements specified in the ESAP	July 2005	300	200
		2	Implement independent external audits to confirm implementation of environmental and social actions.	6 monthly reducing to annually once implementation fully commenced	0	60
13	HSEC system	1	Develop and implement an integrated HSEC system for the Komi Aluminium Programme	December 2008	300	100
	TOTAL				4,117	2,280

Attachment 1
Middle Timan Bauxite Mine
Oil Spill Prevention, Control and Countermeasures Plan

Prepared by: CSIR

April 2004

Approved by:

General Director 10/04/04

Approved by:

Environmental Coordinator 10/04/04

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1.0 Introduction

1.1 Purpose

The purpose of the Fuel/Oil Spill Prevention, Control, and Countermeasures Plan (SPCC) is to prevent discharge of fuel/oil contaminants into the environment in and around the Middle Timan Bauxite Mine (MTBM) located in the Knyazhpogost District of the Republic of Komi

This Fuel/Oil SPCC governs activities at the MTBM, which primarily consists of fueling, fuel storage, and preventative maintenance on mine equipment and company vehicles at the site. The SPCC will be periodically updated, if needed, to reflect the current site conditions and operations.

1.2 General Information

Name:	MTBM
Physical Location:	150 km from Chinyavorak
Type of Facility:	Open pit bauxite mine
Owner:	SUAL Komi Ltd.
	ADDRESS
General Director:	NAME
Head of Engineering:	NAME

1.3 Availability of Plan

One current copy of this plan will be maintained on site and in the Ukhta office at all times. Site personnel shall be aware of its location and have access to the plan. Additionally, this plan will be made available to regulatory agencies and international lending institutes as required under Russian law and World Bank Group (WBG) guidelines. This plan will be made available upon request during any regulatory site inspection.

1.4 Facility Overview

The mine currently is permitted to mine 2.5 million tonnes per year and is currently mining around 1.0 tonnes per year. Phase 1a of the project (up through 2007) is designed to increase the production at the existing operations. Phase 1b of the project (2007 and beyond) is designed to expand the mining operations to ensure that there approximately 6.0 million tonnes per annum is available for mining. This includes extending operations to the north and south of the existing deposits.

Phase 1a does not change the pits to be mined but does change the footprint. Phase 1b requires additional pits to be opened up in order to support mining of up to 6 million tonnes per year. In order to accommodate the expansion, all existing infrastructure will be expanded and upgraded. This includes expanding the footprint and services at the camp, expanding the power capacity with new diesel generators, upgrading the wastewater treatment facility, and upgrading the mining equipment

On-site activities include fueling and maintenance of MTBM mining equipment and passenger vehicles and bulk fuel storage. A diesel fuel and lubricant storage area will be built near the maintenance facility (Figure 1) to provide diesel fuel storage for the power plants and vehicles. Two XXX m³ vertical diesel fuel storage tanks will be built. Additional storage tanks will be installed in a separate bermed area for vehicles requiring gasoline. Pumps will be installed in the fuel storage area for vehicle fueling.

The tank farm will be enclosed in a 1.5 meter high earth berm with a synthetic or clay liner on the pad floor and inner slopes of the berm to ensure appropriate leak and spillage control. Secondary collection systems will be installed to ensure appropriate controls in the event of a spill. Spill treatment will be available prior to any discharge of petroleum-contaminated waters.

A 20-foot storage container will be located near the fuel storage area and have the following equipment:

- 25 boxes of sorbent pads;
- 25 boxes of sorbent rolls;
- 2 bales of oil control booms;
- 5 shovels; and,
- 200 sandbags.

Additionally, minimal spill response equipment will be located in a 20-foot container at the 52 kilometre mark along the road. Spill response equipment stocked in this container will include:

- sorbent pads;
- empty sandbags; and,
- 1 bale of oil control booms.

Fuel is delivered to the site via supplier's and owner's trucks. MTBM has required the fuel trucking contractors (via the contract) to take responsibility for any spill that occurs. Additionally, any fuel truck operated by MTBM will be outfitted with a spill response kit. The procedures listed below are designed to minimize the possibility of a discharge and promote early detection:

- all tanks, hoses, pipes, valves, fittings, etc. will be checked before any fuel transfer begins;
- each tank will be monitored regularly and measurements will be recorded to keep a

running account of the fuel on hand.

Refueling and lubrication of equipment will not occur within 100 meters of streams. Equipment will be properly maintained and checked for leaks. Spills will be reported to the environmental engineer.

Traps will be installed to collect hydrocarbons from equipment washdown areas. The collection ponds receiving this runoff will have skimmers to separate the hydrocarbon materials in the event that the traps should fail. Used hydrocarbon materials will be removed from the site for recycling or incineration.

Used oil, resulting from onsite preventative maintenance activities, will be consolidated and periodically pumped into small tanks located near the shop facility. Used oil will be utilized in a used oil burner to supplement heating in the shop/office/warehouse buildings.

2.0 Inspections and Maintenance

The following visual inspections will be performed as indicated:

- Daily: Fuel truck tanks and associated pumps, hoses, and connections;
- Weekly: Secondary containment areas in accordance with SPCC, Form 1;
- Monthly: Bulk storage tanks, secondary containment structures, associated valves, and connections; and,
- Quarterly: spill response equipment will be inventoried and maintained in good working order on a quarterly basis.

During all inspections, depleted inventories will be restocked and any mechanical problems will be scheduled for repairs. Logs for inspections will be kept by the Environmental Manager on-site.

A procedural review will be conducted annually by the environmental manager to assure that the SPCC remains consistent with changing operational practices, regulations, and other factors. The review will evaluate the locations of response caches, the adequacy of cache inventories, and the operational efficiency of the plan, including notification and reporting procedures, training efforts, spill history recording, and other factors important to the effectiveness of the plan.

3.0 Response to Oil/Fuel spills

To respond to oil/fuel spills, the following steps should be remembered:

- a. Identification of accident spill category (level);
- b. Administration warning; and,
- c. Organization and completion of spill response.

There are 3 categories of spill response:

- a. Level 1 – this is a spill that can be liquidated by efforts of the persons discovering the

spill;

b. Level 2 – this is a spill that can be liquidated by the efforts of the person discovering the spill and additional man-power help;

c. Level 3 – this is a spill that can only be liquidated by significant efforts of the mine site and requires additional large equipment.

3.1 Notification of spill

To minimize confusion and miscommunication during an emergency response situation, a system of responsibility and communications has been defined. A list of contacts to be notified and mobilized in the event of a release is formulated. Because the operation is still in construction, this list should be updated prior to commencement of operations. The list includes the names, phone numbers, and addresses of responsible parties, alternates, and other persons, agencies, and organizations to notify.

To ensure reliable communications in the event of a release, the spill response team must be allowed access to radio and satellite communications. The available communications system will include portable radios for communicating with external support contacts and/or spill sites.

Any person that identifies a fuel/oil spill should immediately report the spill to their supervisor. The supervisor, after having received the report and identified the category of fuel/oil spill should:

- Report Level One spills to Environmental Department;
- Report Level Two and Three spills to MTBM Site Manager and Environmental Department;

The MTBM Site Manager is responsible for coordinating a team to clean up the spill.

3.2 Spill responsibilities

Under this plan, the following responsibilities are assigned:

3.2.1 Person identifying the spill

- a. find out extent of spill;
- b. notify supervisor of spill;
- c. begin spill clean-up; and,
- d. In the event of Level 2 or 3 spills, ensure MTBM Site Manager is notified.

3.2.2 Supervisors

- a. evaluate level of spill;
- b. carry out emergency response in accordance with requirements of health and safety, and environmental protection guidelines;

- c. assemble a team (as necessary) to liquidate the spill;
- d. inform Environmental and Health and Safety Departments about spill; and,
- e. Fill out an explanatory Form 2 as provided in Attachment 1.

3.2.3 Health and Safety Department

- a. compile necessary data and report to General Director and supervisors all health and safety data from execution of spill clean-up;
- b. oversee spill response for Level 2 and 3 spills in accordance with guidelines for Health and Safety;
- c. complete a report form as provided in Attachment 1.

3.2.4 Environmental Department

- a. be part of response team;
- b. send a report to General Director
- c. check completeness of spill response
- d. record and report all measures taken to liquidate spill;
- e. propose (if necessary) additional clean-up measures needed;
- f. review spill site and propose reclamation measures (if needed).

3.2.5 MTBM Site Manager

- a. having received information about a spill, take necessary measures for spill liquidation;
- b. make sure that Health and Safety of clean-up team is highest priority;
- c. review clean-up scheme;
- d. coordinate with outside personnel as required by General Director;
- e. report spill to H&S Department, Environmental Department, and General Director.

3.2.6 General Director

- a. ensure that appropriate agencies are notified;
- b. ensure that SUAL and lending institutes are notified;
- c. act as Public Liaison representative as needed.

3.2.7 Komi Aluminium

- a. ensure that international lending institutes are notified as required;
- b. act as Public Liaison representatives as needed.

3.2.8 SUAL Environmental/H&S representatives

- a. support all efforts as required by either the General Director or international lending institutes.

4.0 Spill Response

The purpose of containment is to prevent the spilled material from spreading and migrating over and through soil and reaching local waterways. The primary goals of containment are:

- Prevent the material from reaching waterways;
- Limit the ground area over which the material spreads; and,
- Direct flow away from areas of heaviest plant cover.

Where possible, use existing roads for access to the spill area. Damage to plants or soils from heavy vehicles or excessive foot traffic can exceed the damage to the environment resulting from a light coating of oil.

First response steps will vary depending on the specific conditions of the spill, however, the following steps can be used to establish control and provide containment:

- If the material is not immediately soaking into the ground, use shovels to build a soil berm across the path causing the material to pool. Shovel soil from areas that are not covered by grass. Prevent the material from spreading and moving toward waterways.
- Barriers such as wood, metal plate and especially visqueen, laid in front of a soil, are better than soil alone. Use these other barriers if you have them available.
- Dig a shallow pit in front of the oil and LINE IT WITH PLASTIC SHEETING. Dig shallow trenches leading to the pit and LINE THEM WITH PLASTIC SHEETING. Stake or anchor the edges of the plastic sheeting down. (Do not puncture the plastic sheeting in the center of the pit or trenches.) These plastic sheeting lined pits and trenches will contain the oil until it can be recovered.
- Build a plastic-lined berm around a leaking tank or valve. Place as much plastic sheeting as possible between the tank platform supports to catch and hold the leaking oil.
- Sorbents (especially sorbent booms) can be used for containment on land as well as on water. Stake them down at the leading edge of the oil to avoid movement of the sorbent.
- Consider directing water into the spill to saturate the ground and float the material. For

materials that are lighter than water, this will prevent the material from soaking into the ground. Do not direct water into the middle of the pool of material. Instead, run water into the margins of the pool.

- Quickly assess the potential for material entering local waterways by way of drainage ditches or small channels. Block all drainage channels using dams or culvert blocks. Use plastic sheeting wherever possible.

Spills on soils that remain wet and muddy are less likely to migrate through the soil. The majority of spilled oil should remain on the surface of wet soils and may form standing puddles. Spilled oil will generally migrate downwards until totally absorbed by the soil or until reaching the water table. Oil from large spills or continuous small spills that soak into the soil could eventually migrate and begin showing up as sheen on surfaces and in water downgradient from the spill site. Material that is blocked from migrating by clay barriers, rock formations, or other confining features will saturate the soil and begin showing up as pools on the surface. Water does not have to be moving for the oil to spread. Any drainage ditches or similar passages could introduce oil into the waterways.

Under harsh winter conditions, the existence of ice and/or frozen ground may help preventing spilled material from entering the groundwater aquifers by reducing the speed of percolation. In addition, snow could absorb significant quantities of oil (up to 60% of its volume) at points where the snow surface is penetrated by spilled oil. Once oil has reached ground or ice, it tends to flow following elevation gradients and pool in depressions under the snow. It is very important, therefore, to have topographic maps of the spilled area while planning clean-up operations.

Oil recovery must begin along with, or as soon as possible after containment is achieved so that the oil does not soak into the soils or top over the containment area. Begin pumping the pooled oil as soon as it has collected to a depth sufficient for the pump being used. A small portable pump may be used to transfer the oil to an empty tank, portable storage tank, bladder, or drum.

Sorbent pads, rolls, and booms are the most common material used to soak up spilled oil. These would also be used to recover residual oil that is not recovered by pumping. They attract only oil and will not pick up water. Minor spills can be cleaned up using small sheets of sorbent to cover the spill area. Use sorbent rolls to cover the surface of ponds and larger spills. Rolls and pads can be used in any combination that does the job effectively and efficiently.

Sorbents turn a yellowish colour when saturated with diesel. Saturated sheets must be retrieved for reuse or disposal. Sorbents can be reused by running them through a sorbent wringer (or old washing machine clothes wringer) to squeeze collected oil from them. Sorbents can be reused until they fall apart. Wringers are especially useful at remote locations where sorbent supplies are not readily available.

In areas where extensive surface disturbance is not advisable, berming for containment and surface flooding with water may float the oil for recovery. The recovery pump may be used to flood the area. Equipment should be operated from the berm (where one has been built) or tank pads to eliminate disturbing the surrounding area. As previously mentioned, water flooding techniques can be used in conjunction with lined sumps and trenches to prevent oil from penetrating into the soil.

Recovered petroleum products, particularly fuels and solvents, can be burned to provide disposal. Consider using any un-contaminated quantities of material as a fuel supplement in the plant generators. Contaminated sorbents, soil, and other contaminated debris that cannot be burned in the mine generators may be burned in-situ in pits, drums, or other open containers.

5.0 Employee Training

Initial and periodic personnel training is imperative in ensuring a safe and effective response to potential spills. A carefully planned program should be developed and provided to all site personnel. All site personnel must be certified to respond to a potential spill emergency. The training must provide information and skills required to identify and assess an emergency, as well as reporting procedures, and provisions for immediate containment and clean-up.

Employee training programs are to include a combination of instruction, classroom discussions, and supervised practical experience. Scheduling and coordination of all health, safety, and environmental training exercises will be conducted by the site Environmental Manager in close coordination with the Human Resources Manager. The training should include instruction on hazard recognition, potential health effects, potential environmental impacts, and the use of personal protective equipment. Discussion of the facility inspection program that provides for regular inspections of piping, equipment, and review of operating procedures should be incorporated into training.

Training should also include general aspects of environmental protection including potential environmental impacts of a spill. Following initial training, safety meetings should be held regularly. In between annual training, regularly held safety meetings would include discussion on potential spill contingency issues. Appropriate training components shall be incorporated into a training schedule to enable all workers to effectively and safely respond to a potential spill emergency while achieving maximum environmental protection. Post-incident evaluations should be reviewed in training sessions to highlight strengths and weaknesses of existing SPCC efforts.

6.0 Short Instructions

The following pages should be copied and posted near fuel storage and fuel transfer areas. These pages can serve as a quick reference guide as to what to do in the event of a spill.

EMERGENCY MEASURES FOR RESPONSE TO A FUEL/OIL SPILL

Measures to complete during response to a small spill that can be handled by the person discovering the spill:

- a. Take measures to prevent further spillage;
- b. Eliminate the possibility of fuel entering waterways;
- c. Localize the spillage by excavating small trenches along the edge of the spill and/or enclose the spill with a berm (of snow/sand/soil/sorbents/ or other absorbing material) to prevent expansion of the spill area;
- d. Collect and remove the contaminated materials (including sorbents) into drums and tanks

for subsequent recycling;

- e. Dispose of oil products that are unusable at the fuel and lubricant landfill area;
- f. Clean up contaminated area. Place the contaminated soil in the appropriate area of the landfill; and,
- g. Report the spill to your supervisor.

If the spill is too large for one person to clean-up:

- a. Immediately report the spill to a supervisor;
- b. If necessary, request supply of emergency spill response equipment, additional machinery, and additional personnel; and,
- c. Begin to control spill in accordance with measures 1-7 listed above.

EMERGENCY RESPONSE FOR SPILLS NEAR WATERWAYS

Measures to be completed for a spill that can be handled by one person and that is located near a waterway include:

- a. Take measures to prevent more fuel from spilling;
- b. Assess magnitude of spill and report to supervisor;
- c. Request sorbent spill response material to include booms;
- d. Localize the spillage by excavating small trenches along the edge of the spill and/or enclose the spill with a berm (of snow/sand/soil/sorbents/ or other absorbing material) to prevent expansion of the spill area;
- e. Install boom enclosures in the direction of the stream flow to prevent the fuel/oil from dispersing;
- f. Remove fuel/oil products with sorbents;
- g. Collect all polluted materials into containers, plastic bags, or special tanks;
- h. Recycle when possible, and place contaminated materials in the appropriate area of the landfill.